Benjamin McLellan *Editor*

Sustainable Future for Human Security

Society, Cities and Governance

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Preface

This volume, *Sustainable Future for Human Security: Society, Cities and Governance*, is the first of two in a series discussing a variety of critical issues for a sustainable and secure future for humanity. Sustainability is a systemic concern that can be examined from a variety of perspectives, at various levels of socio-environmental systems and sub-systems. Sustainable development is also a highly contextual concept, with no two societies or environments being exactly identical with regards to both endogenous factors and exogenous influences. It is therefore impossible to make a perfectly comprehensive examination of the topic of sustainability when considering its applications in (or interpretations from) the real world. However, a range of examples from a variety of fields of examination, such as that offered in these two volumes, should help to create an understanding of the broad landscape of sustainability.

This volume specifically presents on topics of governance, buildings and urban development, environmental science and disaster management.

Governance is a vitally important consideration in effectively achieving the goals of society – whether this is social justice and equitable distribution of benefits or achieving environmental goals such as the mitigation of climate change. Examples in this volume cover human rights, regional identity and the expansion of a renewable energy industry.

Cities are widely acknowledged as vital elements of social change and environmental impact mitigation for the future. Populations of most countries around the world are increasingly becoming more urbanized, as people seek out opportunity in the largest markets. The impact of urban form and the performance of individual buildings as well as their combined effect is vital for the comfort and well-being of the urban population, but also has a significant impact on environmental performance – particularly the need for energy usage and the mitigation of emissions. This volume covers various topics on the impact of vegetation, open spaces and technologies for construction and infrastructure.

Socio-environmental science, linking society's needs with environmental impacts and the improvement of both, is a common theme of many of the chapters in this volume. The use and development of well-being indicators and the examination of a variety of technologies for remediation and valorization of waste are presented.

The final section of this volume is particularly important to the concept of human security, focusing on disaster management. While it is considered that climate change may exacerbate certain extreme weather, and therefore present a greater hazard to human societies, the non-climate related disasters – earthquakes and volcanic eruptions for example – are also important. This volume presents a number of disaster types and their social impacts, as well as solutions for monitoring or mitigating risk.

The chapters presented in this volume were developed by authors who presented at the SUSTAIN 2015 conference, and have been reviewed by the conference committee. The editor would like to acknowledge the efforts of the authors, the editorial staff and the Sustain Society for the successful publication of this volume.

Kyoto, Japan Benjamin McLellan

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Agus Trihartono

Abstract Violence accompanied by a discriminatory state policy continues to place Myanmar's Rohingya at risk of mass atrocity crimes. The United Nations (UN) has classified the Rohingya among the world's most persecuted minorities. A democratized Myanmar failed to protect the Rohingya from violence and human insecurity. The implication of the violence has also spilled over into neighbouring countries in Southeast Asia. Regional responses throughout the Association of Southeast Asian Nations (ASEAN) are thus inevitable. Although ASEAN has issues related to preserving sovereignty and non-interference and could not necessarily intervene through coercive measures, ASEAN could provide a framework through the ASEAN Political-Security Community (APSC) to assist Myanmar in fulfilling its primary responsibility to address the violence in the Rakhine State. This chapter suggests that ASEAN utilize a comprehensive approach to handling the Rohingya crisis comprised of two levels of actions. Firstly, ASEAN supports the new democratized Myanmar in fulfilling the Responsibility to Protect (RtoP). Secondly, through the framework of APSC, ASEAN should ensure that the fundamental principles of the RtoP can be in line with ASEAN development in Political-Security Community.

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1.1 Introduction

This chapter investigates the human insecurity issues that threaten the Rohingya, in Myanmar, previously known as Burma, and identify to what extent Myanmar and ASEAN have responded. The work investigates, especially but not exclusively, a call for implementing the Responsibility to Protect (hereafter RtoP) principles in Myanmar by appraising actions taken to protect the Rohingya. Intercommunal violence in Myanmar accompanied by a discriminatory state policy continues to place the Rohingya at risk of mass atrocity crimes. Hence, the crisis of Myanmar's Rohingya falls within the very core issue of human security. Although some studies have conducted investigations, there has been limited research connecting the Rohingya's problems with a regional response to the RtoP, in particular within the Southeast Asian region.

Since the ongoing Rohingya crisis has become a regional and international concern and has spilled over into other ASEAN member states, this work suggests that ASEAN needs to pay full attention to the resolution of the political problem of Rohingya. ASEAN also needs to help the new democratized Myanmar through capacity building towards to fulfilling its responsibility under the RtoP. Although ASEAN has constraints due to issues of sovereignty and non-intervention, the organization can focus on providing assistance and support to Myanmar to address the violence within Myanmar's jurisdiction, the Rohingya. ASEAN in particular has an opportunity to strengthen the RtoP through the framework of ASEAN Political-Security Community (APSC) because the APSC has been in line with the RtoP. The concept of Responsibility to Protect (RtoP) can offer a solution to one of the severest issues in international politics, namely, mass atrocities. By appraising the relevant trends to implementing the RtoP, this chapter contributes to opening the possibility of applying the RtoP in Southeast Asia's most forgotten issue in human security, the Rohingya crisis.

This chapter explores the current situation of the Rohingya, the present policy of the Myanmar government and international attention towards the Rohingya and to what extent the regional's response has addressed the issue, most notably through the ASEAN. In doing so, it first examines the present Rohingya crisis and how the Myanmar has responded to it. The second underscores the international response, especially by ASEAN, to the issue. The chapter suggests that under as a member of United Nations (UN) and ASEAN, Myanmar has an obligation to apply RtoP to find a solution to one of the gravest issues on the planet.

1.2 The Most Forgotten Human Insecurity

The Rohingya is one of the several groups that have suffered systematic persecution. There are more than a million Rohingya, a predominantly Muslim group in Myanmar. They live mainly in Rakhine State, formerly known as Arakan. This area

on the country's western coast of Myanmar is a dismal state, the second poorest state in one of the poorest countries in Southeast Asia. Myanmar gained its independence in 1948, but the Rohingya have lived in Myanmar since the seventh century and founded a Muslim empire known as the Arakanese Kingdom in 1430. In contemporary Myanmar, Rohingya have no safety and are not wanted to be part of the nation. The law renders most of the Rohingya stateless, which fuels extreme rhetoric insisting that the Rohingya are foreigners who have no right to live in Myanmar.

After the independence of Myanmar, the country recognized ethnic diversity. Thus, ethnic minorities also obtained equal rights to those of other ethnic groups. However, in 1962, General Ne Win, the leader of the military, known as the Tatmadaw, came to power. In 1982, under Ne Win's leadership, the government announced the Citizenship Act or the 1982 Burma Citizenship Law. Under the law, the government has been refusing to recognize the Rohingya as one of the ethnic groups in the country. The Myanmar government states that the Rohingya are Bengali migrants as a part of a legacy of colonial times. Myanmar excluded the Rohingya from the list of groups awarded citizenship and eliminated the Rohingya from the 135 'national races' that received government recognition (International Crisis Group 2016).

Based on Amnesty International's reports, the Rohingya have suffered from human insecurity and human rights violations since 1978. Since the announcement of the Citizenship Act, approximately half a million people, mostly Muslims in the Arakan region, have experienced discrimination. The absence of government recognition of Rohingya citizenship in particular means the Rohingya people do not have access to health care, employment and public facilities. The Rohingya also have limited access to education and less freedom to travel. Restrictions on movement also affect their access to work, essential public services and religious liberties. Most importantly, their names and the very word Rohingya are even forbidden to be spoken in Myanmar.[1]

In the context of political management to maintain power, the military-ruled Myanmar for half a century relied on assimilating Theravada Buddhism and nationalism to create a political commodity in domestic political games. Serious discrimination against the Rohingya and other minorities like the Chinese people such as the Panthayshad and Kokangs was the ultimate 'game in town'. Also, anti-Muslim and minority sentiment have been manufactured by the military and spread broadly by and to some conservative societies. The emerging political atmosphere has become complex in the Rakhine State. The Rakhine are the nation's dominant ethnic group, and Rohingya Muslims are living alongside the (mostly) Buddhist Rakhine people. Consequently, ethnic strife has broken out anew in Rakhine.

The military has also encouraged the Buddhist Rakhine community not to hesitate to struggle for power in the Rakhine region and to do violence against the Rohingya. The violence has ranged from the seizure of land to damaging settlements and even to killing of Rohingya people. This humanitarian catastrophe

[1]Confidential interview with a journalist, Naw Phi Taw, Myanmar, January 26, 2016.

has become so widespread that Rohingya people have determined to leave the country.[2] The level of violence against the Rohingya also reached a stage of brutality in 2012, when violence resulted in the heavy losses of hundreds of Rohingya and left a further 140,000 homeless; many Rohingya people are now housed in internal displacement camps (Than and Thuzar 2012). The violence continued in March 2013 with bloody clashes between Buddhists, Muslims and anti-Muslims, leaving nearly 200 people passed on. More than 120,000 Rohingya remain displaced within the state. As a result, the UN estimates that out of 100,000 Rohingya's boat people left Myanmar by sea. The International Organization for Migration (IOM) reports that there are currently 8000 boat people stranded at sea. Most of the Rohingya who leave Myanmar by sea flee to the neighbouring countries such as Thailand, Malaysia, Indonesia and Bangladesh (Morada 2014).

Furthermore, amid military suppression of insurgents in Myanmar's western Rakhine State, tens of thousands of Rohingya have fled to Bangladesh. However, the Bangladesh government closed its borders to the migrants under the rationale that the Rohingya from Myanmar are not Bengali ethnics. Thus, Dakka did not recognize the Rohingya as refugees.

Based on testimonies from refugees who fled the violence and from other investigation reports up until October 2016, human rights activists have documented numerous extrajudicial killings, rapes and beatings by state security forces. Human Rights Watch indicated that the Tatmadaw had launched a campaign of arson, murder and rape against ethnic Rohingya. Terrible violations on the Rohingya population in northern Rakhine State are thus a dark reality (Human Rights Watch 2016). In the most current report, the crisis has been escalating since October at outposts along Myanmar's border with Bangladesh. Nine police officers were killed in attacks, allegedly by the local and Middle East-trained group of Rohingya. At the time, the Tatmadaw's leaders claimed a search for unidentified insurgents, and the Myanmar military launched a brutal retaliatory operation in Maungdaw Township (Munir 2017). However, the government denies allegations of genocide.

Myanmar's Rohingya have been rejected by the nation they called home. They are not wanted by neighbouring nations and are being detained in even more miserable conditions in refugee camps. Borrowing Dummett words, it is a sorrowful illustration that the *Rohingya are among the world's least wanted societies* (Dummett 2010).

Currently, neighbouring countries of Myanmar are also becoming embroiled in the crisis. Most of the Rohingya who left Myanmar went to Thailand, Malaysia, Bangladesh and Indonesia. More than 100,000 Rohingya who were forced from their homes by violence in 2012 are in resettlement camps (Paddock 2016). Also, the United Nations reported that about 65,000 Rohingya have fled to Bangladesh, and the United Nations High Commissioner for Refugees or UNHCR had made many efforts to negotiate repatriation of Rohingya from Bangladesh. However, human rights abuses in the resettlement camps threatened repatriation (Mathieson

[2]Confidential interview with a university professor, Yangoon, Myanmar, January 28, 2016.

2017). Since Rohingya seek asylum, stable neighbouring countries are increasingly affected by the spill over effects of the crisis. Therefore, Myanmar's Rohingya crisis can no longer be seen merely a domestic problem.

1.3 The International Spotlight

Issues regarding the systematic violence against Rohingya have gradually gained attention from the international community. In 2005, under the RtoP principle, the UN General Assembly unanimously emphasized that violence and discrimination against the Rohingya amount to a violation of Responsibility to Protect within Myanmar's borders ('Spotlight on R2P: Myanmar and Minority Protection under the NLD, Challenges and Opportunities', 2016). In October 2012, the UN Secretary General Ban Ki-moon urged an end to 'vigilante attacks, targeted threats and extremist rhetoric' in Rakhine State. Myanmar's Rohingya crisis has become an international and regional concern. Most importantly, the United Nations and human rights advocates have described Myanmar's Rohingya as 'the world's most persecuted minority' (Kingston and Kingston 2015). In 2013, US President Barack Obama started to strongly urge the Burmese government to end its persecution of the Rohingya minority ('US President Barack Obama urges Myanmar to stop violence against Muslims' n.d.). In 2015, Obama again expressed this stance, urging Myanmar to halt the violence against the Rohingya. In March 2017, the UN once again issued a report regarding the violence in Myanmar. It accused Myanmar's security forces of having committed mass killings and gang rapes in a campaign in which crimes against humanity and possibly ethnic cleansing are 'very likely'. Therefore, the UN human rights body has come to an agreement to send a fact-finding team to investigate allegations of killing, raping and torturing Rohingya Muslims by Myanmar's security forces[3] ('Burma Rohingya Muslims: UN Launch Investigation into Claims Security Forces Are Torturing and Raping Minority Group | The Independent', 2017). Currently, Rakhine Advisory Commission, led by former UN Secretary General Kofi Annan, for instance, has called on Myanmar to consider a programme to verify Rohingya citizenship and repeal restrictions on free movement.

Myanmar's Rohingya crisis also has affected neighbouring countries—Malaysia, Indonesia, the Philippines and Thailand—that gradually have become target destinations of Rohingya refugees. Those countries have had limited choices except to prove help to any refugee reaching their shores. The countries currently follow some humanitarian policies towards Rohingya problems. Kuala Lumpur and Jakarta finally agreed to provide temporary refuge to the boat people of Rohingya. Bangkok also provided humanitarian assistance and does not turn away boats aimed

[3]Based on the interviews conducted by the UN with 220 Rohingya out of 75,000 who have fled to Bangladesh since October 2016.

at entering Thailand's waters. Manila has committed to providing shelter for up to 3000 Rohingya.

Because Myanmar is a member of the ASEAN, Rohingya's suffering has been a call for action for ASEAN leaders to formulate an effective diplomatic solution to the crisis. ASEAN's responses to domestic issues within the member states of ASEAN will spark the old concept of so-called non-interference, which has cast a shadow over the behaviour of ASEAN members. The lack of certainty about Myanmar's problem-solving of the Rohingya crisis has triggered disputes within ASEAN, which has always adhered to the concept of diplomacy consensus and non-interference.

Relying on the argument that interference in the domestic affairs of other ASEAN member states was not allowed, ASEAN has not taken any action in the Rohingya issue, and even ASEAN tends to refuse to engage. The issue remained conspicuously absent from the agenda of the all ASEAN Summits. At that time, thousands of Rohingya were even being denied entry to some ASEAN countries. However, since June 2015, the fate of the Rohingya has been thrust into the world's spotlight after waves of refugees from Myanmar entered the territorial waters of Indonesia, Malaysia and Thailand. Although the refugees were asylum seekers, economic migrants and human trafficking victims, almost 10,000 people have sailed into the Bay of Bengal and the Andaman Sea, thus entering the waters of neighbouring countries. The Rohingya crisis and the broader enmity towards other ethnic minorities in Myanmar are not just a Myanmar problem—they are an ASEAN problem.

1.4 Myanmar Responds

The Myanmar government has initiated several important steps to handle the Rohingya issue. However, it seems that the government has been half-hearted in resolving the problem of violence against the Rohingya. This attitude is a result of domestic political dynamics due to acrimonious political transition as well as the political risk of dealing with Myanmar's military. The Myanmar government has not found the most plausible reason for defending the Rohingya. The violence against ethnic Rohingya is not entirely related to religious differences between Muslim and Buddhists but is also related to the political economy of violence sponsored by the Myanmar military (Saskia Sassen 2017).[4] Expecting the initiative of solution to come from the Myanmar government seems too good to be true.

[4]In this sense, any attempt to resolve the Rohingya issue will always have to include the military, which has an interest in the region. Briefly, the Myanmar military's opportunity to benefit economically by taking control of areas occupied by Rohingya is among the main factors perpetuating the issue. Presumably, until now, the only factor that encourages Myanmar to open up about the Rohingya issue is international pressure, in particular; the strict stance of the major member countries of ASEAN encourages Myanmar to fulfil its responsibility in humanitarian issues occurring within its territory.

Burma/Myanmar under the new civilian government Thein Sein embarked upon a historic transition by initiating a series of meaningful economic and political reforms. Regarding the Myanmar Rohingya crisis, in September 2014, the military announced the so-called Rakhine Action Plan, designed to handle the issues of security, displacement, citizenship and economic unfairness in Rakhine State. Accordingly, the international community had praised Myanmar for its attempt to establish a more tolerant and peaceful society and end gross human rights abuses.

However, the scheme obliged the approximately one million Rohingya to accept ethnic classification as 'Bengali' to obtain citizenship. On March 31, 2015, the government voided the identification cards of many Rohingya, forcing them to apply for citizenship as 'Bengali'. This latest situation followed the government's rejection of the Rohingya's ability to identify themselves in the national census in March 2014. This situation is the first since 1983. Since then, being displaced and neglected is the bitter consequence of being Rohingya. An estimated 700,000 are effectively stateless, and the government has recently voided a temporary identity card that never gave them the right to residency. In short, Rohingya's future has become increasingly bleak.

In contemporary Myanmar, the National League for Democracy (NLD) led by Aung San Suu Kyi won elections shortly after the dramatic exodus of Rohingya people. Aung Sang Suu Kyi came to power in the first open election in the last 25 years. Since she has come to authority, she is facing enormous expectations to make fundamental changes both politically and economically in Myanmar. Regarding the violence against the Rohingya people, enormous hope soared that Aung Sang Suu Kyi would govern more openly and democratically. Even the idea of granting citizenship to the Rohingya in Rakhine is among the realistic expectations.

In fact, her response to the crisis in Rakhine State and of the Rohingya people suggests that Aung Sang Suu Kyi is far from defending the weak, the oppressed and the minorities. She does not seem ready to resolve the dilemma. There have been many reports that the government of Myanmar, so far, has even lifted discriminatory state policies by refusing to acknowledge and grant the Rohingya access to citizenship. Moreover, the government failed to limit anti-Rohingya activities, supports ongoing violations of their fundamental human rights and, most importantly, has reinforced the public perception of the Rohingya as outsiders.

The failure of democratized Myanmar to help the Rohingya has incited criticism that the leader Suu Kyi is merely a common politician, not a statesperson, who is trying to maintain the power balance in the military, even to covering up crimes committed by the Myanmar military. Suu Kyi has particularly been criticized for her silence and inaction over the Rohingya crisis. Moreover, many human rights observers criticized Suu Kyi's failure to prevent conflict. Much evidence also suggests the government's (the military's) involvement in violence against the Rohingya.

Therefore, solving the problem of Rohingya cannot solely depend on the efforts of the government of Myanmar—that is not realistic. ASEAN also needs to take a comprehensive approach to handling the Rohingya issue.

1.5 Calling for the RtoP: Defending the Defenceless

Calling for Myanmar to run RtoP is necessary. ASEAN's role is crucial because Myanmar has failed or at least seems incapable of coping with the crisis to protect the Rohingya from crimes against humanity and ethnic violence. ASEAN might be able to address the issue if only ASEAN's member states have a more calibrated understanding of the difficulties faced by the current Myanmar government. Therefore, ASEAN should play a significant role in yielding practical measures that could provide some alleviations of the Rohingya's suffering. Helping Myanmar apply the RtoP to the Rohingya and to other human right abuses in Kachin and Karen states is the most pragmatic way to address the issues directly. ASEAN needs to assist Myanmar in fulfilling its primary Responsibility to Protect (RtoP) the Rohingya.

RtoP is designed to handle pervasive human rights violations that any society in the world faces. RtoP is a journey through the growth of human rights protection, including efforts to protect internally displaced persons and more recently the development of a norm that refuses to accept mass atrocities. RtoP is a crucial role in the development and application of the norm to rearticulate sovereignty as something that entails real obligations (Cohen 2012). The term 'RtoP' was coined in a 2001 report by the International Commission on Intervention and State Sovereignty (ICISS). It underpins the concept of sovereignty as a responsibility. In a similar vein, RtoP points out that sovereignty needs to yield to egregious violations of humanitarian and international law. The responsibility should include safeguarding people from 'genocide, war crimes, ethnic cleansing and crimes against humanity.' The RtoP concept underscores prevention as 'the single most important dimension' and identifies 'military intervention as a last resort' in the face of mass atrocity crimes. RtoP is an instrument to defend those who cannot defend themselves.

Regarding the application of RtoP in ASEAN countries, Bellamy and Drummond noted that interference in the domestic affairs of other ASEAN states was unlikely. It mostly regards the issues of sovereignty, and non-interference remains delicate in the region.[5] However, there has been movement over recent years that suggests that the gap between ASEAN's position and the demands of RtoP are less substantive than might have been anticipated (Bellamy and Drummond 2012). Therefore, application of RtoP in the region is not unlikely anymore. Similarly, Caballero-Anthony (Caballero-Anthony 2012) stresses that in the context of

[5] ASEAN endorsed a remarkable document, the Treaty of Amity and Cooperation (TAC), in which non-intervention, and hence the strengthening of the sovereignty of ASEAN states, was formally institutionalized. The document indicates that member states have a commitment to respect each other's sovereignty, emphasizing the principle of self-restraint in other states' internal affairs. TAC was admittedly a basis for exercising the so-called ASEAN Way, which obliges member states to adhere to quiet diplomacy and principled non-intervention. Unfortunately, this approach has caused the states to be too cautious about the Rohingya issue. The ASEAN Way faces serious challenges due to the rise of transnational issues flow across boundaries. Admittedly, non-interference lies at the heart of agreements between the states of the region, and ASEAN members are still sensitive about discussing that issue.

Southeast Asia, a sincere effort to implement RtoP is not only relevant but also timely. This argument is in line with that of Rizal Sukma, who stated that one of the ASEAN community's pillars, the ASEAN Political-Security Community (APSC), is an essential element that takes the same approach in the application of RtoP (Sukma 2012). Thus, APSC is ASEAN components that are compatible with and able to support RtoP.

Regarding RtoP under the APSC framework, Sukma (2012) specifically pointed out that the APSC, which was originally conceived as the ASEAN Security Community (ASC)[6] in the 2003 Bali Concord II (Trihartono 2016), is widely seen as the most promising platform for advancing RtoP in Southeast Asia. Since the 9th ASEAN Summit in October 2003,[7] APSC has become an instrument to bring ASEAN's political and security cooperation to generate a 'cohesive, peaceful, stable and resilient region with shared responsibility for the comprehensive security'. Sukma points out that APSC's mission should also include safeguarding ASEAN member states' people from 'genocide, war crimes, ethnic cleansing and crimes against humanity'. In brief, APSC remains relevant by providing a robust framework for implementing RtoP in Southeast Asia. In the context of ASEAN, RtoP has space to function.

Encouraging Myanmar to resolve its Rohingya crisis is on the critical agenda of ASEAN. The Rohingya's suffering has been a high calling for ASEAN to start urging Myanmar to protect its people. More importantly, ASEAN's involvement in the issue may prevent it from breeding more extremism in the region, diminish illegal migration and improve border security. In the context of Myanmar's Rohingya crisis, however, ASEAN could not necessarily impose strong measures to intervene through coercive actions such as economic sanctions. However, ASEAN could provide a framework for using various mechanisms and tools to help Myanmar deal with the Rohingya issue.

There have been huge expectations that ASEAN could play a constructive role in resolving the Rohingya crisis for several reasons. First, the Rohingya crisis is the most serious issue on the planet and has affected ASEAN countries' security. Myanmar is an ASEAN member that has become to be the country most at risk of experiencing genocide or politicide towards the Rohingya between 2011 and 2015 (APR2P 2012). In an increasingly globalized world and with the spread of new security challenges, it is crucial for ASEAN to address Myanmar's Rohingya crisis. The issue undoubtedly contributes to peace and stability regionally. The Rohingya crisis is a sensitive case involving multilateral ASEAN members. But ASEAN's involvement in domestic issues of member states is limited. Thus, the

[6]In the 14th ASEAN Summit in 2009 in Cha-am/Hua Hin, Thailand, ASEAN member's leaders committed to adopt a blueprint of ASEAN Political-Security Community (APSC) 2025. In this blueprint, ASEAN extended the cooperation to both security and political development. Therefore, at this stage, ASEAN is moving into a full-fledged of a security community.

[7]The Bali Concord II consists of the ASEAN Security Community (ASC), the name of which has been changed to ASEAN Political-Security Community (APSC); the ASEAN Economic Community (AEC); and the ASEAN Socio-Cultural Community (ASCC).

Rohingya crisis can be a pebble in ASEAN's 'shoe'. Since ASEAN members are concerned about both traditional and nontraditional security, discussion of traditional issues is not only normal but also unavoidable.

Second, although the Rohingya crisis has not only a religious aspect but also socio-economic and political implications (Saskia Sassen 2017; Suaedy and Hafiz 2015),[8] the protracted crisis may affect the real solidarity of ASEAN members both at the state and the community level. The Rohingya conflict could split religious sentiment in Southeast Asia, the population of which is 60% Muslim and 18% Buddhist, with the rest being Christians and Hindus. The Rohingya crisis can raise great sympathy, especially in Muslim-majority countries such as Indonesia and Malaysia that could affect the harmony of interreligious relations. Surin Pitsuwan, the former Secretary General of ASEAN, warned that failure to respond in a timely and efficient manner could make the Myanmar's Rohingya crisis a factor in destabilizing the international community—especially the ASEAN community ('Surin calls on ASEAN to act on Rohingya' 2012).

Third, ASEAN has instruments to help Myanmar resolve the conflict. The regional framework that can be used is APSC, ASEAN's most important security pillar. APSC is institutionally designed to manage security challenges of its members via the 2025 APSC Blueprint. APSC stresses that ASEAN's peoples could 'enjoy human rights, fundamental freedoms and social justice'. APSC also wants the region to be 'peaceful, secure and stable' and enable 'ASEAN Centrality' in handling the dynamic of ASEAN politics. Addressing the Rohingya crisis could provide an entry point for ASEAN to match the APSC's rhetoric to its deeds.

ASEAN involvement in handling the Rohingya crisis could accelerate resolution of the crisis. In its limited history, ASEAN has contributed to resolving conflicts in Southeast Asia, especially in Myanmar (Oishi 2016). The organization's previous contribution in Myanmar arose from the country's democratizing process. It was about settlement long-standing political conflict between the military and the pro-democracy movement. ASEAN was successful in influencing the Myanmar government's journey to national reconciliation (Trihartono 2017). Internationalization of the Rohingya issue precisely in the spirit of maintaining ASEAN's centrality and cohesiveness also represents a greater chance for ASEAN to take a role in solving the crisis. In the context of humanitarian assistance in Myanmar,

[8]There are two mainstream insights regarding Myanmar's Rohingya crisis. Several reports and studies have focused entirely on religious/ethnic aspects. Religious persecution, violence and crimes against humanity against the Rohingya are part of the agenda of ethnic cleansing. The head of the UN refugee agency, John McKissick, stated that the Myanmar government was carrying out ethnic cleansing of the Rohingya people. Several reports from Human Rights Watch and other organizations concurred. Not only had Buddhist chauvinists exploited this newly opened free space as the arena to fuel prejudice and incitement against Rohingya but also intercommunal violence has spread, affecting the broader Muslim community. Another perspective states that violence against ethnic Rohingya is not entirely related to religion but rather to the political economy of violence sponsored by the Myanmar army. In this view, the economic interests of the military drive its motivation to take control of areas occupied by Rohingya. This approach sees that the victim is not only the Muslims Rohingya but also some non-Rohingya Buddhist communities.

ASEAN has a success story about involvement in domestic issues in the country. Over 130,000 in Myanmar's Delta townships perished in Cyclone Nargis in May 2008. ASEAN, the UN and the Myanmar government successfully organized huge international aid contributions for the survivors.

Placing RtoP within the framework of the APSC will be a more pragmatic approach. On the one hand, the Rohingya issue is an emergency because it involves the lives of hundreds of thousands of Rohingya people. There can be no compromise when it comes to saving people in the region. RtoP thus could be ASEAN's instrument that is open and available. On the other hand, resolving the Rohingya crisis will not be achieved without the widespread participation of the government and military in Myanmar. Therefore, understanding the complexity of the political transition of the young democratic regime in Myanmar is imperative. Assisting Myanmar's political transition will, directly and indirectly, facilitate the process of settlement of the Rohingya crisis.

In addressing the issue of Rohingya, ASEAN could help Myanmar tackle the root causes of conflict, manage conflict and create political reconciliation. Some possible measures include the development of society's and government's capacities to mediate, make peace, prevent conflict and strengthen the ability of local government to manage a peaceful society. When the ASEAN countries also have experience in conflict management, Myanmar could take lessons from its counterparts' experience. In short, ASEAN could help Myanmar build capacity in law enforcement, the rule of law, human rights protection and good governance.

ASEAN also needs to understand the political reality and the complexity of the political transition in Myanmar to help that nation carry out its Responsibility to Protect the Rohingya (such as the main characteristic RtoP). From this perspective, ASEAN needs to acknowledge necessary steps that have already taken by the administration of Aung San Suu Kyi to address these deep fissures. Responding to the current situation, ASEAN also may appreciate the initial steps of Aung San Suu Kyi, who responded to international pressure on the Rohingya issue. Among other things is the announcement of the creation of the so-called 'Central Committee for Implementation of Peace and Development in Rakhine State' and a comprehensive economic development plan, both gestures of openness. An Advisory Commission on Rakhine State was also formed and chaired by the former United Nations Secretary General Kofi Annan. The new civilian government led by State Counsellor Aung San Suu Kyi welcomed the proposals by the Advisory Committee Rakhine.

Finally, under the APSC's auspices, ASEAN needs to ensure that Myanmar could run any efforts to fulfil its Responsibility to Protect the Rohingya. The international spotlight, including support and pressure from ASEAN, brings the Rohingya issue to the attention of the contemporary leaders of Myanmar. The regular meeting of ASEAN members is the venue for solving the Rohingya issue within the ASEAN framework.

There is a significant shift in Myanmar towards more openness on the Rohingya crisis. In a meeting between Retno Marsudi, the Indonesian foreign minister, and Myanmar's leader Aung San Suu Kyi in Nay Pyi Taw on December 6, 2016, they

discussed on examining the situation in Rakhine State, which the Myanmar government responded to positively. Furthermore, after the meeting with Indonesian Foreign Minister, Aung San Suu Kyi invited foreign ministers of ASEAN members to discuss developments in northern Rakhine State at an informal meeting on December 19, 2016 in Yangon. This session is a great step towards providing ASEAN an opportunity to constructively review the situation in Rakhine State, including the Rohingya issue. ASEAN countries can concretely support the efforts of Myanmar to make the situation in Rakhine State more stable and conducive and to support inclusive development there. There is also a demand for an independent inquiry led by ASEAN on various charges of human rights abuses by Myanmar's military.[9] In particular, the session urged full humanitarian access to areas that are now closed, where more than 130,000 people were imprisoned for 2 months without any outside assistance.

It was true that the ASEAN foreign ministers meeting is only the initial step, but there were high expectations that the meeting would open up the possibility of a greater role for the association in addressing Myanmar's Rohingya crisis. The meeting marked the first time in history that the government of Myanmar acknowledged the significance of the problem. The meeting also reflected a significant shift towards more transparency and kept the door open for ASEAN to continue engaging Myanmar on the Rohingya issue. Although there was no specific agreement reached or specific action plan made, Myanmar promised to allow essential humanitarian access for ASEAN to work to resolve the crisis. At least, the good initial step to open up the previously taboo subject of the treatment of the Rohingya in Rakhine State is a move in the right direction.

The Rohingya crisis is an emergency humanitarian problem. Asking Myanmar to run RtoP can reduce the severe impact of humanitarian challenges in Rakhine State, and even the impact regionally in Southeast Asia and beyond. However, this step is intricate and is not easy. Therefore, ASEAN needs to take a more flexible approach. This chapter suggests that in resolving the Rohingya crisis, ASEAN needs to take a comprehensive approach by helping Myanmar to achieve the Responsibility to Protect the Rohingya by providing any assistance Myanmar might need. At the same time, ASEAN can use the framework of APSC to ensure that the fundamental principles of the RtoP can constantly take their proper place in political development. By doing so, the road to protect humanitarian issues, including those of the Rohingya, will not lead to an ivory tower. The deficit of problem-solving of Myanmar's Rohingya crisis and Myanmar's reformation into a new democratic state could make development of an ASEAN community longer and harder.

[9]Regarding the new revelations about the military's actions in Rakhine State, ASEAN foreign ministers addressed core issues and pushed for a regional investigation of the allegations of abuses in Rakhine by an independent group of experts. The Myanmar government and military asked immediately for such an investigation, which may include observers and empower investigators from the third parties to visit all affected areas and interview victims.

1.6 Concluding Remarks

The grave Rohingya crisis in Rakhine clearly falls within the scope of RtoP. The Rohingya issue has become a serious problem for other ASEAN members and a high calling for Myanmar to start exercising its Responsibility to Protect its peoples. This chapter posits that ASEAN needs to pay serious attention to the settlement of the political problem of the Rohingya issue. ASEAN has yet not necessarily imposed strong coercive measures such as economic sanctions. However, to assist Myanmar in fulfilling its Responsibility to Protect its people from the gravest mass atrocities on the planet, ASEAN could provide a framework and tools to help Myanmar address the Rohingya issue. ASEAN should also map the complex realities of Myanmar's continuing transition, which have been inherited after decades of military mismanagement. Therefore, a comprehensive approach to both the Rohingya crisis and the Myanmar transition seems a historical necessity.

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Chapter 2
Village Government Capacity in the Implementation of Village Law No. 6 of 2015 in Indonesia

Novri Susan and Tuti Budirahayu

Abstract This study aims at measuring the political capacity of village governance after the implementation of Village Law (Law No. 6 of 2015) in Indonesia. The Village Law was intended to change the concept of authority in undertaking development. Previously, the villages were controlled from higher levels of government in terms of the authority to plan the development and village budget. The Village Law has provided more authority and money for the villages' governments in order to conduct public administration, development, community empowerment, and social development. Furthermore, the law requires every village government to embrace and practice good governance values such as anti-corruption, transparency, participation, and accountability. A very general question but fundamental is, do the village government officials already comprehend the concept of good governance? The comprehension of good governance is a basic foundation of political capacity. This chapter reports on a survey analysis in eight villages of four districts in East Java. In order to present a comprehensive analysis, this study also undertook informal interviews and focus group discussions.

2.1 Introduction

Indonesian villages have largely existed and built-up a local system of governance before the establishment of the nation state of Indonesia. However, the centralist politics of the New Order regime (1969–1998) ruined these pre-existing governance structures. Villages were seen as only an administrative institution that

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became a layer of New Order regime political control of the people. The villages were not authorized to formulate and implement their own policy and development. After the collapse of the New Order in 1998, Indonesia has been making efforts to give more attention to the villages' political autonomy. During 1999–2014, villages were given more authority but were still under the control of the Kabupaten/Kota government based on the law about local autonomy. The law about local autonomy mainly aimed at giving political power to the district level. This fact has not provided sufficient space for villages to plan and implement their own concept of development. From 2004 to 2013, the village heads held a series of protests to get more village autonomy. Following the villages' aspirations, the political elites and lawmakers, who are concerned with the village government in the Indonesian DPR (national house of representatives), passed the Village Law No. 6 of 2014. Each village, under this process, will receive an average one billion rupiahs for their village budget every year.

The law, to some extent, provides a wide opportunity for the village to build their local social system, known as *adat*, and to thereby plan and implement village development. However, the bigger authority and budget of the village will create two general possibilities, namely, bad governance with high corruption which means village development will likely fail or more progress in enhancing the village's wealth and justice. The Village Law has started to be implemented in 2016. Village governments are required to practice good governance principles such as anti-corruption, transparency, participation, and accountability. Still, there is a distrust nationally that village governments have already built a strong anti-corruption consciousness. The distrust is caused by many cases of corrupt practices by village governments. This study found that the practice of corruption generally can be seen in the case of BLT or *Bantuan Langsung Tunai* (direct cash assistance) from the central government, distribution of *Raskin* (rice for poor people) and administrative areas such as the KTP (identity card), and markups on infrastructure development project budgets from ADD or Alokasi Dana Desa (village fund allocation) from the central government. The practice of corruption at the village level can also be found in the form of *urunan dana desa* (village fund gathering) that is obligated during the payment of property tax, while the use of the obtained funds is not transparent and clear. In turn, the pattern of corruption at village level can be found in four practices, namely, markup of ADD, capture of assistance aid, violations in administrative services, and gathering funds from the citizens (summarized in Table 2.1).

Table 2.1 The pattern of corruption at the village level

Corruption practices at village level				
Markup of ADD (village fund allocation)	Capture of fund aid from central government (BLT/RASKIN)	Violations in administrative services (ID card, land certification, etc.)	Gathering village funds	Manipulating village land (tanah bengkok)

Source: Authors' document research 2015

Much research has already been done to understand the reasons of corruption at the village level. As the study conducted by Rahman (2011) points out, four factors drive the corruption of village chief or village bureaucratic apparatus. First, the village head has a dual role as a formal leader (bureaucratic apparatus of the government) and public figure (as elders or traditional elders/village). With its dual roles, it is rather difficult for the village head to separate formal bureaucratic interests or public interest from their self-interests. As a result, the village head tends to mix up the budget and the use of funds for various self-interest purposes. Moreover, before the implementation of the Village Law, the salaries for village officials were relatively small. The village government officials often rely on the donations from citizens in the form of crops, rice, coconut, or a land. Second, because the village elections are based on the community support, it is not uncommon around the time of elections for the village head to mobilize economic capital to practice "money politics." This pushes the village head, in many cases, to restore their economic capital after the election by power and authority abuses. Third, in the representative democracy system, the village head has a strategic position for political parties. For winning votes at the grass root level, many political parties put forward their cadres to be village heads. Through this network of village heads and political parties, corruption tends to be stronger in the countryside. Fourth, there is a low ability of the bureaucratic apparatus of the village administration to foster a climate of clean and good governance.

In addition to the ability or lack of knowledge about good governance, the village communities also tend to be apathetic to government affairs. An anti-corruption practice at the village level was in fact basically begun through PNPM Mandiri (the national program for community empowerment). Since the launch in 2007, PNPM Mandiri tried to anticipate the possibility of corrupt practices that are often performed by bureaucratic apparatus in the countryside (Yasin 2004). Even so, there was still no great achievement in propagating anti-corruption practices, but the project of PNPM Mandiri started to introduce the concept of good governance and anti-corruption. Together with the implementation of the Village Law by which the village obtained bigger authority and budgets, anti-corruption and good governance are two fundamental requirements that must be fulfilled. This study aims to measure the understanding of village governments in implementing anti-corruption and good governance in response to the Village Law. This study undertook a survey in eight villages of four districts in East Java.

2.1.1 Problem Statement

As described in the context of the study, the main problem statement is "What is the extent of the readiness of village heads and the village bureaucratic apparatus for

implementing good governance based on Village Law No. 6 of 2014?." The details of the problem statement are as follows:

1. Do the heads of the village and its bureaucratic apparatus understand the principles of good governance?
2. What efforts have been made to implement these principles?
3. Do the village heads and village government bureaucratic apparatus understand what corrupt practice is, as well as the laws relating to corruption?
4. Have the village heads and the bureaucratic apparatus of the village administration applied the principles of anti-corruption?

2.2 Literature Review

Although the practice of corruption has been regarded as an extraordinary crime, and many reports have reported corruption cases, still it is difficult to alleviate. The majority of Indonesian people still perceive that actions such as bribes, gifts (gratuities), or demands of compensation from and to bureaucracy are not corruption, because culturally those kinds of actions have been firmly entrenched in social consciousness (Budirahayu et al. 2009). The effectiveness of the anti-corruption movement is being questioned and is doubted when corruption in the structure of bureaucracy in Indonesia is reinforced by the government officials, politicians, entrepreneurs, and law enforcement officials (Aditjondro 2004).

Culturally, corrupt practices are perceived as a normal part of governance. This has become a social value which justifies corruption as a truth. In turn, corruption is a habitus. This means an action has been practiced for generations. It is obtained and adjusted objectively with typical conditions in which corruption is built and perceived (Jenkins 2004: 107). This practice of corruption has become part of everyday life in society. It is socialized and maintained through social practices. Habitus of corruption can be found regularly in daily life. The research report of Transparency International Indonesia about the perception of integrity and anti-corruption of young people in rural and urban areas in Aceh, Kupang, and Surabaya in 2013 (Transparency International Indonesia 2013: 16) shows that young people have experienced or are at least aware of many types of corruption around them. The young people both in urban and rural areas do not reject unlawful acts such as bribery to get a driver's license or vehicle registration and the practice of nepotism in finding jobs, licenses, and other forms of law violations.

Habits of corruption will be intensified when the society is confident that corruption practices can be justified in a certain situation, especially when the quality of law enforcement is "gray" (Pope 2003: 30–31). Some scholars believe that the starting point for all efforts to control corruption actually exists in personal beliefs and perceptions of those who hold strategic positions (Budirahayu et al. 2009: 3:39). A leader has the knowledge, consciousness, and actions that can forbid the practice of corruption. Theoretically, the practices of anti-corruption by a leader

in everyday life both in the workplace and families will replace the habitus of corruption. However, how does this theoretical assumption work in reality? The debate of scholars in social sciences has moved toward a different discourse. Which one is the more strongly influencing factor in eradicating corruption, the actor or the system? Empirically, the practice of corruption involves multiple parties, values, and norms. Therefore, the practice of corruption is an interplay between the actor (agent) and system (structure). The thought of Anthony Giddens regarding structuration theory is one way out from the debate between micro-perspective (actor) and macro-perspective (structure) (Giddens 1986). Giddens' structuration theory works at both the macro-level and microlevel.

In Giddens' theory of how a social practice such as corruption or anti-corruption is reproduced, the relationship between structure and agency is dual; that is to say, the social structure is the outcome and also the means for the social practice (Widoyoko 2013: 32). A structure of rules and resources is used by the agency to interact. Structure is also shaped by the agency through the interaction itself. Structure is also the rules and resources which are formed by, and form, the looping of social practice. As a rule, the structure limits what the agency cannot do, but the structure becomes the resources that empower the agency to be able to do something. Basically, structures are formed by social practices and form social practices.

The role of the agent in the structure is determined by the shaped consciousness. In Giddens' thought, there are three-dimensional actions of the agent that are based on the level of consciousness, namely, (1) an unconscious motivation whereby the practice is automatically conducted, but not actually the action itself; (2) practical realization that refers to the practical knowledge; it often cannot be explained because the knowledge is already embedded in the minds of the agent – this is the result of habituation; (3) discursive consciousness refers to actions that are not only being realized but are also able to be explained by the agent. Practical consciousness is the key to understand the process of how the various actions and social practices gradually shape, change, or maintain the structure (Herry-Priyono, in Widoyoko 2013: 33). Through the practical consciousness, the structuration process occurs: how the structure is formed by the action and how the agent's action is influenced by the structure (Giddens, in Widoyoko 2013: 34).

A discursive consciousness is a capacity of the agent to reflect the self-action. It is capable of questioning the actions that have been practiced. It will, potentially, change the practices. In the concept of discursive consciousness, Giddens argues that a change can be realized. Through the structuration theory, corruption is seen as a social practice, a form of practical consciousness that is repeatedly reproduced. Since the practice of corruption has become a practical consciousness, the agents do not realize that actually, they are undertaking corrupt practices. In other words, corruption is accepted. A practical consciousness provides the tools to perform everyday actions. In the case of corruption, the practice is guided by a practical consciousness so that the agent is not only unaware of it but perceives that corruption is the right action to undertake.

2.3 Methodology

2.3.1 Type of Research Method

This study uses a descriptive survey method. The survey was conducted in the village government officials in which questions were addressed on the implementation of the Village Law – particularly the practice of corruption and governance.

2.3.2 Research Location

The villages in the study were chosen to be representative of the characteristics of region and livelihood of the majority in the population. In Indonesia, there are three characteristics of villages, namely, an agrarian village, where the main livelihood of the population is agriculture and plantations; industrial village, a village where the main livelihood of the population is small household industries; and the fisherman village, where the main livelihood of the population is fisheries and aquaculture.

This study was conducted in four districts of East Java, namely, Malang, Sidoarjo, Lamongan, and Tuban. Malang was chosen as the study site because this region is known as an area of agriculture and agro-tourism. Two villages were selected to represent the characteristics of the region: first, the village of Madiredo, known as one of the centers of Malang apple farming and, second, the village Tawangsari, an agricultural area particularly for vegetable farming. Sidoarjo regency was chosen as one of the fairly rapidly growing industrial areas. Two villages in Sidoarjo are considered to represent an industrial area: first, the village of Berbek that has become a part of a big industrial area and, second, the Wedoro village which is also known for its local footwear home industry (slippers and shoes).

The next two districts, Lamongan and Tuban, were chosen as study sites because of the peculiarities of its beach or coastal areas. The village in Lamongan that can be considered to represent the fisherman area is the Kranji village, while in Tuban, two villages sited in the coastal areas and simultaneously representing a new industrial area were chosen, namely, Glondong Gede village and Tambakboyo village.

2.3.3 Data Gathering and Analysis

The research data was gathered using several methods, among others: (1) through structured interviews on a variety of information pertaining to knowledge about the contents of the Village Government Law, the meaning of corruption and anti-corruption consciousness, and governance; (2) focus group discussion (FGD),

used to capture the opinions and thoughts of the village head and its bureaucratic apparatus, particularly with regard to the efforts of the village administration in operating the village government system and implementing the development projects; (3) observation, especially in the community service activities that were organized by the village government bureaucratic apparatus; and (4) the supporting documents relating to village government programs of the society welfare and the application of accountability and responsibility to the village government.

Once the data was collected, it was analyzed to categorize or classify it according to the theme or focus of this study, which identified and mapped the knowledge of the village head and village government bureaucratic apparatus on the implementation of Law No. 6 of 2014, their understanding of the principles of good governance, and knowledge and consciousness about corruption and the implementation of anti-corruption principles.

2.4 Findings

The findings of the research are focused on the village comprehension of the law about villages, the practice of good governance, and the comprehension of corruption and anti-corruption based on the law about anti-corruption. Those focuses are expected to help create understanding of the political capacity of village government in implementing village governance.

2.4.1 The Comprehension of Village Law

Based on the survey data (Table 2.2) relating to the understanding of the village government's bureaucracy about Law No. 6 of 2014, it can be concluded that respondents generally already have knowledge and a good understanding of the elements listed in the law. The elements that were already known were as follows: (1) the village government and staff, (2) village meetings, (3) BPD (village consultative body) and staff, (4) rural development, and (5) village regulation, while the elements that seem to be still not widely recognized were as follows: (1) the village-owned enterprises (BUMDes), (2) village community empowerment, (3) asset of the village, and (4) village budget.

Based on the data in Table 2.2, the elements in the law that have been conducted by the village government are (1) to establish village government, (2) to form BPD, (3) to organize village meetings, (4) to conduct rural development, (5) to arrange and record a village budget, and (6) to record and preserve the assets of the village. However, the respondents still have not yet implemented BUMDes and empowerment of the community.

Table 2.2 Elements of Village Law

Elements of Village Law	Frequency		Total	Percentage		Total
	Yes	No		Yes	No	
Village government	65	0	65	100%	0%	100%
BPD and staff	64	1	65	98.5%	1.5%	100%
Village deliberation	65	0	65	100%	0%	100%
BUMDes (village-owned enterprises)	54	11	65	83.1%	17%	100%
Village regulation	61	4	65	93.8%	6.2%	100%
Village development	64	1	65	98.5%	1.5%	100%
Village budget	60	5	65	92.3%	7.7%	100%
Village asset	63	2	65	96.9%	3.1%	100%
Community empowerment	61	4	65	93.8%	6.2%	100%

2.4.2 The Implementation of Good Governance

There are six indicators of good governance that questioned the village apparatus, namely, good political services, participation, transparency, accountability, information dissemination, and law justice. These results are shown in Table 2.3.

This study found that the respondents have not fully practiced good governance. According to the interviews and FGD, the village government deals with two main issues. First, their subjective definitions were in contradiction with the definition stated in the law about some principles of good governance such as transparency of village budget and information disclosure related to the budget report. Second, the village government staff do not have the required capacity to implement the system of good governance.

2.4.3 The Comprehension of Corruption and Anti-corruption Based on the Anti-corruption Law

The survey data shows that the majority of respondents still lack information and knowledge about the anti-corruption law (64.6%). Therefore, it is unsurprising that they would claim to have never found or experienced cases of corruption in the village governance. However, the survey signifies that most of the respondents have an understanding about the types of anti-corruption, as follows: (1) bribery (82.6%), (2) the financial loss to the country (78.3%), (3) gratuities (69.7%), (4) embezzlement in office (60.9%), (5) extortion (56.5%), and (6) skulduggery (52.2%), while the lowest understanding on the type of corruption is about (7) the conflict of interest in procurement (39.1%). See Table 2.4.

The survey basically indicates that the respondents still do not comprehend the concept of corruption as mentioned in the law. They know the term corruption but

Table 2.3 The implementation of good governance

Good governance	Practiced	Not practiced yet
Political services	Village meeting and deliberation	Implement rural development
	Establishing and implementing village regulation	The community empowerment
	Maintaining a village asset	Manage the village-owned enterprises (BUMDes)
	Population administration	
Participation	The activities BPD and instrumentalities establishment	Establish BUMDes and carry out the program of rural community empowerment
	The establishment of the village government and instrumentalities	
	Organize village meetings	
	Organize rural development	
	Establish and implement village regulations	
	Arranged and recorded village finances	
	Record and maintain the village asset	
Transparency	Annual report	Operation BUMDes
	Monthly meeting	Empowerment of rural communities
	Village development plan	Creation and enforcement of village regulations
		BPD and devices
Accountability	The establishment process of village regulations	BUMDes
	The results of village meetings and village assets	Rural community empowerment
Information dissemination	The policy of the provincial government	Village development project report
	The policy of the central government	BUMDes
Law justice	Nondiscrimination	Spread information to all citizens
		Neutrality to all citizens (as opposed to family nepotism)
		Anti-bribery

Source: The data analysis of authors

are not able to explain more about it – such as the types of corruption. The study found that there are four corruption types that are not categorized as corruption, namely, (1) collusion with kickback system, (2) bribery, (3) gratification, and (4) conflict of interest particularly in procurement. The respondents reject or disagree if those activities are categorized as corruption. Meanwhile, nepotism and extortion are categorized as a corruption.

Table 2.4 Understanding types of corruption

Types of corruption	Frequency		Total	Percentage		Total
	Understand	Not understand		Understand	Not understand	
State financial lost	18	5	23	78.3%	21.7%	100%
Bribery	19	4	23	82.6%	17.4%	100%
Embezzlement in position	14	9	23	60.9%	39.1%	100%
Extortion	13	10	23	56.5%	43.5%	100%
Fraudulent acts	12	11	23	52.2%	47.8%	100%
Conflict of interest in procurement	9	14	23	39.1%	60.9%	100%
Gratification	16	7	23	69.7%	30.3%	100%

Source: The data analysis of authors

2.5 Conclusion

This study evaluates the awareness of the law and practice of corruption and development in villages in Indonesia. Even though the village government may know about the law on villages, yet they still do not fully understand and practice the principles of good governance – particularly transparency, accountability, and information distribution. Most of the village governments do not understand the content of the anti-corruption law either. The understanding of the types of corruption is also low, as shown by the fact that they are not able to fully define corruption practices. It can be seen from the village government's perception that collusion with the kickback system, bribery, gratification, and conflicts of interest is not considered as practices of corruption. Lastly, this study has found that the comprehension of villages generally toward governance and corruption is very weak. This fact will influence the political capacity of village governments in implementing Law No. 6 of 2014 about villages. Some serious issues including corruption and poor governance will be tough obstacles in village governance and Indonesia's governance in general. However, there is also another question to respond to these study findings: Is the local knowledge of villages defining good governance differently? This question will be a challenge to the theory of governance in Indonesia's local democracy.

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Chapter 3
Surviving in the Globalized World Through Local Perspectives: *Pesantren*s and Sustainable Development

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Abstract There is a broad consensus on the principles of sustainable development, including what should be developed and what should be sustained. However, which dimensions should be prioritized remains under debate. One reason, among others, is the diversity of people's social fabric and their embedded ecosystems. After discussing how the concept of sustainable development evolved, including its goals, this chapter focusses its empirical investigation on the commitment of *pesantrens* (Indonesian traditional Islamic boarding schools) to sustainable development. Although they have their own attributes and local narratives, it is argued that *pesantrens* are undoubtedly strongly dedicated to such development as manifested in their social missions, particularly through their traditional education. Yet, the challenges they face, particularly their efforts in human development, are unquestionably huge. Entrenched globalized values, particularly modernism, have resulted in a disarrayed response. Surprisingly, however, with their various creative efforts, most have been able to maintain their existence and continue their social missions. This project compares three different *pesantrens* in Jember district in search of new insights regarding how each *pesantren*, as a traditional institution, finds its own way to keep its commitment to sustainable development. Finally, the lessons learned from this 'traditional' perspective will be refined to critically review the existing concept of sustainable development and thus to suggest conceptual contributions in the field. This project essentially comprises qualitative research wherein most data were extracted from various interviews.

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3.1 Introduction and Overview

Conceptually speaking, sustainable development has been widely accepted on the world agenda. It represents a new global awareness of the need to preserve human life and its future. The concept emerged from the collective consciousness on the jeopardy of separation between 'development' and 'environment'.[1] Critical thought has suggested that the disconnection between these two has brought destructive impacts to human life, as indicated by the eradication of a life support system for humankind. The continuing detachment of these two projects would thus endanger the future life of human beings.

Thus, several world efforts to promote sustainable development have been made in sequence. The importance of adopting the two critical notions, development and the environment, as related concepts was collectively acknowledged in the 1972 Stockholm Conference on the Human Environment and then reaffirmed at the 1980 World Conservation Strategy of the International Union for the Conservation of Nature. In addition, in 1987, the Brundtland Commission committed to unifying the two concepts while ensuring that 'it meets the needs of the present without compromizing the future generations to meet their own needs'.[2] This definition has since become the main reference for all works devoted to sustainable development as a concept, a goal, and also a movement.

There has also been a consensus on the main principles of sustainable development, including what should be developed and what should be sustained. The aspects that should be developed are divided into three clusters – people, economy, and society – while those which should be sustained are nature, life support, and community.[3] While the definition and goals of these basic principles have been relatively agreed upon, appraisal is nonetheless available. The concept of 'sustainable' or 'sustainability' has progressively evolved into a general term wrapped up in the phrase 'all things to all people', but the phrase has been criticized for being 'vague'.[4] Such a sweeping term might be effective for conducting any related project because the clear-cut references regarding what is appropriate to do or not are available for anyone. However, on the other hand, it could also potentially simplify the substance and context across various communities for at least two reasons. The first is the fact that there is diversity in people's social fabric and their embedded ecosystems in which they have their own problems that require specific

[1]Quoted in Robert W. Kates, Thomas M. Paris, Anthony A. Leiserowitz, "What is a Sustainable Development?" in *The Issue of Environment: Science and Policy of Sustainable Development*, Vol. 47, No. 3, April 2005, pp.8–21.

[2]Ibid., pp.9–10.

[3]Ibid., p.11.

[4]Zainal Abidin Sanusi, Robert Steele, Hamoon Kheighat-Doost, Govindran Jagatesen, Hefizah Rosli, eds., *Education for Sustainable Development: Issues, Principles and Practices for Global Application*, Centre for Global Sustainability Studies, University Sains Malaysia, Penang, 2011, p.9.

strategies to solve. Secondly, scholars seem unable to agree upon which dimension must be prioritized.

Thus far, the concept of sustainable development has been used at the state level of analysis. Consequently, any problem of development always pays specific attention to state policy. This chapter disagrees with this strategy, arguing that any analysis of sustainable development issues should not be narrowly or only limited to policy set by state actors. We may expect sustainable development to also cover the non-state sphere in which any social group, through its own principles and empirical methods, might matter on any dimension of sustainable development. In this sense, I would like to argue that traditional religious institutions, called *pesantrens* (Indonesia's traditional Islamic boarding schools),[5] have indeed dealt with the issue for a long time although they have never intentionally been involved in any conceptual contestation of sustainable development.

As elaborated previously, the concept of sustainable development, particularly in terms of its definition and dimension, has evolved over time. Since the 1987 Brundtland Commission, there has been some progress. Besides a broadened definition that covers the necessity of managing the environment to secure 'intergeneration equity', the Commission has also suggested the details of 'what should be developed' and 'what should be sustained'.[6] The 2002 World Summit on sustainable development organized in Johannesburg then revised the definition by suggesting three pillars of sustainable development involving environmental, social, and economic aspects.[7] This advancement has marked the expansion of concern to supplement the previous definition which was oriented solely to economic aspects. Social development, for example, has three variants involving generic noneconomic social designation, human development, and value-based issues, such as equity or poverty mitigation.[8] Nevertheless, little attention has so far been paid to the important role of human factors in sustainable development, at least empirically.[9] The emphasis on human dimensions clearly reflects the growing collective awareness of the importance of the human dimension. The underlying assumption is that human beings are unquestionably the most determining, or even central, actor in any issue of sustainable development.

[5] *Pesantrens* are mostly situated in Java and the Madura Islands. In line with Indonesia's economic development, their number has dramatically increased over time. In 1977, there were 4195 *pesantrens* with 677,388 students across Java and the Madura regions. That number rose to 6176 and peaked in 2011 at 28,000. See Zamakshsyari Dhofier, *Tradisi Pesantren: Studi Pandangan Hidup Kyai dan Visinya Mengenai Masa Depan Indonesia* (The *Pesantren* Tradition: A Study of *Kyai*'s Life View and His Vision of Indonesia Future), revised edition, LP3ES, Jakarta, 2011, pp.77–78.

[6] Robert W. Kates, Thomas M. Paris, Anthony A. Leiserowitz, *loc. cit.*

[7] Ibid.

[8] Ibid.

[9] Sapia Moalam Abdurachman, 'Integrating Spiritual Dimension in Sustainable Strategy: An Islamic Perspective', *OIDA International Journal of Sustainable Development*, Vol.2, No.11, 2011, p.1.

Somewhat different from the general concept of sustainable development, however, the Islamic perspective also has its own distinct weight. While the sustainable development concept seems to place the economy, society, and the environment at the same level, Islam places special emphasis on the human dimension. This perspective originates in the religious teaching that in creating human beings, God Almighty places them as His vicegerent on earth (*khalifatullah fil-ardh*), regarding which in the Holy *Qur'an* it is written as follows[10]:

> *It is God who has created for you all that is on earth. . .Verily, I am going to place a viceroy (mankind) on earth*. (Al-Baqarah, 2, 29–30)

> *I have not created the Jinn and men but to serve me*. (Adh-Dhariyat, 51:56)

Those *Qur'an* verses cited above underline the fact that God, Allah Almighty, gives special preference to human beings coupled with an authority to manage everything on earth, but doing so should be in line with God's guidelines. In other words, Islam accordingly encourages the centrality of human beings in the management of the earth, but they should be responsible for their actions. All these have been nicely reflected in the Shariah (Islamic law) of how they should perform their deeds. Those that are relevant to sustainable development involving, for example, religious teaching says that because the earth and all its contents, both the human and non-human environment, belong to God, Allah Almighty, thus every single Moslem should take care of it and any mistreatment of it is strictly forbidden.[11] Consequently, in any development, humans are expected not only to be consumers but also to take care of themselves and others and are even encouraged to be appropriate in all their doings.[12]

For the above reason, Islam substantively is not unfamiliar with the issue of sustainability. Its teachings, contained in both the Holy *Qur'an* (the compilation of God's messages) and *Hadith* (the teachings of the Prophet Muhammad), obviously appeal to the materialization of sustainable development ethics. Many verses of the *Qur'an* and numerous teachings of the Prophet even provide norms and values to build a basic framework of sustainable development. Al-Ghazali wraps these up into what is called *maqasid* (goals) Shariah. These goals of Islamic law can be summarized as follows: 'to promote the well-being of *all* mankind that lies in protecting their faith (*din*), their human self (*nafs*), their intellect (*aql*), their posterity (*nasl*) and their wealth (*maal*)'.[13] Fulfilling these Shariah objectives in real life requires, of course, both values and methods. While the core issue of sustainable development is the strain of both economy and people, in which they are

[10]H. Aburounia, M. Sexton, "Islam and Sustainable Development", p.759., in http://www.irbnet.de/daten/iconda/CIB9051.pdf [Accessed on 10 November 2016].

[11]Ibid., pp.760–761.

[12]Muhammad Nouh, 'Sustainable in a Muslim Context', in earthcharter.org/invent/images/uploads/11 Manuscrip_Muhammad.pdf, pp.39–43 [Accessed in February 2016].

[13]Zubair Hasan, 'Sustainable Development from an Islamic Perspective: Meanings, Implications, and Policy Concerns', *Islamic Economy*, Vol. 19, No. 1, 2006, pp.3–18.

being constrained by a limited environment, Islam alternatively suggests that the four following key concepts should be simultaneously well-managed: wisdom (*hikma*), justice (*adl*), public interest (*maslaha*), and innovation (*ijtihad*).[14] Having all these, we may expect Moslems to be robust both spiritually and materially in order to achieve all of the desired concepts, not only those involving technical or policy matters but also those related to the quality of society.

At the empirical level, the *pesantren*, as an Islamic institution, constantly tries to abide by the Islamic development perspective, in at least some of its aspects. This embarks from the basic principles which are derived from the Islamic teachings and spirits that put human beings at the centre of development, in the sense that building moral character is seriously prioritized. In order to internalize character education among their students, they have made endless efforts to materialize the established 'five souls of *pesantren*', comprising soul of simplicity, sincerity, spirit of self-independence, Islamic-based brotherhood, and responsible freedom.[15] The five basic principles were coined in the 1955 congress of *Rabithah Ma'ahid Islamiyah* (RMI), a *Nahdlatul Ulama* (NU)[16]-affiliated organization which coordinates *pesantren*s across the nation.[17] As will be shown below, the internalized character, directly or indirectly, has since then strengthened the sustainability of their students, particularly their ability to survive. Nevertheless, while being relatively victorious in managing people, at the institutional level, *pesantren*s are really facing a serious challenge to survive in the modern age. In this respect, as a traditional educational institution, *pesantren*s are looking forward to an uneasy situation in which they struggle for their existence while coping with widespread capitalism-based modernization. In response to this, the different paths that have been taken by three *pesantren*s in Jember district, as elaborated below, will provide insight.

3.2 *Pesantren*: Local Context, Growth, and Resilience

The district of Jember is located approximately 200 km away from Surabaya, the capital city of East Java province, Indonesia, to the east. The district is topographically a highland area positioned as a hinterland of the eastern part of East Java. Historically, the area has largely been inhabited and belongs administratively to

[14]Odeh Rashed Al-Jayyousi, *Islam and Sustainable Development*, Gower Publishing, 2012, United Kingdom, p.15.

[15]A. Halim Soebahar, 'Konsep Ihsan dalam Pendidikan' (The Ihsan Concept in Education), a paper presented in the 'ASEAN Community Leadership Engagement', AKEPT, Kuala Lumpur, 14–15 August 2015, p.6.

[16]*Nahdatul Ulama* (NU) is the largest Islamic organization in Indonesia. It has been perceived to represent traditional and moderate Islam. The majority of existing *pesantren*s belong to this organization.

[17]The principles were refined from KH. Zarkasyi and KH. Achmad Shiddiq, two respected intellectual *kyai*s, communication with Professor A. Halim Soebahar, 5 February 2016.

Besuki region. Its socio-economic development started when a private Dutch company opened a commercial agricultural enterprise there. On 21 October 1859, George Bernie supported by his two friends, A.D. van Genep and C. Sandenberg Matthiesen, established *N.V. Landbouw Maatschappij Oud Djember* (*LMOD*) to plant tobacco.[18] Since then, the Jember district has been known as the main area in which a famous *Besuki Na Oogst* tobacco is produced, especially when the tobacco product reached the European market.

The plantations, in turn, had significant social impacts. Labour shortages encouraged the colonial Dutch to bring many people to Jember, and there were two waves of migration. The first was the Madurese who came from Madura Island and who mostly settled in the northern part of Jember. The second wave comprised Javanese people from Central Java and the western part of East Java who mostly settled in the southern part of Jember. As a result, the district population increased dramatically in a short time from approximately 10,000 to 100,000 people.[19] Since then, the population has been socially segregated into two ethnic groups, Madurese in the north and Javanese in the south part of the district. Economically, the Javanese descendants are generally wealthier than the Madurese due to their economic background. The former are mostly farmers, cultivating wet rice fields, while the latter live chiefly in unirrigated field areas. The success of the Javanese enclave in establishing an irrigation system in the south enabled the Jember district in the 1880s to become the biggest rice producer, besides tobacco, for the surrounding Besuki region.[20] This significant commodity growth in turn encouraged more economic progress as signalled by the emergence of a number of local markets in some surrounding sub-districts. The district economy developed even further in the late nineteenth century after the Dutch established railways connecting Jember to Probolinggo and Surabaya.

The social segregation of Javanese and Madurese descendants is not only in terms of economic aspects but also relates to their social features. The two social communities have a number of different social characteristics. The Madurese descendants who live in the north are mostly devout Moslems, hard workers, and socially hierarchical and paternalistic, while their mentality tends to be impatient, temperamental, and expressive. On the other hand, the Javanese heirs in the south also have a good working ethos while being economically thrifty, socially more egalitarian, and having a relatively more patient and resolute temperament than their Madurese counterparts.[21] Differing from the Madurese heirs who are mainly pious Moslems, the Javanese heirs generally are religiously syncretistic in

[18] *Dewan Perwakilan Rakyat Daerah: Dalam Perkembangan Kabupaten Jember* I, DPRD Jember, 2009, p.30.

[19] Ibid., p.27.

[20] Ibid.

[21] Ibid., p.98. See also, Himawan Bayu Patriadi, "Reformasi di Jember: Kasus Pemilihan Bupati," in Jim Schiller, ed., *Jalan Terjal Reformasi Lokal: Reformasi Lokal di Indonesia*, The Flinders University of South Australia- Universitas Gadjah Mada, Pusat Studi Politik Lokal dan Otonomi Daerah – Pascasarjana UGM, Yogyakarta, 2003. pp.279–322.

the sense that while they have in fact adopted Islam as their official religion, in daily life practices, they are mostly still bound to Javanese spiritualism. However, in line with the prompt progress of capitalistic economy, social pathology, particularly commercial sex and criminality, has risen dramatically, even in some areas that are inhabited by dominantly Islamic-referred communities. This is the main reason, among others, why many *pesantren*s grew rapidly at that time in the Jember district.[22]

The first *pesantren* was established in 1884 by KH. Muhammad Siddiq. He was a Javanese-origin Islamic preacher from Rembang, Central Java, who was assigned by his respected teacher, *Kyai* Cholil from Bangkalan of Madura Island, as an Islamic missionary. The main reason for this, among others, was that Jember district was a newly opened area that was experiencing rapid economic development. It was assumed that the district would need a *kyai* (Islamic preacher) to lead and guide the people to maintain their lives firmly in accordance with Islamic teachings.[23] Since then, many *pesantren*s have emerged in the district for a number of reasons. The first reason is religious: Many *kyai*s who felt devotedly that they were called to preaching generally saw *pesantrens* to be an important vehicle for conducting Islamic missionary work, particularly in anticipating an increased social pathology, such as commercial sex and criminality, following the swift progress of the capitalist economy.[24] The second is sociological: As the number of migrant plantation workers grew dramatically, particularly those of Madura ethnic origin, many *kyais* joined their followers and then established new *pesantrens* surrounding the plantations in which their followers worked.[25] While keeping their followers to be religious, some *kyai*s were then also asked by plantation administrators to participate in securing commercial tobacco enterprises.

The third reason is more political: *Pesantrens* also functioned as an alternative educational institution to colonial Dutch formal schools. Under the colonial education system, elementary schools were classified into two types. The first type was the Europe large school (ELS) provided exclusively for European children, and the second was *Hollandsch-Inlandsche School* (HIS) whose pupils varied and included the children of high-ranking indigenous bureaucrats and local aristocrats. This exclusive colonial educational policy left other indigenous children without access to education. As such, numerous indigenous people viewed *pesantrens* as the only option to allow their children to study.[26]

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[22]According to a report, the *kyais* intentionally often set up their *pesantren*s in the 'black' areas with the aim of getting people back to the Islamic-based life; see Zamakshsyari Dhofier, *Tradisi Pesantren*, LP3ES, Jakarta, 2011.

[23]'Dewan Perwakilan Rakyat Daerah', *op.cit*., p.110.

[24]According to a report, the *kyais* intentionally often set up their *pesantren*s in the 'black' areas with the aim of getting people back to an Islamic-based life; see Zamakshsyari Dhofier, *Tradisi Pesantren*, LP3ES, Jakarta, 2011.

[25]Interview with Alfan Djamil, April 2014.

[26]'Dewan Perwakilan Rakyat Daerah', *loc. cit*.

Yet, in relation to the facts above, the religious motive should not be underrated. The Islamic-based interpretation, at least in the colonial period, might also have contributed to making many ordinary people more comfortable studying at *pesantren*s. There was a wide perception among ordinary people that studying at colonial formal schools was 'religiously' *haram* (forbidden), as, for many, the Dutch were perceived as *kafirs* (infidels). This was based on the *kyai*s' teachings that '*man tasyabbaha biqowmin fahuwa minhum*' (those who imitate another community, such as in their behaviour, belong to that referred community). In fact, at the colonial schools, it was compulsory for all pupils to wear clothes and behave like the Dutch.[27] From a socio-political perspective, the standing of such *pesantren*s might also be a manifestation of their resistance or patriotism against the colonial power. As such, the two arguments arguably made many indigenous people reluctant to study at Dutch formal schools, and, instead, they preferred to learn at the available *pesantren*s.

The end of Dutch colonialism, followed by Indonesia's independence in 1945, had a significant impact on education in general. If, under colonial power, the education system contained discriminative policy, in the independence era, national educational policy changed to what has been called the policy of educational democratization. In this respect, each person was free to choose his education in either a formal school or *pesantren*. Interestingly, although there were educational democratization and the chance to enter government formal schools without any constraint, the public desire to study at *pesantrens* remained high. Some arguments can be raised here. The first and most significant was the religious motive. Studying at a *pesantren* was widely perceived not only to be important for daily life but also for the hereafter. One of the arguments for this was that studying at a *pesantren* is also seen as part of religious worship. The *santri* (student) not only acquires religious knowledge but also has good morality and good *akhlaq* (deeds). The best source from which to obtain all those needs is the *kyai* figure. It is not surprising, therefore, that the *kyai* is the central figure used by the *santri* who followed all his excellent personal attributes, including his thinking and deeds. The other reason was that there had previously been only a small number of public schools available. To illustrate, up to the 1970s in Jember district, there were only two junior high schools and one senior high school. The fact that government formal schools were very limited ultimately made many people continue to view *pesantrens* as the main available study option for their children.

The third, and probably the most interesting reason, is that the durability of the *pesantrens* might also be found in their capacity to modernize in the face of contemporary challenges. Since the 1980s, some *pesantrens* have begun to creatively open an alternative education within the *pesantren*. If previously *pesantren* only concentrated on the *sorogan* system (studying personally face to face with the *kyai*s), since that time they have opened a new studying model by introducing the *bandongan* (class) system as well as maintaining the *sorogan* system.

[27]Interview with Alfan Djamil, 25 April 2014.

In addition, as part of the adoption of the *bandongan* system, many *pesantrens* also established modern formal schools from elementary school up to senior high school level within the *pesantren*, as well as maintaining the existing *salaf*-type (purely traditionally Islamic) education. In terms of curricula, the new formal schools also adopted general subjects like those taught at formal schools outside the *pesantren*. The main difference lies only in religious teaching subjects in which, in the newly adopted *pesantren* class system, the proportion of religious subjects in the curriculum are greater than that in formal schools. In respect of all these matters, it can therefore be argued that the durability of *pesantrens* is not merely due to the enforcing of environmental factors but also, and perhaps more importantly, depends on their creative adaptation in the changing environment. The statistics show that up to the 2000s, more than 600 *pesantrens*,[28] both large and small, have existed in Jember district.

3.3 *Pesantrens* at the Crossroads: Tradition Versus Modernity

Contemporary modernity confronted *pesantrens* with huge challenges to their existence. Of the 600 *pesantrens* in Jember district, their responses to the contemporary challenges have varied. In this sense, in general, there have been two types of response. The first type is one in which the *kyais* firmly continue to maintain the *salaf*-type education as the only one of their business. This reflects their refusal to take up any modern school model based on their conviction that the most important mission of *pesantrens* is to foster good *akhlaq* (deeds), which can only be achieved through *salaf*-type education. One example of this is the *pesantren* named Salafiyah, situated at Curah Kates village, Jember. Its current leader, *kyai* Achmad Sumardi, is the third generation since the *pesantren* was established in 1936. This is one of few *pesantrens* that fanatically maintains its character as a pure *salaf*-type *pesantren* with its own curriculum. The teaching subjects comprise local contents, particularly the materials of *kitab kuning* (literally meaning 'yellow book', pointing to the main references of Islamic thought written by famous Islamic thinkers). Although the total number of its *santris* has dropped dramatically from approximately 2000 previously to only 350 persons more recently,[29] *kyai* Achmad Sumardi remains firm in keeping *salaf*-type education alive. He convincingly argues as follows:

[28]Dealing with the total number of existing *pesantrens*, there have been different statistics between those that are registered at the office of *Kementerian Agama* (local religious department) and other agencies such as the local office of the *Nahdlatul Ulama* (the largest Islamic organization) to which most of the *pesantrens* are affiliated. However, all agree that more than 600 *pesantrens* are available in Jember district.

[29]Interview with KH. Achmad Sumardi, Curah Kates, November 2013.

> I believe that the choice of retaining the *salaf*-type education is undoubtedly appropriate. The major reason for this relies on my conviction that the main mission of a *pesantren* is to strengthen good *akhlaq* for the people and the *salaf*-type education is the best way to realize this, although some argue that modernity, for various reasons, will increasingly encourage people to leave the *salaf*-type *pesantren*. It is true that the number of our *santri* has significantly dropped, but maintaining the *salaf*-type education intact is not the main cause of this. There are many factors behind this phenomenon. Based on our own experiences so far, the major reason for the drop is the declining charisma of the *kyai* as the central figure of the *pesantren*. Introducing the modern formal schools does not mean that it can be done without any price. Just to illustrate, please look at the Darussalam Blokagung *pesantren* [situated in the neighbouring district of Banyuwangi], that has established many modern formal schools and that right now starts to say that it is hard to manage their *santris* who are studying at the modern formal schools. This is why I am still optimistic that in the future people will look back at the *salaf*-type *pesantren*.[30]

With such a statement, KH. Achmad Sumardi seems to confidently view the main threat of the modern era to be the erosion of *akhlaq*. From his point of view, the only answer to that is *salaf*-type education. Concentrating on *salaf*-type education, however, does not mean that the Salafiyah *pesantren* is fully opposed to modern education. While learning at the *pesantren*, their *santris* are allowed to study at modern formal schools outside the *pesantren*, such as *Madrasah Ibtidaiyah* (Islamic elementary school) or *Madrasah Tsanawiyah* (Islamic junior school). When asked about his concern with any possibility of *akhlaq* erosion, he confidently replied: 'I don't worry about that! By having the *salaf*-type education, coupled with the boarding system, my *santris*' *akhlaq* is well-guaranteed because it is good and impervious to any modern contaminating element!' Nevertheless, unfortunately, there has only been a small number of *santri*s who are interested in studying concurrently at the modern formal schools. Of the total available 350 *santris*, only less than 150 persons have done so.[31]

Another interesting phenomenon is that the Salafiyah *pesantren* seems to firmly embrace its idealism. It sees education as a social mission rather than merely a commodity. This can be seen, among other factors, in the compulsory student fees, which are much lower than public school fees. Each *santri* pays just 10 thousand rupiahs (US$0.90) in school fees and 150 thousand rupiahs (US$12) in monthly lodging fees.[32] Although having limited financial resources, institutionally, the *pesantren* is self-financed, and this condition does not make KH. Achmad Sumardi being anxious, he even said jokingly: 'different from the modern *pesantren* where it is not rare for the *kyais* to earn money *from* their *pesantren*s, in the *salaf*-type *pesantren* it is common that the *kyai* should get the money *for* the *pesantren*'.[33] Incongruously, however, he is very strict about any financial donation, including those from any government-derived institutions. He may receive donations but they should be very selective. He assertively stated that he would refuse any donation

[30]Interview with KH. Achmad Sumardi, Curah Kates, November 2013.

[31]Interview with KH. Achmad Sumardi, Curah Kates, November 2013.

[32]Interview with KH. Achmad Sumardi, Curah Kates, November 2013.

[33]Interview with KH. Achmad Sumardi, Curah Kates, November 2013.

that has a distrustfully hidden agenda. As part of its effort to keep its souls alive, particularly the 'simple life', sincerity, and 'the spirit of self-independence' as well as 'Islamic-based brotherhood', the *pesantren* also has an environment that is conducive to allowing these to materialize. While spiritually it consistently emphasizes that all the *santris*' behaviour should be part of religious worship, empirically the *pesantren* also creates some orders. For example, if anyone breaks the *pesantren*'s regulations, he must pay a five thousand rupiah (US$4) fine or, alternatively, collect a pile of river sand for physical development of the *pesantren*. Interestingly, in order to pay the fees, many *santri*s are financially self-reliant by working independently, such as selling household daily goods. At the same time, the majority of students cook their own daily meals. Furthermore, any collective *pesantren* activities, such as the compulsion to pray together and actively participate in environment cleaning, are aimed at developing an Islamic-based brotherhood as well as social sensitivity and empathy. As such, the impact of all of these can be seen in their alumni, who generally have the spirit of independence and subsistence with a high work ethos, in which most of them work in non-state sectors, such as entrepreneurs.[34]

Another type of response to modernity by *pesantrens* is reflected in their *kyai*s' attitudes towards accepting the elements of modernity. Their *pesantren*s are called the *kholaf*-type (accommodating the modern education model). This *kholaf*-type *pesantren* can be qualitatively divided into two categories. The first is the *pesantren* which only accepts limited modern elements for certain purposes. One example is the As-Sunniyah *pesantren* situated in Kencong sub-district. With approximately 1000 *santri*s,[35] it is led by KH. Sadid Jauhari, one of the respected *kyai*s in Jember district. Initially, the As-Sunniyah *pesantren* only dealt with *salaf*-type education; however, in line with the entrenched modernity, it in turn evaluated its educational system as a *kholaf*-type one, by instituting a modern formal school. Up to now, the *pesantrens* have had modern formal schooling from elementary school to university level. However, their intention in establishing these schools was merely reactive rather than deliberately planned. The opening of the formal schools was a response to the increasing public demand and, indeed, did not emerge from the *kyai's* own initiative. In this sense, KH. Sadid Jauhari stated bluntly:

> The establishment of the modern formal schools in this *pesantren* was mainly because of accommodating public demand for a formal education certificate for their children, something that was not issued by the *salaf*-type *pesantrens*. At the previous time, in many *salaf*-type *pesantrens*, the *kyai*s did not issue this kind of formal certificate because it was perceived to be used only for making money and, consequently, neglecting the religious mission. Yet, this kind of certificate is increasingly becoming important for their children as it is one of the essential requirements for getting jobs in modern world institutions. Later on, many alumni were then also reluctant to encourage their children to study at the *pesantren*s for the same reason. All these had finally forced the As-Sunniyah *pesantren* to establish the modern formal schools. There has been a changing perception regarding the importance of

[34]Interview with KH. Achmad Sumardi, Curah Kates, November 2013.

[35]Interview with KH. Sadid Jauhari, November 2013.

> issuing a formal education certificate. If previously many *kyai*s perceived that the certificate was only used to get a job, we now see it as a medium to widen the area of *dakwah (missionary endeavor)*. If having the certificate would make it easy for many alumni to find a job in various sectors, this means that we could enlarge our area of struggle in which to engage in Islamic missionary work.[36]

From the above statement, the As-Sunniyah seems to have been instrumentalist in its opening of a modern school. From the start, the establishment was part of the *pesantren*'s strategy, under the current modern era, that mainly aimed to attract many *santri*s to join. This is clearly reflected in *kyai*'s principle that 'you can follow the [modernity] stream but should not be trapped in it'.[37] According to this principle, the As-Sunniyah then manages two types of education. The first type is the *salaf*-type in which the curriculum consists of 100% local content comprising all religious subjects. The second type is modern formal schools from *Madrasah Ibtidaiyah* to university level. While adopting the general teaching subjects, the latter type also maintains a local content, which specifically comprises Islamic subjects at a ratio of 70 to 30%. However, the existing formal schools have so far been treated merely as complementary to the *pesantren*'s prioritized education. As stated, its opening did not aim to intentionally modernize the *pesantren*s' education system but was simply a tactic to recruit students. KH. Sadid Jauhari frankly states:

> The adoption of the modern formal school aims to have many *santri*s, because if they have no formal education certificate they will leave the *pesantren* because without having a certificate it would be hard to find any job. Yet, we should prioritize the *salaf*-type education because if the *santri*s were deeply trapped in the modern formal schools their ability to master religious subjects would be slowly undermined and this, in turn, would make our *salaf*-type/*diniah* education disappear. One of the recipes to avoiding this kind of possibility is by making the performance of the existing modern formal schools not to progress well. They are managed merely in order to achieve the minimal target, that is to enable my *santri*s to pass the government-managed national exam and fulfil *santri*s' obsession with getting the formal education certificate.[38]

The above statement clearly indicates the As-Sunniyah's scepticism in anticipating contemporary challenges. The penetrating modernization has forced the *pesantren* to have an ambiguous and reactive policy rather than a conceptual one. Substantively, it reflects the conviction that the *salaf*-type or *diniah* education is the only alternative to strengthen students' characters and secure them from any threat of moral degradation embedded by the penetrating modernity. Like its counterpart, the Salafiyah, the As-Sunniyah *pesantren* is also very committed to managing character education. While sincerity, self-restraint, and obedience are developed through various subjects and daily practices in the two kinds of education, both the formal and *diniah* classes, other characteristics such as Islamic-based brotherhood and self-reliance have also been socialized in their daily life habits. The Islamic-based brotherhood is shaped, among other factors, through the regulation of

[36]Interview with KH. Sadid Jauhari, November 2013.

[37]Interview with KH. Sadid Jauhari, November 2013.

[38]Interview with KH. Sadid Jauhari, November 2013.

learning Islam and regularly praying together, while the spirit of self-independence and soul of simplicity are nurtured, for example, in the management of serving meals. Unlike the Salafiyah *pesantren*, As-Sunniyah prohibits its *santri*s from cooking their daily meals for themselves but instead has a different strategy to enable its *santri*s to learn self-reliance and have soul of simplicity and social empathy. To serve daily meals, for example, the *pesantren* has created a co-op that is exclusively managed by the *santri* themselves. For this, every single *santri* pays less than 200 thousand rupiah (approximately US$16) per month.[39] From this educational model, a large number of its alumni go on to work in the private sector and only a tiny number take jobs in the state sector.

Compared to the Salafiyah, in terms of economic management, the As-Sunniyah *pesantren* is relatively more modern and creative. For its daily operational budget, each *santri* is asked to pay low fees of a total of 160 thousand rupiahs (US$13) per month, for both education and boarding fees.[40] However, unlike the Salafiyah *pesantren* that does not have any commercial business, in order to support alternative revenue-generating sources, the As-Sunniyah has developed a number of commercial projects, including establishing a goat farm, three retail shops, and one printing house. Additionally, this *pesantren* is also not too strict in receiving financial donations, including those from the government. Furthermore, to develop its education facilities, its modern schools also receive an annual government financial subsidy through the *Bantuan Operasional Sekolah* (BOS – school operational subsidy).

The second *kholaf*-type are those *pesantren*s who reacted against modernity by fully accepting it. One example is Al-Qodiri *pesantren* of Gebang village. As I have written elsewhere,[41] the leader of Al-Qodiri, *kyai* Achmad Muzakki Syah, is totally committed to modernizing his *pesantren* in anticipating contemporary challenges. Different from his colleagues at both the Salafiyah and As-Sunniyah, *kyai* Muzakki Syah confidently perceives modernity as something unstoppable and unavoidable. He thinks that in order to survive, *pesantren*s should smartly adopt modern management. This perception seems to have been borne from Muzakki Syah's deep contemplation, particularly his concern with the sustainability of his *pesantren*. This occurred after his close colleague, *kyai* Mochtar, from the Darussalam Blokagung *pesantren* situated in the neighbouring district of Banyuwangi, advised KH. Muzakki Syah on dealing with the future of the *pesantren* as follows:

> Like what happens at every single *pesantren*, no exception with the Al-Qodiri, the position of the *kyai* [both as the leader and manager] is undoubtedly very central and essential for the *pesantren*'s development and sustainability. It would be a misfortune if any *pesantren* that has been well-developed and materializes the *kyai*'s idealism and social mission should ultimately and regrettably be closed down once its *kyai* passes way. It is therefore good for you to find the best way to avoid this kind of terrible story.[42]

[39]Communication with A. Halim Soebahar, 28 October 2016.

[40]Interview with KH. Sadid Jauhari, November 2013.

[41]Patriadi, Abubakar and Hamat, 'Human Security in local wisdom perspective: Pesantren and its responsibility to protect people', *Procedia Environmental Sciences*, 28 (2015), pp.100–105.

[42]Interview with Asmad, November 2013.

Bearing the above advice in mind, KH. Muzakki Syah then saw that future preparation should be conducted in anticipation of the period after he passes away. Moreover, the *kyai* himself seemed to be aware that not all his charisma and capacities can be passed on to his successors.[43] As such, to sustain his ideas and social mission, this kind of institutionalism within the *pesantren* was urgently needed. While maintaining the *diniah* (traditional Islamic) education, the *kyai* therefore established a foundation to manage modern educational schools.

Thus, unlike some other *kyai*s who tend to be reluctant to engage in any kind of innovation, KH. Muzakki Syah, interestingly, seems confident in so doing. There are some explanations for this. The first, and probably the most important, lies in his spiritual belief and personal conviction and optimism. When asked about the possibility that modernization will be destructive to the *pesantren*, he convincingly replied: 'I am not afraid. As long as I have a good intention, the God, Allah Almighty, will help'. The second is that, personally, he seems also to be keen on innovation, as reflected in his own metaphor – 'I myself am like an ocean without border'[44]– which can be interpreted as his constant ideas and innovation, specifically related to his wish to maintain the *pesantren* to continually exist across different epochs. In facing modern challenges, he consistently encourages his followers to adopt a survivalist and competitive ethos of the spirit of hard work by saying to them: 'I am a stick for lazy people!'[45] The third refers to his adoption of the general principle, which has been popular in the *pesantren* community, in saying that '*Al'muhaadhafu 'ala qodiymish shoolih wal akhdzu bil jadiydil ashlah* ['while keeping any good old tradition, it is necessary to prioritize adopting any new tradition which is better']'.[46] Retaining all these arguments, and differing in this respect from many other *pesantren*s such as the As-Sunniyah of Kencong, the modernization of Al-Qodiri educational system is thus not primarily in response to public demand but is instead genuinely more self-motivated, in being specifically based on the *kyai*'s own vision of how Islam should respond to real-life contemporary challenges.

This vision was finally materialized on empirical grounds. Since then, the *pesantren* has steadily developed and modernized its education system with relatively low fees, which in total are roughly half of public school fees.[47] In terms of its curricula, its formal schools from elementary to higher education are loaded with up to 90% general subjects, and just 10% are allocated to Islamic subject matter. However, to balance this, and particularly to protect students from the realistic threat of moral degradation, some creativity has been adopted by firmly managing its *salaf*-type or *diniah* classes that focus on learning the referred Islamic

[43]Interview with Asmad, November 2013.

[44]Interview with KH. A. Muzakki Syah, November 2016.

[45]Interview with Asmad, November 2013.

[46]Interview with Asmad, November 2013.

[47]Interview with Asmad, November 2013.

literature, which are commonly held from evening until night. Same as what happens at the Salafiyah and As-Sunniyah, with its arrangement, organization, and spirit of togetherness; this *diniah* model education is the main anchor of the *pesantren* to shape the Islamic character of their students such as sincerity, self-restraint, and Islamic-based brotherhood. Furthermore, to a certain degree, character, such as self-reliance, soul of simplicity, and social empathy, is also continuously implanted through regulation of everyday life. In terms of providing daily meals, for example, and totally unlike its previous *pesantren*s, the Al-Qodiri manages this aspect with rather different guidelines. The male *santri* are allowed to cook for themselves or buy their meals outside of the *pesantren*, while the female students are prohibited from cooking for themselves or from buying their meals outside. Some of the reasons are, besides the safety reason, that it is difficult for female *santri* to find any cafes at night, while for the males it is still possible for them to reach any canteen far away and return to the *pesantren* before 9.30 PM. Consequently, the *pesantren* provides all daily meals for female *santri* but, interestingly, at very low fees of 120 thousand rupiah per month, which is a mere US $0.30 per day.[48] This is not surprising given that the *pesantren* has been well self-financed through its various successful business projects.[49]

Additionally, innovation has also touched upon its daily performances and activities. In order to erase the pejorative perception of the Islamic community, which is often labelled as 'traditional', 'conservative', 'underdeveloped', and 'left behind', the teachers of Al-Qodiri senior high school have been accustomed to wearing modern uniforms with ties.[50] Modern extracurricular subjects, such as English club and marching band, were also introduced even at the *diniah* classes. Such a drastic modernization seemed in turn to reap fruits, as it received an enthusiastic public response. After no more than a decade, the *pesantren*'s students had dramatically multiplied to 900 persons in 1985 and then jumped to approximately 6000 students in 2014.[51] With such a huge number of students, its alumni have also spread and now work in various positions, mostly in the private sector, while only a small number go on to work as civil servants.[52]

Yet, having various models of education due to their different standings against modernity, the three *pesantren*s described seem to agree that their educational orientation should ultimately shape the characters of the *santri*. This is the main reason why the principles have been adopted and strongly socialized by *pesantren*s, through their various teaching subjects and the daily life practices. From various interviews carried out at the three different *pesantren*s, so far, this mission seems to a large extent to have been fulfilled. Interestingly, the findings at this micro level exactly fit with the macro level conclusion. The 2010–2011 national survey,

[48]Communication with Asmad, 30 October 2016.

[49]Patriadi, Abubakar and Hamat, *loc. cit.*

[50]Interview with Asmad, November 2013.

[51]Patriadi, Abubakar and Hamat, *loc. cit.*

[52]Communication with Asmad, 27 October 2016.

conducted by the Asia Foundation in tandem with six other institutions, also showed that the principles embraced have successfully built the character of the target *santri*s, especially those that support their survival.[53] Bearing all those in mind, a further question can thus be raised here: How is the *pesantrens*' education system model relevant to sustainable development?

3.4 Sustainable Development: Bring Human Beings In?

From the above exploration, some important notes can be underlined. Although they have adopted different responses to modernity, all three *pesantren*s described have an identical perception of modernity as something frightening. Referring to Anthony Gidden's notion that modernity is a double-edged phenomenon, being both opportunity and dark side,[54] all three *pesantren*s incline to see modernity as the dark side in the sense that its embedded aspect is perceived as a threat to human life due to its potential to downgrade society's moral values. Yet, this should not be simply interpreted as paranoid, but instead, directly and indirectly, it reflects their serious commitment to the future of human life departing from the Islamic perspective. At the conceptual level, this human-based perspective questions the existing mainstream of the sustainable development concept, which puts emphasis on the economic aspect. Through its prosperity approach, the conventional concept has placed human beings as a mere element, among others, in achieving any economic policy. The Islamic concept, in contrast, offers a holistic approach involving all aspects of life by placing the human dimension as the central subject in resolving the problem of sustainable development. The main reason for this is its conviction that humans are God's spiritual representatives on earth with responsible authority. Embarking from this Islamic teaching, it can be argued, therefore, that sustainable development can no longer merely rely on economic development, but for various reasons it should also consider the significance of human development.

The lessons learned from this empirical study of the three *pesantren*s strongly support the above line of reasoning. My arguments can at least be suggested at two different levels. First, at the institutional level, as indicated above, all three *pesantren*s were worried about modernity, particularly its entrenched elements which potentially downgrade honourable moral values. Against the perceived threat, they consistently protect people to preserve their moral values, and at the same time they have also struggled relentlessly at the institutional level to sustain their existence in the face of contemporary challenges without receiving any assistance from other agencies, including government. Yet, interestingly, the *pesantren* that avoids modernity has tended towards a slowdown in performance

[53] A. Halim Soebahar, 'Konsep Ihsan dalam Pendidikan', *loc. cit.*

[54] Anthony Giddens, *The Consequences of Modernity*, Stanford University Press, Stanford, California, 1990, pp. 7–10.

and has even been abandoned by the public, whereas those that do not totally avoid 'modernity' continue to survive and steadily develop. One of the reasons is that the latter type of *pesantren* has been successful in smartly manipulating selected elements of modernity into their educational systems. Another reason is that people have generally trusted the *pesantren*s which accommodate some elements of modernity without losing their moral fibre of maintaining the public moral character. In this respect, the *pesantren*s were familiar with sustainable development for a long time before the concept became a world issue and even implemented it empirically on an independent basis. They also made a great effort to survive, including keeping their own institutions going, even before the 2002 World Summit in which the human dimension obtained importance in the discourse on sustainable development. For this reason, it is fair to say that the empirical role of any traditional institution has been undervalued in the discourse of sustainable development. Their local wisdoms, such as the Islamic perspective on education, might be precious in enriching the existing concept of sustainable development.

Second, at the individual level, the research even strengthens the argument that human-based development adopted by the *pesantren*s can provide an alternative view on sustainable development. The fact that the three *pesantren*s have, to a large extent, succeeded in adopting the Islamic perspective, by shaping moral character through both their education system and daily life practices, provides a solid foundation for this argument. As indicated, the majority of their alumni have been able to sustain their lives. Their internalized moral character, including such values as independence and self-discipline, has empirically allowed them to be economically self-reliant and sustain their lives without being dependent on the state sector. Therefore, it can be argued that the concept of sustainable development can no longer view humans as simply economic commodities, such as treating them as 'human capital'. Instead, any sustainable development needs to seriously consider the human-centred approach. If the 2002 World Summit expanded the definition of sustainable development by adopting three pillars of sustainable development, that is, environmental protection, social development, and economic development,[55] in contrast, the workable *pesantren* education model unquestionably raises the spirit of evaluating the existing economic-based sustainable development model or at least balances it by including the human dimension.

In short, dealing with the dichotomy of 'what should be developed' and 'what should be sustained', arguably, the *pesantren*s have been critically doing both simultaneously without aid. They have indeed developed the human aspect of people, which will hopefully contribute to making the community sustainable in the changing context. Meanwhile, at the same time, the *pesantren*s have, to a great extent, also been successfully sustaining the society in which they are situated, particularly in preserving the culture through their continuing efforts to establish the moral character of their students.

[55]Robert W. Kates, Thomas M. Paris, Anthony A. Leiserowitz, *op. cit*., p.12.

In a wider context, this fieldwork research also provides a challenging academic exercise. As discussed, through their education and daily activities, all the *pesantren*s have shaped the characters of their students, such as fostering close Islamic-based brotherhood and deep social empathy. Nevertheless, interestingly, despite having a sense of strong Islamic-based brotherhood, *pesantren* graduates are inclined to become moderate Moslems. In his explanation of the relationship between religious aspects and economic development, Max Weber persuasively argued that Protestant Christianity, particularly that which is originated from Calvinism, 'gives the most consistent religious basis for the idea of the calling'[56] for the development of the modern European economic development. In a similar vein, we can therefore expect that the *pesantren*-shaped characters might provide a spiritual foundation for 'the calling' to nurture any social civility which is believed to be conducive to a consolidated and sustainable democracy. It is widely recognized that, unlike its counterparts in the Middle East, Islam in Indonesia is generally moderate and is thus more compatible with the value of democracy. In this respect, interestingly, the research also opens a new research area of the mysterious relationship between Islamic values and modern-sustained democracy, a puzzle that it is unquestionably stimulating to explore in the contemporary epoch.

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Chapter 4
The Concerns and Sustainability of ASEAN Intergovernmental Commission on Human Rights (AICHR)

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Abstract This chapter attempts to examine the extent of importance that ASEAN gives to human rights issues. In particular, it examines the extent to which the ASEAN human rights body named ASEAN Intergovernmental Commission on Human Rights Commission (hereafter AICHR) can sustain human rights promotion and protection. As many people have predicted, the functions of the body are slow moving. This is particularly because of the nature of ASEAN cooperation efforts itself, which places strong emphasis on the principles of non-intervention and sovereignty of its members. These principles have prevented them from enacting policies and making statements to protect human rights of members that may be seen as interfering in the domestic problems of another ASEAN member.

4.1 Introduction

This chapter attempts to examine the extent of importance that ASEAN gives to human rights issues. In particular, it examines the extent to which the ASEAN human rights body named ASEAN Intergovernmental Commission on Human Rights Commission (hereafter AICHR) can sustain human rights promotion and protection. As many people predicted, the functions of the body are slow moving. This is particularly because of the nature of ASEAN cooperation efforts itself, which places strong emphasis on the principles of non-intervention and sovereignty of its members. These principles have prevented them from enacting policies and making statements to protect the human rights of members that may be seen as interfering in the domestic problems of another ASEAN member.

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However, this does not mean that ASEAN does not take human rights seriously on the regional level. As will be examined in this chapter, ASEAN members have attempted earnestly to include human rights in their agenda and finally were able to set up AICHR on 23 October 2009 through a long and difficult process. Due to a lack of consensus among different views and interests, AICHR could not be expected to function effectively within a short time. It seems that more time is needed for ASEAN members to enable this newly formed body to function to protect human rights. The role of non-state actors in ASEAN including non-governmental organizations (NGOs) is important in this process.

This chapter is divided into three main parts. First, it analyses the phases of human rights inclusion in the ASEAN charter. Second, it elaborates on the formation of AICHR and the expectations and criticisms of the body. Third, it explains the likely sustainability of AICHR.

4.2 The Phases of Human Rights Inclusion in ASEAN

The adoption of human rights articles into the ASEAN Charter in 2008 has been welcomed by both state and non-state actors in ASEAN. The so-called founding members of this organization, particularly Indonesia, Malaysia, Thailand, Singapore, Brunei, and the Philippines, have developed a shared understanding that human rights need to be discussed at the regional level, and some of them also have established human rights commissions in their home countries. When the new members, Vietnam, Laos, Cambodia, and Myanmar, joined ASEAN, they needed to accept this condition and conform to the existing understanding of human rights norms.

The development of human rights inclusion in the ASEAN Charter is a unique phenomenon. The adoption involved a process whereby the universal principles of human rights were adopted, interpreted, adjusted to local needs, and, finally, included in ASEAN human rights discourse. How the changing perception of human rights happens and what kind of role the international community has in this changing process are the topics that will be discussed in this section. The evolution of human rights understanding in ASEAN is a tri-phasic process. The first phase can be viewed as a rejection period followed by the second phase that is the compromise and localization of human rights principles. The third phase can be seen as the process where ASEAN develops its discourse on human rights.

To explain these phases, I will use a constructivist approach of how norms are spread, adopted, and adjusted. According to Acharya, transnational norms such as regionalism, democracy, and human rights are rarely completely rejected by recipient countries. There are always localization processes present, which are defined as ‘a reinterpretation and re-representation of the outside norm, including framing and

grafting, but may extend into more complex processes of reconstitution to make an outside norm congruent with a pre-existing local normative order. It is also a process in which the role of local actors is more crucial than that of outside actors' (Acharya 2004, 244).

Below is an elaboration on the three phases.

4.2.1 The First Phase

During the first phase, human rights had not become a central issue within ASEAN. From 1967 to 1989, ASEAN was in the process of consolidating the organization and finding a platform of cooperation. Taking lessons from previous conflicts, the organization then strengthened their commitment to the principles of sovereignty and non-intervention as the primary norms to be supported in their cooperative efforts. The member states would not tolerate any kind of intervention to the domestic problems of other members.

In this situation, ASEAN was able to comfortably serve the need of its member states. The government and societies of members were prevented from commenting or acting in ways that would be considered as intervening in problems of other members, including human rights problems. However, the absence of discussion did not mean that there were no human rights problems between ASEAN members. The authoritarian states, namely, Indonesia and the Philippines, were controlled by military-dominated regimes that paid little heed to political rights at that time. There were also similar human rights problems to a lesser degree in semi-democratic countries such as Malaysia, Singapore, and Thailand at this time.

Given the fact that many channels at the national and regional levels, including the media during this phase, were dominated by the government in authoritarian states such as Indonesia and the Philippines, in semi-democratic states such as Malaysia and Singapore, the discussion on human rights issues took place underground using Western media, newspapers, and books. Human rights activists and organizations conducted their activities silently and maintained the hope of human rights being realized by facilitating cooperation with international NGOs and Western states. These activists were often arrested with the justification being that they threatened the stability of the state.

Most ASEAN states emphasized economic development as their main priority to the detriment of human and political rights. The Singaporean government, for example, used the survival of its small state as the main justification for their harsh policy against opposition and human rights activists. The Indonesian New Order government under Suharto used development and political stability as the jargon by which to oppress opposition factions who demanded the implementation of human rights.

Internationally, the situation was also not ideal for human rights activists because Western democratic states did not really pay attention to human rights issues during this time. Their concern rested more on maintaining their own political and ideological interests, which mainly involved preventing the spread of communist influences in Southeast Asia.

4.2.2 The Second Phase

In the second phase, ASEAN started to discuss human rights issues because of Western pressures to do so. In this period, lasting roughly from 1989 to 1998, Western countries which were not distracted by Cold War issues paid attention to human rights and democracy. However, instead of bowing to Western pressures, ASEAN members gave strong reactions. These countries became upset when the West switched from supporting their authoritarian and semi-democratic regimes during the Cold War to making them pariah states because of their human rights records.

In this post-Cold War context, the implementation of human rights was seen by almost all ASEAN states as an enforcement of Western values and norms over their own cultures and traditions. The ASEAN states perceived that Western states often linked human rights with their economic and political interests. Being understood this way, the countries in the region reacted by emphasizing the importance of preserving local needs, norms, and values. According to some government elites in Singapore, Malaysia, and Indonesia (which was still under authoritarian Suharto's regime), these values placed more emphasis on the community than on the individual.

The perspective taken by other ASEAN members, such as Singapore and Malaysia, was usually called 'Asian values' and in Indonesia's case, 'Pancasila values'. In both the 'Asian values' idea and that of the Pancasila perspective, the individual has a duty to be responsible to the society or community and the family. According to Hoang (2009), individuals have to give their trust to authority and to cooperate rather than enable conflict in achieving their goals. In the 'Asian values' context, state security, economic development, and political stability were more important than civil and political freedom. By having state stability, they could build the economy, maintain social cohesion, and prevent the unwanted excesses of liberal democracy such as single parenthood, crime, narcotics, and other social ills. They also informed the West that it was imperative to understand the multitude of Asian cultural differences compared to the West (Avonius and Kingsbury 2008) before it attempted to promote human rights. 'Pancasila values' also adopted similar characteristics to 'Asian values', the only differences being that they placed more emphasis on Indonesia's specific historical and cultural context.

However, although these states rejected Western pressures, they did not completely reject human rights principles. The strong reactions and counters were mainly motivated by Western approaches (which often dictated human rights) at the end of the 1980s. According to the proponents of 'Asian values', what became the priority during this time were not civil and political rights as promoted by the West but economic development and political stability. Some ASEAN states such as Indonesia, Burma, the Philippines, and Thailand had signed the Universal Declaration of Human Rights after they gained their independence.

Following Acharya's theory about the spread of universal values, ASEAN can now be said to be entering a phase of the localization process (Acharya 2004) of human rights principles. The adjustment to the principle to the local context and needs was best described in the ASEAN ministerial statements. In a meeting in Singapore between 23 and 24 July 1993, for example, ASEAN states declared their position on human rights. This meeting reaffirmed ASEAN's commitment to and respect for human rights and fundamental freedoms as set out in the Vienna Declaration of 25 June 1993. The ASEAN Ministerial Meeting (AMM) was attended by six foreign ministers from Singapore, Indonesia, Brunei Darussalam, Malaysia, Thailand, and the Philippines who concluded that human rights was a matter of application and priority. The ministers said that the application should be balanced and without ambiguity. They also stressed that human rights were interrelated and indivisible, comprising civil, political, economic, social, and cultural rights (Chalermpalanupap 2008).

Another indication that ASEAN did not fully reject human rights principles could also be found in its statements calling on members to reject gross violations of human rights and to initiate the formation of a human rights body. In the aforementioned 1993 meeting in Singapore, the foreign ministers agreed that ASEAN should coordinate a common approach to human rights and actively participate and contribute to their application, promotion, and protection. It is also clear that the ASEAN members paid serious attention to the implementation of human rights mechanisms. One interesting statement related to this AMM was the plan to set up a regional human rights commission.

From this statement, proposals for setting up a human rights mechanism began, and this was reflected in the formation of Human Rights Commissions (HRCs) in some ASEAN states such as in Indonesia, Thailand, the Philippines, and Malaysia during the 1990s. This also showed that the respective regimes did not reject human rights principles, and they even accommodated some of the demands from Western countries. The national HRCs concern on human rights violation but at the same time tried to negotiate with their government of how to handle certain human rights issues, but primarily focusing on urgent economic, cultural, and social problems.

To follow up the idea of setting up a human rights body in this period, some steps had been taken within ASEAN. A Working Group (WG) was set up by the Law Association for Asia and the Pacific Region (LAWASIA) on July 1995 in Manila, its purpose being to outline a human rights mechanism for the entire body. ASEAN members also supported the Hanoi Plan of Action (1998), which both contained an appeal to ASEAN states to respect human rights and recommended necessary steps

to promote human rights in their regions as outlined in the United Nations Charter, the Vienna Declaration, and the Program of Action. ASEAN countries also signed the Convention on the Rights of the Child (CRC), and with the exception of Brunei, they also agreed to sign the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) pact.

4.2.3 The Third Phase

The third phase began after the 1998 Asian financial crisis. In this phase, the 'Asian values' discourse was no longer used by ASEAN officials to support practices of human rights and democracy (Barr 2002, 3–10), the view being that they had been discredited because of Asia's financial crisis. The crisis showed that the 'Asian values' discourse was too exaggerated to explain Asia's economic success, and in fact, the values were not able to support Asia's emerging industrializing states in facing the crisis. In addition to this, the 'Asian values' discourse was also criticized as being part of ASEAN leaders' efforts to perpetuate the myth that they had their own particular cultural and political system, which made it possible to reject Western pressures on human rights (Jacobsen and Bruun 2000, 7–9).

During this phase, ASEAN pioneered the establishment of the ASEAN Human Rights Body in its meetings. The formation of the body was difficult because of differences in political systems, made more so with the inclusion of four new countries into ASEAN: Myanmar, Cambodia, Laos, and Vietnam (MCLV). At the time, these new members had subpar records on human rights issues and needed to gain the confidence to discuss them. After long discussions and debates, veteran ASEAN members were able to convince the MCLV states that the body did not aim at placing blame on other states. Unlike the MCLV states, ASEAN founding countries had experience debating human rights with the West and were ready to move forwards. However, MCLV states re-emphasized the specificity of state-centric approaches to human rights.

However, in general, the founding countries of ASEAN were not yet ready for a formation of a strong regional human rights body with the function of monitoring and protecting human rights. All ASEAN member countries have encountered human rights violations, including Indonesia. Indonesia has not been able to uncover the death of human rights activist, Munir, and some student activists during the protest against Suharto in 1998. Indonesia has also not settled human rights problems occurring in its Papua Province (locating in the the western half of the New Guinea island near the border with Papua New Guinea). Malaysia has had problems regarding oppression of opposition factions, particularly with the improper arrest and treatment of the former Vice Prime Minister Anwar Ibrahim. Singapore and Malaysia still have strong acts that restrict individual freedom. The Philippines faced the problem of Muslim Moro minority rights in Mindanao, and Thailand also had problems in the handling of demands from Pattani people in

Southern Thailand. Meanwhile, Myanmar faced more serious human rights problems with the expulsion and killing of Rohingya people.

Singapore has made it clear that the ASEAN treaty should consider whether the clauses agreed upon were in accordance with its national laws (Durbach et al. 2009, 214). Former Minister Raymond Lim said that all ASEAN members needed to get consensus on what the body would look like, and he agreed that the body needed to function as a 'consultative and not prescriptive' body (quoted in Durbach et al. 2009, 214).

Regarding the establishment of the ASEAN human rights body, there were members who were more active than others. According to Haris Azhar, head of Kontras, an Indonesia-based NGO, Indonesia was one of the most active promoters of AICHR.[1] Former Indonesian foreign minister Hassan Wirajuda also supported the strengthening of the AICHR, but the other nine ASEAN members were reluctant. According to Azhar, it seems that Indonesia made a vain attempt to promote AICHR at ASEAN because it would be against the nine other members. As a new democracy, Indonesia's leaders think that human rights should also be part of the new ASEAN identity.[2]

4.3 The Formation of AICHR: Expectation and Criticism

ASEAN perceptions on human rights developed from a strong reaction to the Western approach, which often claims the universality of human rights principles over the localization of principles. Localization means a selection process of human rights aspects that can be implemented and modified to meet local and community needs. ASEAN leaders in particular prefer to uplift the importance of social, cultural, and economic rights while making some preservation on the implementation of political rights. Through these phases, ASEAN understood the limits of what it can do and cannot do so that every member can restraint their position for the sake of unity.

When the ASEAN human rights body was finally formulated, its power was limited. Its main concerns are on issues that relate to people's economic, social, and cultural rights. So far, two areas that have become the focus of discussion relate to the protection of women and children rights and of migrant workers. However, some NGOs and human rights activists are also promoting the importance of political rights, arguing that the above rights cannot be achieved without guaranteed political and civil rights.

So far, only four ASEAN member states, namely Indonesia, Malaysia, the Philippines and Thailand have a national human rights commission. Not all of the ASEAN member states are party to the International Bill of Rights (comprised of

[1] Interview with Haris Azhar, 10 February 2016.

[2] Ibid.

the International Covenant on Civil and Political Rights (ICCPR), the Universal Declaration of Human Rights 1948 (UDHR), and the International Covenant on Economic, Social, and Cultural Rights (ICESCR) 1966) or to all of the nine core international human rights treaties as stipulated by the Office of the High Commissioner for Human Rights (OHCHR). This will make it difficult for ASEAN, at present, to achieve a consensus on the formation of a convention.

From the above discussion on ASEAN's perspective on human rights, it is still difficult to expect its human rights body to fulfil its function. Different human rights issues and political situations within ASEAN states prevent the formation of a strong body that can investigate any violation of human rights principles in one member state. It is no wonder that the AICHR is composed only of a government-appointed commissioner. The AICHR's official tasks and mandates seem to be restricted; the AICHR Terms of Reference (ToR) mentions that the new commission operates in the capacity of a consultative body, which indicates that it does not truly have independent power (Munro 2011, 1189). The mandate and functions given are only for promotion of human rights (Hermawan 2010). There are no clear items to impose sanctions for non-compliance to human rights in the ToR (Munro 2011, 1193).

After about 8 years of formation, AICHR activities concentrate only on promoting and making campaigns to support human rights in meetings and seminars. It is silent on human rights violations in many cases, such as those against the Rohingya in Myanmar and the Pattani in Thailand. It also did not make any statements related to individual and press freedom in Malaysia, Singapore, and Indochina. AICHR also does not have power and is not independent of governments that make it possible to investigate human rights abuses. It has a function to get information or reports of human rights issues from member states, but AICHR has not used this authority.

However, the formation of AICHR can be seen as progress. ASEAN members have started to think of human rights at the regional level, in addition to the state mechanism for protecting human rights available in each ASEAN state. AICHR commissioners are also busy with running programmes to promote human rights in their home states, attempting to mainstream issues such as the danger of human trafficking. Some individuals have also sent reports about abuses of human rights they experienced to AICHR, although only one or two cases have since been discussed or followed up on.

4.4 Sustainability of AICHR

Given the above limitations faced by AICHR, there is a question of its sustainability. ASEAN is often able to form good consensus and decisions, but the shortcoming is always in its implementation.

More sceptical views mention that AICHR was formed as a tactical strategy to show that ASEAN, like many other regional organizations which have already set up such a regional human rights body, is very serious about dealing with human

rights issues. It may also be seen as the strategy to counter criticisms which argue that ASEAN has not functioned well after the end of the Cold War. Therefore, the formation is a move to improve ASEAN's image, which is seen as still disregarding clashing issues that cross the sovereignty of other members. The charter itself is seen as a minor point in ASEAN development since, as with many other ASEAN agreements, it has been very difficult to implement.

On the other hand, there are optimistic views circulating among civil society groups, non-governmental organizations (NGOs), and officials about the formation of AICHR. In particular, NGOs welcome this step as progress in ASEAN cooperation efforts, especially since for a long time, this organization mainly concerned itself with government-to-government cooperation and represented elite interests. The ASEAN Charter, therefore, was seen as a real step in line with NGOs and people's interests. These NGOs for the last 10 years have organized meetings, protests, and avocations demanding a more people-oriented ASEAN.

Pertinent human rights problems often related also to cross-border movement, meaning things such as human trafficking, refugees, migrant workers, and asylum seekers (Hara 2007). The migrant workers often experienced abuse of their labour rights. Some other issues listed by Amnesty International were also relevant to ASEAN, such as violence against women, limitation to freedom of speech and to form association, and extrajudicial executions. These cross-border human rights issues necessitate a formation of a human rights body because there are cases that cannot be handled by one state only.

The above views towards the sustainability of AICHR had some reasonable justifications. Sceptical views that saw the inclusion of human rights and formation of AICHR as a tactical decision, for example, may yet prove valid, since ASEAN was under strong pressure domestically and internationally in the 1990s, particularly on the military regime in Myanmar, and needed a strategy to survive as a workable organization. ASEAN leaders needed to show that the organization was still useful and had relevant functions in a changing political environment. However, if the explanation gave emphasis mainly on this explanation, we missed some points since the discussions and discourses on human rights in ASEAN had started for a long time before the case of Myanmar got international attention.

Apart from the above contrasting views, one aspect that may make AICHR sustainable is non-state actors' participation, particularly regarding the role of NGOs. NGOs have been very critical on ASEAN's weak commitments to human rights issues. Nowadays, NGOs have set up many meetings to demand that ASEAN leaders pay attention to issues such as poverty and human rights, particularly since the 2000s.

One important meeting that gathered the above civil society groups was the ASEAN Civil Society Conference, held from 27 to 28 October 2007. This conference was organized by the Singapore Institute of International Affairs, and it aimed at gaining views from civil society regarding many issues including human rights. The participants were drawn from regional non-governmental organizations (NGOs), think-tanks, and civil society organizations (CSOs) who had participated in larger meetings and networks among their counterparts in preparation for the ASEAN Summit. These networks include the ASEAN People's Assembly, the

ASEAN-Institutes of Strategic and International Studies, the Working Group for an ASEAN Human Rights Mechanism, the Solidarity for Asian Peoples' Advocacy, and the Southeast Asian Civil Society Environment Alliance.

These organizations particularly criticized ASEAN because of its elitist approach. According to them, ASEAN mainly serves state and regime interests rather than people's interests. People on the ground questioned the functions of the organization for citizens of ASEAN states. The critiques came out particularly after the end of the Cold War, which birthed the view that security is not mainly about state security but human security. Some nontraditional security agendas that were hidden during the Cold War became big security issues. According to the critics, it is time for ASEAN to solve these problems.

In such a condition, AICHR should also serve the people with a stronger commitment. ASEAN should change the focus from government to people-oriented organizations. This development is supported by countries just experiencing democracy such as the Philippines, Thailand, and Indonesia. Former Indonesia President, Yudhoyono, welcomed this people-oriented approach, saying that ASEAN should start to think as an organization of nations, instead of the just organization of governments. He said that now, people need to understand the policies and programmes made by ASEAN leaders on their behalf. He called for mass media and civil society to participate in a kind of bottom-up decision-making process and to monitor their implementation. This change reflects a drive towards a people-oriented ASEAN (Yudhoyono 2005).

4.5 Conclusion: The Way Forward

ASEAN has set up a human rights commission named ASEAN Intergovernmental Commission on Human Rights (AICHR). It does not have a strong mandate, for it is a consultative rather than prescriptive body that takes into account the sovereignty of all member states. ASEAN also has no tradition of blame yet still openly criticizes other members for any ethical issues they raise. In this situation, people cannot expect much from them, since ASEAN's decisions are still in the hands of the elites who dominate policy-making.

However, hope exists: A human rights body starts from merely the promotion of human rights, but later it may have a broader power of protection that can accommodate individual claims on human rights abuses. As with national human rights commissions in some ASEAN states, AICHR may be given authority to conduct investigations at a later date as part of its evolutionary process.

In the current situation, one of the primary tasks of AICHR is to 'improve public awareness of human rights through research', which can be conducted to examine and investigate both large-scale and individual abuses. This is part of the function of 'obtaining information from member states in the field of human rights protection', and 'conducting studies on thematic issues of human rights' as outlined in its ToR (Munro 2011, 1190). The said research can cover social issues such as issues of women and children, migration, human trafficking, and others.

AICHR may go beyond its modest official mandate and tasks, as the former Thai Prime Minister Abhisit Vejjajiva, for example, stated. According to him, 'the new body will be welcome to Thailand to investigate any human rights abuse case' (Zulfakar and Chun 2009). This is certainly a strong commitment that should be proved in practice; however, it has not yet been implemented. Similarly, AICHR ToR stated that there would be a dialogue between the human rights commission and civil society. In this dialogue, civil society groups can bring cases related to victims of human rights abuses.

Despite its limited power, there are ways to make the body sustainable in the future. The roles of NGOs and academics are very important to continue their critiques of ASEAN leaders and to give support to the exercise of human rights. They can use media and findings to create public awareness of human rights violation in certain ASEAN states. Concerns of the media, academics, and NGOs on Rohingya issues, for example, have prompted ASEAN states to take certain actions to protect the human rights of these people who are not recognized by the Myanmar government as complete citizens.

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Chapter 5
Development of the Photovoltaic Industry and Its Technology in Indonesia: A Multilevel Perspective

Anugerah Yuka Asmara

Abstract In Indonesia, the potential of photovoltaic (PV) energy is 4800 watt hour/m^2 per day and 2000 h per year. This country receives about 12 h/day of sunlight, especially in the dry season. In this country, governmental PV projects were started since the 1970s. Whereas, PV enterprises have been more active since the Indonesian Solar Module Manufacturer Association (APAMSI) was established in 2010. Unfortunately, PV has not been optimized to generate electricity at a national scale. The Government of Indonesia prioritizes fossil-fuel electricity energy as the main energy source to supply electricity to households and industries. Consequently, the PV industry cannot expand because of the limitations of its market at a national scale. In addition, national PV technology is not being further developed due to the unavailability of large investment funds and government support. This study used a qualitative method based on the multilevel perspective (MLP) to describe why the PV industry and its technology cannot mature in Indonesia. Development of the PV industry and its technology is not merely determined by technological and economic factors but also by institutional and political factors. Data were directly derived from several informants (primary data) through interviews and also from many supporting documents such as scientific articles, books, websites, newspapers, and reports (secondary data). The time period of data analysis is limited in range from 2010 to 2015. The finding of this study is that the PV industry and its technology development is strongly influenced by governmental PV projects. However, there is a potential to develop the PV industry and its technology.

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5.1 Introduction

Solar cells or photovoltaics (PV) are one of the most promising new and renewable energies (NREs) in the world. They are an environmentally friendly energy source that generates electricity without engendering pollution on air, land, and water. As an archipelagic country, PV is very beneficial for Indonesia to light many remote and rural areas located far from each other. It can be widely installed in those areas through "on-grid" or "off-grid" systems from the state-owned electricity enterprise (PLN). In addition, this country receives sunlight for 12 h per day consistently (especially in dry season).

In Indonesia, the potency of solar energy is very large, approximately 4.8 KWh/m^2 or 112,000 GWp (2000 h per year) in Indonesia. Of its potency, only 10 MWp is used (Ministry of ESDM 2008a). Though PV was firstly introduced by the government in the 1970s (Almanda 1997), its issue increased due to environmental issue in 1994, but PV has not been optimized to generate electricity at the national scale recently. Even though national electrification has increased from 65% in 2009 up to 80% in 2013 (RUPTL PT PLN 2015–2024), it is predominantly generated by fossil-fuelled electricity energy sources (Sumiarso 2011).

However, the contribution of two major NREs, namely, geothermal and hydro (RUPTL PT PLN 2013–2022), is not sufficient in fulfilling electricity energy needs in Indonesia. More recently, PV has been paid more attention when a new part of the Ministry of Energy and Mineral Resource (Ministry of ESDM) was created in 2010, namely, the General Directorate of New and Renewable Energy and Energy Conservation (Dirjen EBTKE). After its creation, the Indonesian Solar Module Manufacturer Association (APAMSI) was established in the same year (APAMSI 2015). APAMSI is a nongovernment organization which focuses on the production, sale, and installation of PV in Indonesia. Commonly, APAMSI also works to support implementation if there are PV projects initiated by Dirjen EBTKE at the Ministry of ESDM (Setiawan et al. 2014). Until now, the total capacity of installed PV in Indonesia is 42.77 MW, while the government has also funded 123 units of PV (4.8 MWp) in 2012 and 121 units of PV (5.27 MWp) in 2013 (Direktorat Aneka Energi Baru dan Terbarukan 2014).

National PV development is not separated from its technology and industry which exists in Indonesia. Technologically, the PV or solar cell industry is classified as a manufacturing sector using high technology and needing activities of advanced research and development (R&D) (IRENA 2012). Promotion of the PV industry is strongly influenced by innovation activities conducted by R&D actors. Both the PV industry and its technology are entities which cannot be separated from each other. In other words, the PV industry can support PV technology and vice versa.

Development of the PV industry and its technology is part of the innovation system involving various actors and linkages. Development of both components is

not merely determined by technological and economic factors but also by institutional and political factors. This phenomenon can be analyzed through a multilevel perspective (MLP). MLP is an analysis framework which is used here to describe why PV industry and its technology cannot fully mature in Indonesia. It is analyzed through three levels: niche, regime, and landscape (Geels 2005; Geels and Kemp 2007). A previous relevant study of NREs using MLP was conducted by Marquardt (2014) where it was concluded that weak local capacity, a lack of awareness for national intentions among local authorities as well as missing understanding for local circumstances among national policy makers, and a lack of consultation between decisionmakers (horizontally and vertically) during the policy formulation process is the main hindrance to expansion.

Other studies related to PV implementation in Indonesia, such as Veldhius and Reinders (2013), reveal that PV can contribute to increase electrification ratio and to reduce greenhouse gas emissions in Indonesia. Their conclusion is that electricity energy issues in Indonesia, especially in rural and isolated areas, can be solved through installing grid-connected PV. Another study conducted by Outhred and Retnanestri (2015) compare the PV system in Australia and Indonesia. Based on their study, though PV was initially installed in both Indonesia and Australia from the 1970s, the PV development approach in Indonesia needs to be paid attention to, particularly regarding valuable long-term outcomes in terms of cost-effective deployment, operation, and the maintenance of PV system.

5.2 Literature Review

5.2.1 Photovoltaic (PV) Technology

Photovoltaic technologies are electronic components that convert sunlight into electricity directly. A PV system consists of PV cells that are classified together to create a PV module and the auxiliary/supporting components (i.e., balance of system – BOS), including the inverter, controls, etc. PV cell technologies are usually grouped into three generations, depending on the basic material used and the level of commercial maturity, namely:

1. The first PV model utilizes the wafer-based crystalline silicon (c-Si) technology, either single crystalline (sc-Si) or multi-crystalline (mc-Si), for the sake of economy/business activities. In this model, solar cell is lowly sold in the market. Besides, it is an efficient and common solar cell that is used by consumers.
2. The second PV model is structured from thin-film PV technologies that are fascinating due to low cost in raw materials and production. In this model, PV is an early deployment into the market. Although, the second PV model may be less efficient than the first PV model.

3. The PV model is the most advanced solar cell technologies using concentrating PV (CPV) and organic PV cells. This model is still mostly laboratory scale (having not yet being widely or commercially available in the market) (IRENA 2012 p. 4).

5.2.2 Multilevel Perspective (MLP)

One of the ways to understand development of the relationship between society and technology is a multilevel perspective (MLP). MLP was firstly introduced by Geels (2005), Geels and Kemp (2007), and Geels (2011) to understand the development of product or technology in a particular region (country). As such, the theory is based on a social technical system (STS) that involves many actors and its institutions in explaining a transition period of an existing product or technology to new products and technologies. MLP perspective can be used to explain how a product or technology can permeate a market through that transition method. MLP defines transition as an outcome of multifaceted interaction among the niche level (where a new product or technology is created), the regime level (where policy, regulation, status quo industry actions, and legal institutions are present to support or to hinder a new product or technology), and landscape level (a general situation in which external factors such as international pressures and domestic pressures within Indonesia such as the national economy, politics, education, unemployment, etc. can influence the standing position of a regime in promoting or hindering a new product or technology) (Geels 2011; Kern 2012; Whitmarsh 2012). See Fig. 5.1.

Infant or new technology developed by research and development (R&D) units in the niche level will pass into the regime level if opportunities exist. In this regime level, that technology will be selected and filtered according to regulations, policies, and interests of a regime that occupies a particular area at that time. If a new technology is in accordance with existing regime interests, it may be taken up, or otherwise that technology will be stopped if the technology is not accepted by regime interests. Existing and established regime interests are strongly influenced by market, politics, economy, and social culture at the landscape on recent condition. Therefore, three levels are connected with each other for the growth of new technology (Kern 2012; Whitmarsh 2012). In the PV context of this study, the niche is the level or place where new PV products and technologies are developed by either industry or R&D institutions. At regime level, it consists of regulation, policy, industry acceptance, or governmental programs which can hinder or support the PV industry and its technology. At the landscape level, it is the political, economic, and institutional factors which can influence the support of the existing regime toward development of PV industry and its technology at national level.

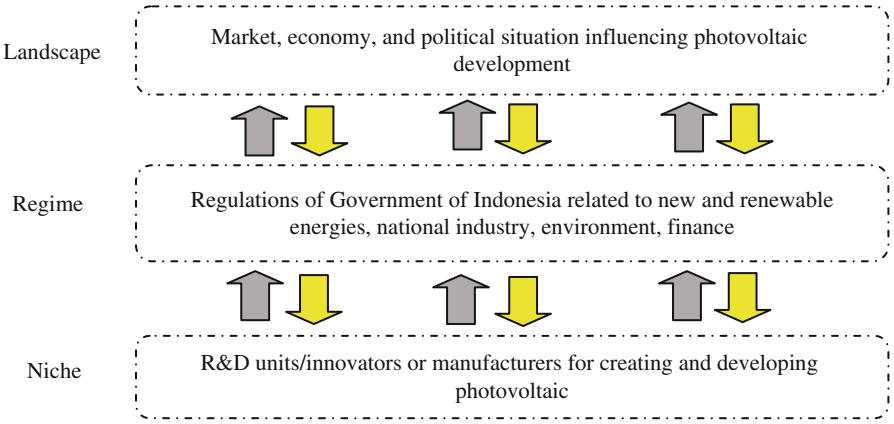

Fig. 5.1 Photovoltaic development in Indonesia from a multilevel perspective (Source: Modified from Geels (2012))

5.3 Research Method

This is a qualitative research study using the multilevel perspective (MLP) as its main analytical framework. Data were directly derived from several informants (primary data) through interviews with experts during November 2014–October 2015 (Table 5.1). Each of the informants represented their institutions, which were in turn related to the PV discourse. Again, supporting data were compiled from many documents such as scientific journals and articles, books, website, newspapers, and reports (secondary data). The secondary data were used to trace old data related to the transition of PV industry and its technology in Indonesia. After data were collected, they were classified into three levels, niche, regime, and landscape, according to an MLP analysis. The time period of data analysis is limited to the period from 2010 to 2015. This is the period when PV technology and its industry were paid attention in Indonesia. However, the triangulation method is used to reinforce and to minimize false data analysis. Triangulation is important to describe many events and to reinforce the existing evidence (Suurs et al. 2010).

5.4 Discussion

Development of PV has been prominently marked by the emergence of two institutions since 2010. Firstly, the General Directorate of New and Renewable Energy and Energy Conservation at the Ministry of Mineral Resource and Energy (Dirjen EBTKE – Kementerian ESDM) was legally formed in 24 August 2010. Dirjen EBTKE is the new first echelon at the Ministry of ESDM which is

Table 5.1 Informants list

Number of informants	Institutions	Number of informants	Institutions	Number of informants	Institutions
1	State-owned electricity enterprise (PLN) at central office	2	Physics Research Centre at Indonesian Institute of Sciences (LIPI)	2	PV experts
2	The General Directorate of New and Renewable Energy and Energy Conservation (Dirjen EBTKE) at Ministry of ESDM (Dirjen EBTKE – Kementerian ESDM)	2	Research and Development Agency at Ministry of Industry (BPPI Kementerian Perindustrian)	1	Research Technology Centre for Natural Material - Indonesian Institute of Sciences (BPTBA-LIPI Gunung Kidul-Yogyakarta)
1	National Energy Board (DEN)			1	Indonesian Solar Module Manufacturer Association (APAMSI)
1	PV manufacturers			2	PV user at junior high school of 19 (SMPN 19), Jakarta

structurally directly under the Minister of ESDM. Secondly, the Indonesian Solar Module Manufacturer Association (APAMSI) was formed in 10 August 2010. The headquarters of APAMSI is located in Bandung City. Now APAMSI consists of six domestic photovoltaic manufacturers, namely, PT. LEN Industri (Persero), PT. Adyawinsa Electrical and Power, PT. Surya Utama Putra, PT. Swadaya Prima Utama, PT. Azet Surya Lestari, and PT. Wijaya Karya Intrade Energi (APAMSI 2015).

5.4.1 The Niche Level

Since 2010, local PV manufacturers joined with APAMSI, which has received many governmental PV projects, especially from Dirjen EBTKE at the Ministry of ESDM. Those PV manufacturers not only produce PV panels but also install PV in remote areas, frontier islands, and villages where PLN's electricity grid is absent in those areas. Since the 1987 era until now, PV industry development is also

supported by R&D activities and feasibility studies of PV generated by R&D organizations and universities. The Agency for the Assessment and Application of Technology (BPPT) and the Indonesian Institute of Sciences (LIPI) are R&D organizations that conduct PV research and feasibility studies. Also, Bandung Institute of Technology (ITB) and other private and state universities have conducted PV research. PT LEN, as a state-owned enterprise, also conducts PV research at panel scale to support the PV manufacturing process.

Recent research shows the use of ingot silicon and thin film as wafer material for solar cell. Those materials can be drawn from mining activity in Indonesia. There were reserves of quartz sand of 17,491 billion tonnes in Indonesia[1] (Oemry 2012). Wafer-making technology for solar panels is known to R&D agencies in Indonesia (Akhmad 2012). Despite this, national PV manufacturers still import the main PV components (like silicon, ingot, etc.) from advanced countries to complete PV panels. Mostly, national PV manufacturers only assemble PV panels and sell them to market in Indonesia (Table 5.2).

Even though new PV technology can be found, unfortunately, most of those commercial research results are not widely published. Another problem is that each of those institutions runs separately PV research. There are several consortia or agreements among R&D organizations, industry, and government to build PV plants in Indonesia, but those plans have not yet been implemented.

5.4.2 The Regime Level

At this level, development of the PV industry and its technology is dominantly influenced by government intervention. The regime of the government is the crucial factor to enable the promotion or hindrance of existing industry and its technology of PV in Indonesia. The Government of Indonesia can make a variety of decisions relating to PV and whether it is considered important or not to be implemented.

5.4.2.1 Supporting Policies

Not only The General Directorate of New and Renewable Energy and Energy Conservation (Dirjen EBTKE) at Ministry of Energy and Mineral Resources (Ministry of ESDM) but also other ministries and government agencies can change the flow of PV development at national level. Many regulations have been issued to support PV industry and its technology in Indonesia. Before 2010, regulations and programs which support PV development are based on three main regulations to wit: Government Regulation (PP) Number 5/2006 about National Energy Policy

[1] 30 metric tonnes of quartz sand will yield 8 metric tonnes of silicon. By using recent technology, it yields 1 MW of solar cell.

Table 5.2 PV industry and technology at niche level (period of 2010–early October 2015)

Year	Main supporting activities	Progress
2010	Many studies of PV and its potencies	At laboratory scale and document only
	PV hybrid was began and introduced by BPPT and PLN	A discontinued project
2011	Feasibility studies and potency of PV conducted by R&D organizations and universities	At laboratory scale and document only
	BPPT's road map on time range of 2011 onward to develop crystalline technology and solar cell industry	Document only
2012	Feasibility studies and potency of PV conducted by R&D organizations and universities	At laboratory scale and document only
2013	Feasibility studies and potency of PV conducted by R&D organizations and universities	At laboratory scale and document only
	PT LEN in collaboration with state-owned oil mining corporation (Pertamina) plans to materialize PV industry in Indonesia (joint consortium)	Not implementable program
2014	Many feasibility studies of PV conducted by R&D organizations and universities	At laboratory scale and document only
2015	Many feasibility studies of PV conducted by R&D organizations and universities	At laboratory scale and document only

Sources: Compilation of various data and from Setiawan et al. (2014), Oemry (2012), Akhmad (2012), and PT Wika (2014)

mentioning the increase of NREs in the energy mix to achieve 17% NREs of total energy in 2025, Act of Republic of Indonesia (UU) Number 30/2007 about energy, and Act of Republic of Indonesia (UU) Number 30/2009 about electricity. Since 2010, there are many derivative regulations, policies, programs, and directives of the government supporting PV development in Indonesia (Table 5.3).

Not only the government agencies mentioned above but also the involvement of other ministries such as the Ministry of Research, Technology, and Higher Education (Menristekdikti)[2] and Ministry of Villages[3] are important to support PV development. Menristek (dikti) funds many PV research projects of public R&D organizations and also several state-owned universities. Commonly, Menristek (dikti) provides research funding through a general scheme for other research projects. While the Ministry of Villages also launches many PV projects to light villages and remote areas around Indonesia. In this case, the role of the Ministry of Villages and Ministry of ESDM in developing PV in rural areas is similar.

[2]Before the regime of Jokowi governs starting from 20 October 2014 until now, the name of ministry is Ministry of Research and Technology (Menristek) which is separated from higher education affairs (period of SBY's regime 2010–20 October 2014).

[3]Before the regime of Jokowi governs starting from 20 October 2014 until now, the name of ministry is Ministry of Development for Village and Remote Areas (period of SBY's regime 2010–20 October 2014).

Table 5.3 Supporting regulations for PV development in Indonesia

Year	Regulation/direction	Concerning with PV
2010	Regulation of Government (PP) No. 4/2010 about appointment to PLN in implementing acceleration of development of electricity energy generator using NREs, coal, and gas	PV is one of NREs to be massively developed by PLN in Indonesia
	Regulation of President (Perpres) No. 54/2010 about procurement of governmental goods and services	At least 40% of local content product degree components (TKDN) are needed to win in PV product procurement process in Indonesia
	Government Vision of Energy 25/25	PV and wind energy are determined to contribute energy as much as 0.6% or 16.3 million Barrel Oil Equivalent (BOE) in 2025
	Directive of President Susilo Bambang Yudhoyono at Tampaksiring in 2010 to use NREs	This directive opens larger opportunity for developing PV as green energy in Indonesia
	6 (six) key courses for developing PV	(1) Implementation of PV on large industries, commercial buildings, and luxury houses; (2) implementation at feed-in-tariff; (3) technology audit to components of solar cell-based electricity generator (PLTS) installation; (4) developing PV components and its industries; (5) target to achieve economy value of PLTS to PLN's grid-connected tariff in 10 years later; (6) developing full capability of national PV technology by either purchasing license or improving research and development
2011	Road map to develop PV industry initiated by the Ministry of Industry starting from 2011 to 2025	First phase (2011–2015) is the period for manufacturers to develop PV component and local market to develop national PV industries
	Regulation of President (Perpres) No. 61/2011 about national action plan to diminish greenhouse effect emission by 2020	The Government of Indonesia can reduce greenhouse effect by 6% on energy sector by 2020
	Decision of Minister of ESDM No. 634–12/20/600.3/2011 about business license in providing electricity energy of PLN	License to build electricity energy generators including PLTS which its management is operated by PLN as business unit
	Regulation of Government (PP) No. 52/2011 about facility of income tax for investing asset in special venture fields in special areas	This allowance is aimed at electronic industries and includes silicon, ingot, and photovoltaic module
2012	Regulation of Minister of ESDM No. 4/2012 about purchasing of tariff of electricity energy by PLN from electricity energy sources using small- and medium-scaled renewable energies and/or excess of electricity energy	This law contains standard cost for purchasing electricity energy (including PV) operated by PLN on NRE-based electricity generators up to 10 MW

(continued)

Table 5.3 (continued)

Year	Regulation/direction	Concerning with PV
	Regulation of Minister of Industry No. 54/M-IND/PER/3/2012 about the guide in using local products to development of electricity infrastructures	This regulation is about local content product degree (TKDN) including PV products made in Indonesia
	Regulation of Minister of ESDM No. 10/2012 about implementation of physical activities using NREs	This law focuses on development of NREs in remote/rural areas, and one of them is PV
	National Electricity Public Plan for 2012–2031 periods	Ministry of ESDM will restrict the use of fuel oil as the main energy source on new electricity generators
2013	Regulation of Minister of ESDM No. 17/2013 about purchasing of electricity energy by PLN from PV electricity generator	The electricity tariff of PLTS/solar home system (SHS) is accounted by U$D 25 cent/kWh and U$D 30 cent/kWh if electricity providers use local PV modules (at least 40% components of TKDN)
	Regulation of Minister of ESDM No. 3/2013 about technical guide for using special allocation fund on rural energy sector in 2013	Government of Indonesia can widely build PLTS in rural areas and develop national PV manufacturers
	Regulation of Ministry of Finance No. 180/PMK.07/2013 about public guide of special fund (DAK) in year 2014	This regulation is to support development of PLTS and SHS in rural areas in Indonesia
	National Standardization Agency (BSN) has stipulated Indonesian National Standard (SNI) of photovoltaic module sold in Indonesia	(a) SNI IEC No. 61215:2013 – PV module, silicon crystal, qualification design – and (b) SNI IEC No. 61194:2013 – parameter of independently PV system characteristic
	PLN's Business Plan for providing electricity energy (RUPTL) in 2013–2022 period	PLN installs SHS, 1000 PLTS projects at remote and rural areas, dispersed and centralized PLTS
2014	Regulation of Minister of ESDM No. 03 year 2014 about technical guide in using special allocation budget (DAK) on rural energy in 2014 budget	This regulation supports establishment of PLTS in rural areas in Indonesia
	Regulation of Government (PP) No. 79 year 2014 about national energy policy (KEN)	Energy mix is increased from 17% NREs of total energy in 2025 to 23% NREs of total energy in 2025 and 31% NREs of total energy in 2050
2015	Ministry of Industry's National Industry Development Plan (RIPIN) period 2015–2035	Developing solar cell and battery of PV as main PV industry need. In this plan, PV industry is designed to be developed from downstream up to upstream
	PLN's Business Plan for providing electricity energy (RUPTL) in 2015–2024 period	Building centralized PLTS in remote and rural/village area through hybrid PLTS to accelerate national electrification from 80% in 2014 to 99.4% in 2024

Sources: RUPTL 2015–2024; Sumiarso (2011); RUPTL PLN 2013–2022; Ministry of ESDM (2010), Esdmmag 4 (2012), Directorate of Informatics and Telematics (2014), Current Awareness Service Bulletin (2013), RIPIN 2015–2035

5.4.2.2 Hindering Policies

The Government of Indonesia, through state-owned electricity enterprise (PLN), prioritizes two main new and renewable energies (NREs), namely, hydro- and geothermal-based electricity generation (RUPTL PT PLN 2015–2024; RUPTL PT PLN 2013–2022). Hydropower potential is 75,000 MWe, and geothermal potency is 29,164 MWe (Indonesia Energy Outlook 2013 in RUPTL PT PLN 2015–2024). The geothermal reserves in Indonesia are estimated at 40% of the geothermal reserves in the world (Gunawan 2015).

Electricity subsidies for fossil fuel are also a main hindrance to developing PV in Indonesia. For example, the Government of Indonesia subsidizes fossil-fuelled electricity energy of Rp.100 trillion (US$ 9.0 billion) in 2013 and Rp.282.1 trillion (US$ 25.4 billion) for subsidizing electrical energy and fuel oil in 2014 (ISSD 2014). Through this subsidy, the price of fossil-fuelled electricity is cheaper than the price of PV to fulfill daily electricity needs. Therefore, manufacturers, households, and public and private buildings prefer using fossil-fuelled electricity provided by PLN. Even though many policy documents supporting PV development exist in formulation stage, practically PV industry and its technology development is not the main agenda in the implementation stage.

5.4.3 The Landscape Level

Since 2012, economy growth in Indonesia has fluctuated. Growth of the national economy was 6% (2012), 5.6% (2013), 5.0% (2014), 5.3% (2015), and 5.9% (2016) (OECD 2015). Generally, the national economy growth is bolstered by fossil energies like coal and oil which are both widely dispersed and more established compared to NREs. While national electricity growth was 7.8% annually during 2009–2014 (RUPTL PT PLN 2015–2024; Direktorat Aneka Energi Baru dan Terbarukan 2014), during the period 2009–2013, the number of electricity customers increased from 39.9 million to 53.7 million (or 3 million growth annually). Household is the highest rank of consuming electricity energy (2.8 million/year), business sector (134 thousand/year), public sector (70 thousand/year), and industry (1800/year) (RUPTL PT PLN 2015–2024).

Until 2014, more than 20% of the national budget was spent to subsidize energy fuel and electricity in order to keep costs down for fulfilling daily households need[4]. In the 2015 national budget, the Government of Indonesia stipulated that subsidies for energy fuel accounted for 1% of the total national budget[5]. The government

[4]Household is the population per capita. Income per capita of population in Indonesia is USD 9300 approximately (OECD 2015).

[5]When the 2015 national budget was formulated by the government and house of representative last year, the government mentioned the subsidy value accounted for 15% of total national budget (OECD 2015).

prefers to allocate the national budget to build public infrastructure and social affairs spending. The electricity subsidy has a number of problems. The majority of electricity generators are derived from coal and oil sources, and most of these are old electricity generators. The Government of Indonesia's allocated electricity subsidy accounted for 8% of the total national budget (OECD 2015). Dependence on fossil-fuelled electricity is very high at 94.97%, but its reserve is increasingly limited (Direktorat Aneka Energi Baru dan Terbarukan, 2014).

The opportunity to use NREs, including PV, is supported by decreasing mining activities – especially because the price of coal is decreasing. When Indonesia joined the agreement of the G20 in 2009 to reduce greenhouse gas emission by 26% by 2020, the Government of Indonesia committed to rejuvenate some old electricity generators based on international and Asian standards and also to change to more efficient and cleaner electricity generators (OECD 2015). It is important to note that Indonesia is the fifth largest country in terms of generation of electricity from fossil fuel in the world [OECD 2014a in OECD 2015].

Concerned with research and production activities in Indonesia, currently import tax is still charged at 10% for all materials imported from overseas, including basic and additional materials that are used for research interests and also for manufacturing processes. Unfortunately, there is no import tax (0%) on final products imported from overseas. National PV manufacturers import basic material like ingot and silicon from advanced countries, but the number of solar home system (SHS) mostly imported from China is more dominant than the number of PV panels manufactured in Indonesia. SHS made in China is cheaper than SHS made in Indonesia. Also, the national PV market is very limited, and users of SHS are in remote areas and outer islands where there is no PLN's electricity grid.

5.4.4 Niche, Regime, and Landscape in Development of PV Industry and Its Technology

As discussed previously, the presence of research and development (R&D) organizations and their PV research results have generated new findings like ingot and silicon as main materials to produce solar cells. These materials are abundantly available in Indonesia. The problem is that public R&D agencies and universities cannot develop because of limitations of funding and governmental support to buy the supporting technology and equipment. Besides, governmental research funding schemes investing in public R&D organizations are not appropriate to operate this research across multiple years, mainly due to the research funding cycle (Ariana et al. 2014). This makes progress almost impossible if basic PV research is conducted by national private enterprises in Indonesia[6]. Again, high import taxes

[6]Most R&D spending is dominated by governmental budget in Indonesia (Pappiptek 2011). It is the main reason why public R&D organizations and state-owned universities are more active to run R&D activities compared to private universities in Indonesia.

on raw PV materials (ingot, silicon) and inverters are also a key reason why solar cell technology is difficult to be developed in Indonesia.

Market uncertainty is a crucial factor why PV technology does not develop well at the national level. Even though public R&D organizations have made advances in solar cell-making technology at the early stage, it needs a long time to produce mature and feasible solar cell technology to be directly used on a production scale. On the other side, national PV manufacturers prefer to buy imported solar cells from overseas because those manufacturers want to obtain solar cells quickly to fulfill their production needs. National PV manufacturers only assemble PV panels in various products like solar home system (SHS), solar-based lamps on the street, and so on. Even many PV manufacturers and traders also import PV panels from China because the price is cheaper than the price in Indonesia. The role of national PV manufacturers, as business entities, is limited because of the lack of resources (such as funding, human resources, technology) to run R&D on PV at a commercial stage.

Compared to fossil-fuelled electricity generator, PV is more expensive for generating electricity energy. SHS is not affordable for households because the electricity energy generated by SHS is very limited and costly. The business sector also relies on fossil-fuelled electricity provided by PLN due to its stability and its low price. Until now, supporting infrastructure to use PV has not been widely developed in cities. The cost to build basic PV infrastructure comprising establishment of PV-based electricity generator, transferring process, electricity charge booth, and maintenance of PV equipment is very expensive.

Practically, the Government of Indonesia implements two types of national PV projects: photovoltaic-based electricity generator (PLTS) and solar home system (SHS). The Ministry of ESDM and PLN are dominant actors besides the Ministry of Village and local governments to install PLTS and SHS. Both install PLTS and SHS in remote areas and frontier islands, not in urban areas. Unfortunately each actor runs PV projects separately without coordination between each other. Corruption and rigid budget scheme at government sector is still a classic problem hindering PV implementation at the national scale. Consequently, PLTS initiated by the government does not function well because there is no implementative regulations which support installed PLTS in those areas.

PLTS installed by the Ministry of ESDM is often neglected and without a maintenance program, whereas PLTS installed by PLN is sustainably maintained. The Ministry of ESDM tends to use project-based activity in building PLTS, while PLN uses business-based activity in building PLTS. Setiawan et al. (2014) reveals that lack of information and knowledge of local people about how to maintain PLTS and costly components are crucial problems for those who live in remote and rural areas where public infrastructures (electricity, road, communication network) are absent in those areas.

National PV development is not supported by existing political conditions. Emergence of new PV technology and its industry is hindered by unwillingness

Table 5.4 Implementing PV projects in case

No.	Planned/implemented activities	Progress
1	Plan to firstly build PV plant in Karawang, West Java Province, in 2010 by capacity 60 MW to crystal silicon and 30 MW to produce solar module	Non-implementable project
2	Ministry of ESDM built the two first largest on-grid PLTS in 2012 (capacity 1 MW, respectively) located in Bangli and Karangasem Regency, province of Bali, Indonesia	Implementation of these projects is restricted by local government law itself

Sources: Setiawan et al. (2014), Akhmad (2014)

of particular actors to build PV industry in Indonesia. Indeed, when the Ministry of Industry, Ministry of ESDM, Pertamina, BPPT, PT LEN, and local government are involved on PV consortium to build PV plant firstly in Indonesia, but each of them has various interests, the impact of the plant plan does not function well. Lobbying to executive agencies and house of representatives (DPR) is not enough if it is only conducted by APAMSI or one ministry/government agency. Cooperation and commitment of those actors are essential to promote PV development continuously, not only project-based commitment as demonstrated in this period (Table 5.4).

5.4.4.1 Dualism Policies

Environmental issues are not the main leverage to use PV as the main NRE in Indonesia. Though the Government of Indonesia has an agreement toward a green environment by 2020 through reducing carbon emissions, PV is a lower priority than geothermal and hydro which both are the main priorities for using NREs in Indonesia. PV will be installed in particular areas, not as massive and established electricity energy but as a temporary source of electricity energy only. However, PV is not the only energy source that can reduce carbon emission in Indonesia. For example, PLN has planned to build new coal-fuelled electricity generator using ultra-supercritical technology to yield low CO_2 emissions (RUPTL PT PLN 2015–2024).

5.4.5 Trend of PV Development in Recent Decade

Coal-fuelled electricity generator will be primarily used to generate electricity energy until 2024 (RUPTL PT PLN 2015–2024). Notwithstanding this policy, the opportunity to develop PV industry and its technology is still open for development. It should be noted that the Government of Indonesia has launched a road map to

utilize solar energy of 0.87 GW or 50 MWp/year by 2025, and assuming that the extent of solar cell market be up to 50% in Indonesia, it can absorb products of solar cell industries having the capacity of up to 25 MWp per year. This is a big opportunity for local industries to develop their business in solar cell manufacturing (Ministry of ESDM 2008b).

Nowadays, the Government of Indonesia has two key PV programs. Firstly, to create a PV market, PLN is ready to receive excessive electricity energy generated by PLTS or SHS by an export-import arrangement within the electricity system. This system functions when delivery of excessive electricity has two electricity supply sources from both PV panel and PLN (Metro 2013). Secondly, government directives install SHS on roof of buildings especially on public buildings and luxurious houses in urban areas. Based on PLN's Business Plan for providing electricity energy (RUPTL) PLN 2015–2024 (RUPTL PT PLN 2015–2024) and Ministry of Industry's National Industry Development Plan (RIPIN) 2015–2035, the Government of Indonesia has commitment to build many NREs-based electricity generators, to diversify and to conserve energy, and also to provide electricity energy for national industry. By 2050, PV is predicted to be cheap, with many buildings and automotive sectors using PV energy and its infrastructure will have been widely constructed, not only in Indonesia but around the world.

5.5 Conclusion

The Government of Indonesia prioritizes fossil-fuelled electricity to supply electricity energy to households and industries. Electricity subsidies are mostly allocated to usage of fossil energy, not to usage of NREs. From a socioeconomic perspective, PLN prefers hydro and geothermal instead of PV to be developed as a source of national electricity energy. Currently, PV is not competitive and costly compared to fossil energy in Indonesia. PV industry and its technology cannot mature because of the limitation of its market and governmental funding, weak coordination among actors, rigid projects and funding schemes, and the absence of political interests. Development of the PV industry and its technology is strongly influenced by governmental PV projects in Indonesia. Recently, fossil-fuelled electricity subsidy was reduced by government through increasing the basic price of electricity for households and business sectors. Recently, the Government of Indonesia has prioritized funding to build public infrastructure such as NREs.

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Chapter 6
The West Papua Imagined Community: A Bondless Plural Society

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Abstract This study discusses the architecture of the society of West Papua (region) in Indonesia and explores how modernisation, democracy, and conflict shape its identity formation. The study challenges previous studies on West Papua that portray the society as homogeneous and tribal. It proposes that contemporary West Papua's society is also characterised by multiethnicity. Further, this study suggests that a new phenomenon of a divided society is factual in West Papua, and the situation is sustained by political and economic competition among different groups. The map of the contemporary society of West Papua in this study can be used as a departure for further studies on West Papua.

6.1 Introduction

The region of West Papua in Indonesia consists of the following two provinces: Papua Province and West Papua Province. West Papua region (hereafter, West Papua) has suffered demographic explosion and unequal economic growth due to a flood of migrants. As a result of this migration, West Papua's society is heterogeneous with different ethnic groups mingling and blending without any real distinction among the communities. The diversity is mostly shown in the feeling of being different from others and down to loyalty to its imagined community based on ethnicity. Socially, communities are assimilated. Politically, the gap is apparent and growing wider. However, segregation in the society based on ethnicity does not

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parallel with class stratification based on economic power. Each ethnic group presents various layers of the class system, although some ethnic groups have relatively stronger economic power than others.

The discussion of West Papuan social architecture in this study is based on racial diversification in the society. It starts with the description of the native inhabitants of West Papua. This is followed by an examination of non-indigenous communities that have been unrecognised and perceived as the source of the problem by many studies of West Papua. The examination of a political incentive, namely, the Special Autonomy Status, that is given by the central government, reveals that the incentive has encouraged fundamental sociopolitical change in the society.[1] This study concludes that the ongoing change of the social map of West Papua society and the dynamic of West Papua's inhabitant's identity formation need to be recognized in further studies on West Papua.

6.2 The Discourse on "Indigenous Versus Migrant"

Indigenous community in opposition to migrant community is the main subject in discussing the West Papuan inhabitants and their problems. Many studies tend to describe West Papuan society as a traditional and underdeveloped homogeneous society that is sustained by tribal—somewhat mystical—conducts. Such as depicted in studies by Boelaars (1981), Gibbons (2013), Hayward (1997), Rutherford (1999, 2003, 2012, 2015), Zollner (2005), Muller (2008), Pouwer (2010), Corbey (2010), Kirksey (2012), MacLeod (2013), Sugandi (2014), Stasch (2007, 2009, 2015), and Timmer (2015). These studies have also left non-indigenous communities out of the discussion. Many studies, such as McGibbon (2004a, b), van Den Broek (2005), Zollner (2005), Chauvel (2008a, b), Rathgeber (2005), Timmer (2008), MacLeod (2013) and McWilliam (2011), also portray West Papuan society in two group divisions: indigenous people and migrants (with Javanese migrants as a leading faction). Sharp distinctions between the two groups have been constructed in these studies. They also tend to see the migrant communities as the problem and the enhancer of Papuan grievances and resentment. Further, judging from the statistical report of the region's

[1]The Special Autonomy Law is a special law granted by the central government to reduce the tension of Papuan turmoil. The Special Autonomy Status is a special status that is established under the Special Autonomy Law. Since 2001, Papua province and West Papua province (after the province was established in 2003) have received the status of Special Autonomy provinces, meaning that the two provinces are granted rights to manage certain affairs without the involvement of the central government. Under the law, the two provinces are mandatory to establish a provincial customary assembly, namely, the Papuan People Assembly (hereafter MRP: *Majelis Rakyat Papua*). The MRP is an assembly to advocate the culture and identity of the Papuans.

population trends, a suspicion of genocide towards indigenous people also emerges, as seen in the works of Elmslie (2010) and Banivanua-Mar (2008). However, these studies that exclude non-indigenous communities from discussions on West Papuan population tend to underestimate the impact of intermarriages among ethnic groups that have been common in West Papuan society for decades.

The Indonesian Statistics Bureau's national census in 2010 recorded that Papua Province is populated by 75% indigenous people and 23% non-indigenous people, while approximately 2% of the population could not identify themselves in a certain racial category (Badan Pusat Statistik Provinsi Papua, 2010). Papua Barat (West Papua) Province is populated by 51% indigenous people, 48% non-indigenous people and 1% of racially unknown people. How is it possible that 2% of the population in Papua Province and 1% of the population in West Papua Province could not put themselves in one category of racial stratification? This is connected to the methodology of the census in which the census questionnaire did not provide a mixed-race category as a choice for an answer. As the object of the census, the interviewees were given the opportunity to claim themselves as belonging to a certain racial or ethnic group (BPS Papua, 2012). Because the category of mixed-race was not provided, many mixed-race interviewees had to decide on one ethnicity that was relatively familiar for them. As a result, the census showed the number of people in a population based on ethnicity, but it was unable to present adequate data on the number of racially/ethnically mixed people in the region of West Papua. Even with this limitation, the census is still very useful, as it provides a rough illustration of the population profile of the region.

6.3 West Papuan Indigenous Community

The Tribes West Papua region is the home of hundreds of indigenous tribes who have different cultures and languages. Even though they are all classified under the same race, the physical features among tribes can be slightly different.[2] West Papuan indigenous people are Negroid by race, as the first migrants who came to the island of New Guinea 50,000 years ago were from the African continent. The first settlers then merged with the second wave of migrants who came around

[2]Benedict Anderson (1998, pp. 321–330) argues that due to their diversity, West Papuans were not fit to be grouped under one ethnicity. The ethnic categorisation of West Papuans into the Irianese ethnic group was the Dutch construction as part of its colonial strategy in 1950–1963. The Dutch needed to classify the Indonesian society into majority versus minority to create a situation in which the minority could cooperate to face the majority. The minority coalition would be the Dutch people (white people), the Chinese people and the Papuans. Furthermore, Anderson opines that Papuan was part of the Netherland East Indies (Indonesia's former name) in the position as non-Indonesian ethnic.

5000 years ago from Taiwan or Austronesia. The second migrants first landed in the Bismarck Islands before moving to Yapen and Biak (Muller, 2008). The West Papuan indigenous people are also categorised under the cluster of Melanesian. However, Muller (2008) argues that the term Melanesian might not be entirely precise, as Melanesian mostly refers to the Austronesian people, while the Papuans are a mixture of the African and Austronesian people.[3] However, anthropologically, the concept of the Melanesian race is accepted based on the characteristic of the culture of the people that is from the Lapita culture.[4] Regarding the physical features of the Papuan people, the common traits are dark skin colour and woolly hair.

Indigenous communities of West Papua are living in three geographic environments that affect the cultures and lifestyles of the communities. Fishers and mariners populate the coastline, farmers are excessively populating mountain areas, and seminomadic hunters and gatherers are living in low numbers in swampy lowlands that divide the coast and the mountains (Zollner, 2005). However, discourses on political and social spheres usually recognise only two types of indigenous communities: the coastal people and the Highlanders. The geographical aspect of the island presents a challenge in organising a single authority in West New Guinea, as shown by the existence of hundreds of small fragmented tribes inhabiting the island. The Netherlands government, the former ruler of West Papua, estimated that around 250 tribes were living on the island in the 1950s. Interestingly, a population census in 2010 conducted by Papua Province's Statistics Bureau shows that the number of tribes has grown to 294 tribes in Papua Province, as many clans are currently claiming themselves as independent tribes.

Even though the ways of life, economic models and traditions of each group are very much affected by their geographical environment, most indigenous groups share Melanesian culture that is characterised by a trapezium model society. The trapezium model means the relationship among members of society are egalitarian, collegial and communal. The unit of society is the extended family with a strong tie to kinship and clan. In practice, few families live together and share daily life as a group in one hamlet. A single traditional authority that ruled all tribes was unknown. West Papuan tribal communities usually consist of a few clans under one tribe. Some areas on the west coast of the island—such as Fakfak and Kaimana—and the Bird Head areas—such as Raja Ampat and the Onin Peninsula—previously had institutionalised government, in the form of a kingdom, headed by a "*raja*" (king). Those kingdoms, however, consisted only of a few villages and did not reach the interior areas of the islands. Thus, it is safe to assume

[3]The word is derived from the Greek word Mela (meaning black) that was coined by French navigator Dumont d'Urville in 1832 in regard to New Guinea as an "island of black-skinned people".

[4]Lapita is taken from the name of a place in New Caledon, Africa.

that kingdoms on the west coast of West New Guinea/West Papua were essentially similar with tribes that were more common in the other parts of the island. In modern-day West Papua, especially in urban areas, compounds of groups and clans may no longer exist, however, the spirit of group loyalty is still very much alive in West Papuan indigenous communities. The tribal system and communalism have preserved the sense of tribal loyalties and identities both for coastal and highlander tribes.

The indigenous Papuans have two clumps of vernacular languages in the region, Austronesian and non-Austronesian or Papuan, with 275 language variations (Kluge, 2014). Each tribe of the region practises its exclusive tribal language. Central Highland languages are mostly under the non-Austronesian cluster (Supardi, 2014). Kluge's studies (2014) found that the Sarmi District on the northeast coast is inhabited by indigenous communities who speak both Papuan and Austronesian. Due to the relatively undeveloped vernacular language and for the sake of missionaries spreading Christianity, the Malay language has been used as the lingua franca since the 1930s (Bachtiar 1963).[5] Since Indonesia administered the region in 1963, Bahasa Indonesia (Indonesian language), a close branch of the Malay language, has been used as the formal lingua franca in the region. Later, West Papua's residents developed a descending cluster of Bahasa Indonesia, namely, Papuan Malay. This language differs in dialect, phonology and "grammar" from Bahasa Indonesia (Burung, 2008; Kluge, 2014). The Papuan Malay language, however, is very similar to the casual language of the Moluccans in the nearby Maluku Islands. Although the Papuan Malay language is used only as a verbal language and never as a written or official language, the language is necessary to build West Papuan society's shared identity and to act as a political instrument to promote West Papua's uniqueness with the majority of Indonesians.

The Belief System West Papua's traditional communities also lived under a cosmological belief that a supernatural power influences their people's way of life. From Biak to Merauke, west to east, the cosmologic faith is one of the striking characteristics of West Papua's native communities. The cargo cult, as an attribute of the Melanesian culture, is also very much alive in West Papua's indigenous societies. Giay's study of the Mee people (1995), Hayward's study of the Mulia Dani (1997) in the Central Highlands, Rutherford's study of the Biak people in the Cenderawasih Bay (2003), Corbey's study of the Marind-Anim of Merauke (2010) and Boelaars' research on the Jaqaj (Yahrai) in the southern part of West Papua (1981) present that in the Papuan's belief of the cargo cult, their wealth and well-being were lost because the ancestors' supernatural power have taken it. With proper ceremonies and rituals, indigenous communities appeal to the ancestors to

[5]After Indonesia gained independence and the Netherlands delivered its official recognition in 1949, the Dutch language was tried to be taught in the region. The effort, however, was opposed by S.I. Kijne, a missionary and educator in Papua, who defended the Malay language as the lingua franca of West Papua. Drooglever (2010) notes that Kijne's argument to preserve Malay as the lingua franca was based on political, business, and cultural reasons.

release them from pain, sickness and death and provide them with material goods. The most well-known cargo cult in the West Papuan vernacular society is Koreri, held by the Biak-Numfor people.[6] Other tribes have different words to address a similar movement and spirit.

Religions from the sixteenth century have been altering the belief system of the indigenous Papuans, but they have not removed cult practice entirely. Hayward (1997) notes that in the 1950s, the Mulia Dani people first encountered Christian preaching regarding eternal life and heaven; these people translated this encounter as a promise of the return of their lost treasures, similar to their cargo cult. To some extent, the similarity between the religions—which insist on the existence of a greater power above human beings—and the cargo cult—which believes in a supernatural power of the ancestors—helped to spread religion teaching in the island. More so, religious practices have assimilated with the vernacular belief system in some communities and have created a new belief system unique to the place. Examples include communities in Wamena in the Central Highlands that combined Christianity and the local belief, the Fakfak and Kaimana communities that practised Islam in combination with the local culture since the seventeenth century and the Amungme people in Timika that had long been familiar with the Catholic faith (even though they held the belief of the power of their ancestors). However, a small difference could be seen in the Tolikara District in the Central Highlands. There, the Tolikara people believe that a denomination of the Protestant church, namely, the Evangelical Church of Indonesia (GIDI: *Gereja Injili di Indonesia*), is above their *adat* and the state because the bible was descended in Tolikara. In the Tolikara District, the GIDI church is more powerful than other vernacular institutions.

Studies on West Papua's post-colonial period place Christianity as the belief system of the Papuans and contrasted it with the majority of Muslim Indonesians (Garnaut and Manning, 1974; Kirksey, 2012). An account of observers in the precolonial period, however, is somewhat different. In 1875, a Dutchman named Leupe (in Widjojo, 2009 p.96) noted that Papuans in mountains were "naked except for the private parts and accessories in their arms and neck. Their weapons were bow, arrows, shield, swords, and javelin. They were innocent and ignorant but cruel, rapacious and murderous". As for the coastal Papuans, Leupe described them as "good sailors with long hair and dressing like the people in Maluku, said to be Muslim but never practiced Islamic worship and conducted local religion". Leupe's account indicates that indigenous Papuans in the interior highland were not familiar with the outer world, while the coastal people had already adopted the Muslim

[6]Koreri is the cargo cult movement in Biak-Numfor area. Koreri regards Manseren Mangundi as the lord of the people. The figure of Manseren Mangundi was a mysterious man who possessed power from the "morning star" or *sampari*. As the messiah, during a hard time, Manseren Mangundi might come to free people from suffering and replace it with a new world and order without sickness and death. The leader of the Koreri movement, also known as the prophet of Manseren, was called Koonor.

culture. Therefore, assuming that all Papuans are Christians might also cause problems in understanding West Papuan societies.

The Way of Life Another characteristic of the West Papuan traditional communities was the proneness to violence. Nonetheless, not all scholars agree with this idea. Kirsch (2007) argues the depiction of violence as close to West Papuan vernacular communities is outdated, as it is based on old anthropological studies and is used only as a means to justify state intervention in the region. Kirsch's second argument is convincing, still, the proneness to violence in West Papua's indigenous communities is not just a myth to glorify a story of people living in the Stone Age who were discovered by the Western world, missionaries and anthropologists in this respect. Anthropological works and personal notes from missionaries, government officers and explorers are solid proof of this unfriendly part of the culture. Since the early sixteenth century until the mid-twentieth century, the Biak people were notorious for being pirates and looters while sailing their kora-koras (i.e. small boats) (Rutherford, 2003; Widjojo, 2009). The Doreh and Masinam people were cruel and thirsty for revenge and often yielded to the lust to kill (Ottow et al. n.d.). The Asmat tribe on the west coast of the island was recorded as an aggressive tribe (Muller, 2008; Pouwer, 2010), along with the Marind-Anim tribe in Merauke (Corbey, 2010) and the Jaqaj/Yahrai (Boelaars, 1981) tribes of the southwest coast of the island. The Asmat, Jaqaj and Marind-Anim tribes also practised headhunting and cannibalism due to their supernatural power beliefs. Many other tribes in the Central Highlands, such as the Ekari, Mee, Nduga and Dani/Lani tribes, were also known as warmonger tribes (Gibbons, 2013; Drooglever, 2010), even though the indication of cannibalism was unreported. Headhunting and cannibalism in vernacular tribes were banned when the Netherlands kingdom colonialised the region in the early 1900s. As for tribal wars, the practice is still carried out even in contemporary West Papua, as many tribes and groups still engage in communal clashes to vent disagreements.

As of 2015, modern West Papuan society is still familiar with the term "tribal war", such as in the Mimika District and the Central Highland districts. Most reasons for the current tribal wars are the same as the old reasons, such as land conflicts, murders, harassment, sexual-related assaults, acts of adultery, and love affairs. Present-day tribal wars, however, are also caused by political contestations, especially during election periods. In addition, present-day tribal wars have been omitting glorious ceremonial preparations. The absence of pre-war "sacral" ceremonies indicates that these tribal wars are not linked to supernatural beliefs; they are just means to resolve disagreements among groups of people. Nevertheless, to justify the violence, groups involved in communal clashes claim to be practising their culture to settle problems through tribal wars. Media help to preserve the image by labelling communal clashes among indigenous people as tribal wars. As

the demand for cultural acknowledgement is high, authorities provide room to exercise "culture" as seen in the Tolikara District where people from the Gika clan and the Panaga clan clashed in July 2015.[7] The glorification of tribal war preserves, and the violent culture continues in West Papua's indigenous communities.

A strong connection to the ancestral land is also a characteristic of the West Papuan tribal communities. Ancestral land is the source of life and philosophical belief. Most importantly, the land is perceived as the mother who provides life to her children. Erari (1999) presents an elaborate study on the indigenous ideological thought that the land is the life itself. The religious faith of valuing the land makes the land serves not merely as a possession or a token of wealth but as the symbol of life and existence of human beings. Collectively, land is also regarded as the pride of a community. Land is never a personal belonging, and a decision of delivering the rights of a piece of land should not be a personal decision or a family judgement. A collective ownership of land is known as *tanah adat* (customary land) as a part of *hak ulayat* (customary rights) in current West Papua. Conversely, modern society sees land as a possession, a token of wealth and economic capital that can be handed over from one party to another.

West Papua's virgin forests and natural resources have attracted investors who flood the region to exploit its natural wealth. However, different concepts of respecting land between indigenous communities and investors have created complicated problems. The problems are exacerbated when the government neglects to protect indigenous communities with relevant laws. One of the most devastating examples is the operation of an international gold-copper mining company, PT Freeport Indonesia, that has been throwing out the Amungme and Kamoro people from their ancestral lands since 1967. In the early period of the operation of the Freeport mining industry in the 1970s, Amungme tribal communities were involved in a series of clan wars among themselves, as some clans accused other clans of selling the sacred land where their great ancestors were being laid.[8] A similar case

[7]The people from two clans engaged in a tribal war (*perang suku*) for days. The incident was caused by a sexual assault towards the wife of Tinanggup Wanimbo by Tenggen Weya. At that time, the settlement of the crime was being negotiated by the village heads, Uliton Wanimbo (Enggawogo Village) and Yerimes Wanimbo (Mamberamonggen Village). However, the problem escalated when Tinanggup Wanimbo sadistically murdered Tenggen Weya on July 8, 2015, at the Toli riverbank, Gelogu Village, Panaga subdistrict, Tolikara district. After the burial of Tenggen Weya in the Kelowiya Village of the Gika subdistrict, the deceased's family declared a tribal war on the perpetrator's family. During the next day, communal clashes erupted. In response to the violence, the authorities provided an opportunity for both parties to perform tribal wart for three days. However, the violence did not cease in three days and continued for one week. Many people died, and their properties were burnt down. School buildings and government offices were also burned to ground by the people. Most of the villagers took refuge in the nearby forests to escape the violence.

[8]During 1976–1977 at Arwanop of the Amungme area (now PT Freeport area), the Amungme tribe living in Arwanop was objecting to PT Freeport's mining exploration in Yelsegel Ongopsegel (Ertsberg) Mount, as it caused a wrath from the ancestors in the form of natural disasters and diseases. In their opinion, the Narkime and Nagal clans, who were living in the exploration sites, were responsible for the death of many people caused by natural disasters and diseases (Mampioper, 1980).

was observed in the Marind-Anim people in Merauke in 2000 due to the MIFEE projects.[9] Since 2010, the governments of the Nabire District and the Paniai District have been feuding over gold mining industries at the Degeuwo River, while indigenous communities are left as bystanders (ICG, 2012). The fight over hak ulayat has been positioning the native people as the enemy of the state, especially when the land in dispute is under the target of a big corporation or government project. The state apparatus, especially security forces, have conveniently accused the resistant communities as being separatists, anti-government and anti-development. Wuryandari (2014) recounts how Jaap Solossa, a former governor of Papua Province, expressed his frustration of the behaviour of the state security apparatus in handling people's struggles for land acquisition in 2004. Many communities have received negative treatment from the state apparatus on land issues. Losing the land for the West Papuan vernacular communities is equal to losing the means of life for some of their community members since the people's livelihood is based mainly on the land for hunting and gathering, or small-scale farming.

The Subsistence Until the early twentieth century, the hunting and gathering economy still characterised the West Papuan indigenous society, especially in the interior areas of the island. The agricultural economy was narrowly practised, such as in the highland Wamena area, and the limited trading economy was commanded in the coastal areas with a barter system. The currency system was almost nonexistent, and only a few coastal ethnic groups and tribes acknowledged *Bia* skin (lizard's skin) and clamshells as the currencies. The indigenous lifestyle changed dramatically since the introduction of money as currency. Along with money, a modern lifestyle, which included possessing factory-made goods as tokens of wealth, was entering the life of indigenous Papuans. Gibbons (2013) notes that in the first period of her missionary work in Enarotali in 1953, clamshells were still used as currency among the Damal, Dani, Ekari, and Mee people in the Central Highlands. In the early 1970s, after their encounter with the "outside world", the Central Highland tribes started to prefer money as currency, as it could be changed into clothes, cookware, farming tools, soaps, and other new necessities. In 1979, to help the indigenous tribes to get money, PT Freeport flew a helicopter once a week all the way from Tembagapura to Beogaat Enarotali to buy people's vegetables (Gibbons, 2013 p.396).

The introduction of money, nevertheless, was asymmetrical with people's capacity to acquire money by doing industrial jobs. In the present day, the majority of indigenous West Papuans are still making a living through small-scale farming and irregular hunting and fishing. The indigenous people rarely hold positions in service industries and commerce that require skill and craftsmanship. Clerical jobs in government offices or school teachers, however, became the most favourite

[9]MIFEE (Merauke Integrated Food and Energy Estate) is a megaproject to exploit Merauke's forests for farms and plantations owned by giant companies. MIFEE became problematic due to its neglect of indigenous rights of land and lifestyle. Elaborated studies of the MIFEE project and the impact on the livelihood of the Marind-Anim people can be found in a study by the Forest People Programme, Pusaka and Sawit Watch (2013) and a study by Zakaria et al. (2011).

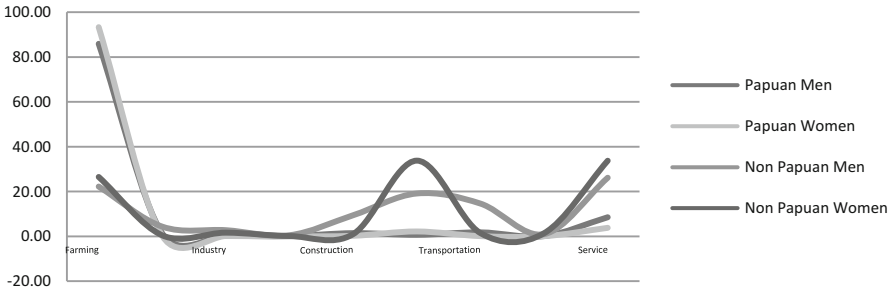

Fig. 6.1 Occupation based on race and gender of Papua province 2010 (Source: Profil Penduduk Menurut Suku Hasil SP 2010 di Papua. BPS-Statistics of Papua Province 2012)

occupations among educated natives because of the promising financial stability with low accountability. The Special Autonomy Status of Papua Province and West Papua Province became the new justification for indigenous youth to demand positions as government civil servants. In many new districts in both provinces, indigenous youth gather in the capital every year demanding to be selected as government officials, as can be seen from a riot in Manokwari in 2012. At that time, the city was tense after a group of people who failed the public servant's recruitment test ran amok following a demonstration.[10] Apart from this, as politics is also a source of economy as well as power, a political position became an appealing job for the educated elite. During the national elections in 2014, three politicians with indigenous family names stated that one of their motivations to join political contestations was to gain social status, to have a stable income, and to acquire power, especially since the rights to do so for the indigenous are guaranteed by the Special Autonomy Law. They promised to channel people's political aspirations once they secured a political position.[11] Most industrial-related jobs are still occupied mostly by non-indigenous people. The most underprivileged group is the indigenous women. An illustration of the occupation distribution between indigenous and non-indigenous communities in cross-cutting with gender in Papua Province in 2010 is shown in the following figure (Fig. 6.1). Similar data are unavailable from West Papua Province because the Statistic Bureau of West Papua Province did not conduct the same survey; however, it is suspected that the occupation distribution between the two provinces is not extremely different.

The Food and Economic Power The staple foods of the West Papuan indigenous people follow the geographic conditions of their habitations. Coastal people eat sago and fish as their staples, while Highlanders eat tuber crops and hunted animals. Pigs are the most valuable livestock for both highlanders and coastal

[10]See: "Gagal CPNS Warga di Manokwari Mengamuk," *Kompas*, October 16, 2012. Available at: http://regional.kompas.com/read/2012/10/16/16144747/Gagal.CPNS.Warga.di.Manokwari.Mengamuk. [Accessed 4 May 2015].

[11]Interviews. MG, IA and LD, local politicians. April 2014.

people, as they hold a traditional value of wealth. The food staples of the people, however, have been changing gradually. Rice has been replacing sago and tuber crops, especially since sago forests are becoming scarce and tuber crops are hard to preserve. Rice eating has become a lifestyle, as it is also a symbol of advancement, while sago and tuber crops have become variation foods. Unfortunately, indigenous communities are not traditionally equipped with rice-farming skills. Rice is produced by migrants or taken from outside the region. The changing of eating habits is not a simple matter because it is connected with the economic power of the people and the evolving culture of consumerism. Indigenous communities, especially in rural areas that have low education and are unfamiliar with the roles of producers and traders, automatically end up as consumers. The phenomenon has enhanced a circle of poverty in the indigenous communities because they lack the ability to produce their new foods (i.e. rice). Moreover, most indigenous Papuans are unskilled in upgrading raw food materials to more marketable products. In traditional markets, it is common to see a lady of a local tribe selling a bag of sweet potatoes from her garden in the morning and using the money to buy a small pack of fried sweet potatoes or a pack of rice as her brunch. This case suggests the incapacity of the indigenous people to upgrade their raw products into more valuable materials and the change of lifestyle. During fieldwork in Merauke in 2013, I found groups of families along a river at the Wasur National Forests bartering their hard-to-catch river fish for rice, sugar, coffee, and canned sardines (sardencies).

The economic gap is wide in West Papua. According to the Indonesian Statistics Bureau (2013), the Gini coefficient number was 0.431 in Papua Province and 0.442 in West Papua Province; the number was higher than the national number, which was 0.413.[12] The number, however, cannot precisely illustrate the gap between the indigenous and non-indigenous people. The gap in economic capacity is virtually assessable from the condition in rural areas where indigenous people mostly reside. Rural areas are practically tangled in poverty and backwardness. While the indigenous elite are notorious for their upscale lifestyles, the people in rural areas are known to be underdeveloped. Rampant corruption and cronyism in West Papua facilitate the elite, many of whom are indigenous, to consolidate economic power. The absence of local leaders and government officials from a region, district, or city that they serve is common, because most local elites reside in Jayapura or other big cities. Many West Papuan local elites also live in Jakarta to secure the access to the power and resource. Service deliveries, especially in rural areas, are halted due to grave corruption of the local elite and officials. In turn, children from remote areas are detached from education because schools are under-facilities and teachers are absent. Moreover, books and other school necessities are insufficient, albeit many schemes of school financing have been formed by the government. Due to absent or

[12]The Gini index number can be found at: BPS – Badan Pusat Statistik (2013). *Gini Ratio Menurut Provinsi Tahun 1996, 1999, 2002, 2005, 2007–2013*. Available at: http://www.bps.go.id/linkTabelStatis/view/id/1493 [Accessed: 25 January 2015].

inadequate formal education, the literacy rate is very low for indigenous Papuans. While in Papua Province the literacy percentage for non-indigenous people is 51.92%, the literacy percentage for indigenous Papuans is only 5.23% (BPS Provinsi Papua, 2012). The absence of education has enhanced the cycle of poverty in rural areas, as indigenous people are not able to find payable employment.

The Change West Papua's society, in particular, is also unique because modern communities are living alongside underdeveloped communities. Nevertheless, as contemporary technology has infiltrated greatly into rural areas, some indigenous communities are familiar with modern gadgets and instruments even though they are still very traditional in their lifestyles. In deep rural areas in West Papua, such as in the Central Highland areas, many villagers walk tens of kilometres to come to town just to charge the batteries of their handphones in many kiosks that provide the service for a small fee. These villagers actually cannot use the handphones in their villages for making calls because phone signals barely reach remote places. They only own the handphones because the handphone is considered as a token of modernity. Handphones are mostly used for listening to songs or for other non-communication purposes. Some villagers receive handphones as presents from their "successful" relatives during elections; some others buy them with village funds from the government that are meant for rural empowerment. In several rural towns an internet connection, despite being very slow, has already been established. While television is very familiar to the people. Internet and televisions promote changes to the indigenous people's lifestyles by offering new habits—such as watching entertainment to spend time—and modern goods—such as fashion and food. The rapid development of technology forces traditional society to endure sudden transformations. Moreover, as the possession of material goods become an important token of modernity, many communities fall to the lower end of the economic chain, as the consumer is unable to produce due to a lack of production skills.

The Special Autonomy Status for the two provinces comes with enormous financial support for the development and empowerment of the region. During 2002–2017, central government in Jakarta has channeled, in total, more than 60 trillion Rupiah (452 million USD) to Papua Province and West Papua Province. The flood of money, combined with Indonesia's democratisation, has also created new elite in indigenous society. However, the accountability to the budget distribution is low due to the bad governance of the central and the local government. As a result of the low accountability, the local elite, by claiming that they represent the people, can gain access to the money to build their power. At the same time, Indonesia's post-Suharto democratisation has brought opportunities for emerging politicians in the region; many of them are university educated or ex-government officers. Therefore, a visible impact on political and economic development in West Papua is the emergence of a new class in society. This new class consists of politicians with access to money (i.e. the government's funds). Tribal leaders have begun to lose their power in the communities, being replaced by new big men with power in the economy. Tribal communities have also started to lose their traditional pattern of social order, as the big men direct tribal conduct and demand

tribal loyalty. Mostly, tribal loyalty is collected during political contestations. During the legislative election 2014, families, clans, and tribes in Central Highlands were feuding among themselves due to contestation in supporting the candidates. Communal clashes caused by tribal loyalty during political contestations also can be seen from incidents of the Puncak District in 2011, the Tolikara District in 2011–2012 and the Nduga District in 2013.

6.4 Mixed-Race Papuans

Since the twenty-first century, West Papua has been home to mixed-race communities and individuals who are the products of intermarriages between various ethnic and racial groups. Mixed-race people in West Papua are especially concentrated in areas where migrant communities reside, such as Timika, Nabire, Manokwari, Sorong, Biak, Jayapura, Fakfak, Kaimana, and Merauke. Naturally, many mixed-race individuals present physical characteristics that are different from the majority of the indigenous people. However, these individuals identify themselves as Papuans.[13] Unfortunately for the mixed-race Papuans, the stereotype of the Papuans' physical features as Melanesian-Negroid with black skin and woolly hair has been widely accepted.

The physical characteristic is especially challenged in politics. Discourse over the definition of "Papua Asli" or truly Papuan is very lively. During the region's government head elections or other political contestations, ethnicity and racial purity become a serious issue. According to the Special Autonomy Law, only a Papuan is allowed to lead the region as a governor, a district head (*bupati*) and a mayor. Moreover, according to the law, the authority of granting the legitimacy of "Papuaness" is in the hands of the Papuan People Assembly (MRP: *Majelis Rakyat Papua*). So far, the definition of a Papuan according to the body is quite ambiguous towards the mixed-race individuals. Many times, the institution is failing one individual as a Papua Asli but granting another person with the same characteristics as a Papua Asli.[14] As a consequence, the definition is highly politicised, and the definition is also a handy weapon in political contestations as people without the status of Papua Asli have difficulty joining in these contestations.

West Papua's patriarchal culture, in which lineage follows the father's line, creates a large burden for mixed-race or mixed-ethnic individuals for the acknowledgement of their identity. In interviews, three West Papuan activists state that even though they were each born from a Papuan mother, they will never be considered

[13]Recorded interviews: JI, August 18, 2012; NK, August 6, 2012; AI, August 7, 2012; August VM, August 20, 2012; TW, August 21, 2012; AG, August 26, 2012; BG, August 29, 2012.

[14]For more detail on the matter, see: "MRP pertegas syarat orang Papua Asli," *Antara News*, December 14, 2011. Available at: http://makassar.antaranews.com/berita/34677/mrp-pertegas-syarat-orang-papua-asli [Accessed 4 August 2012].

Papuans due to their non-Papuan family names. Racism is apparent, even among political and social activists. It is common for activists from mixed-race parentage to be excluded from the inner group and access to networks.[15] One mixed-race Papuan, a journalist by profession, admitted that he stayed away from public demonstrations and rallies conducted by hard-liner Papuan youth groups during 2011–2012, as his presence would have been undesirable and may have invited violence towards him. Due to his brown skin tone and straight hair from his mother's side, he was bound to stand out like a *pendatang* (migrant) in the region.[16] Therefore, for mixed-race Papuans, the definition of Papua Asli is an entry point to receiving racist treatment from larger communities. The seed of racism is growing steadily and is causing many mixed-race Papuans, who never knew any homeland other than West Papua, to never have enough to be Papuans.

The number of so-called mixed-race Papuans has not been known yet because the formal statistics provide only known categories of ethnic groups in the census. During a census, a person is allowed to claim only to one ethnic group, whether it is a West Papuan ethnic or another ethnic group. The way the census was conducted had made mixed-race Papuan statistically unrecognized. Ethnic and racial identification, however, is changing depending on the state of affairs. In the social venue, mixed-race Papuans usually define themselves as Papuans and are acknowledged by others as such. In daily business, a mixed-race individual is usually addressed fondly by others with abbreviated names, such as Jamer (Java-Merauke) for the mixed-race of Marind-Anim people (Merauke's indigenous) with Javanese people. Perancis (*peranakan* Cina Serui) for the offspring of ethnic Chinese people with people from Serui. Torabika (Toraja, Biak and Kaimana) for the mixed-race of Torajan people (South Sulawesi) with Biak and Kaimana people. In political affairs, however, the same individual is categorised mostly as a *pendatang* (migrant), which is in the same box with non-Melanesian Papuans.

Above all, the most unfortunate group from the mixed-race Papuans is the mixed-race Papuan Muslims. These people originated mostly from the west and south coasts of New Guinea island and the far eastern parts of the region, where the inhabitants have long interacted with the outside world. Currently, the mixed-race Papuan Muslim communities are spread scarcely in all over the region. These people and communities are simply left out from politics and are nonexistent in scholarly studies. Most studies on West Papuan habitually provide the picture of the society as the indigenous Christians versus the non-indigenous Malay-Muslims. Moreover, as ethnic politics mingle with sectarian politics, it is very apparent in West Papua that mixed-race Papuan Muslims mostly stay away from political and social movements.[17] Unfortunately, this absence in politics has been enhancing

[15]Recorded interviews and email correspondences: FM, August, 2014; AW, February, 2012, April, 2014; YL, February, 2012, April, 2014.

[16]Recorded interview. JO. August, 2012.

[17]Recorded interviews. JI, February, 2012; AAG, February 2012, August 2013.

antagonism and highlighting the tenet that the mixed-race Papuan Muslims do not belong to the West Papua vernacular society.

The central government's political incentive to the Papuans, in the form of the Special Autonomy Status, encourages racism in its rawest form as a result of the political economic opportunities that come with the package. These opportunities trigger contestations and, in turn, provoke ethnic politics as a means to leverage support from the community and eliminate competitors.

6.5 The Non-Melanesian Papuans

The non-Melanesian Papuans' arrival in the island of New Guinea long preceded Western explorers who claimed to discover the island and recorded it. Documentation, dated in the early sixteenth-century, of the inhabitants of New Guinea noted that vessels of Tidore Kingdom had ruled the area of Fakfak during the period. In the seventeenth century, Ternate traders, along with the Kei people, were recorded to have explored the New Guinea island. The Arabs were found in Fakfak, Kaimana, and Babo (Drooglever, 2010). Corbey (2010) notes that Chinese traders were also active in the coastal areas. Goodman's study (2002) describes that an explorer, Miguel Roxo de Brito, noted in his memoir from 1581 that there were populous and wealthy communities in the villages of Patipi and Rumbati on the Onin Peninsula, located on the west coast of New Guinea's main island (now in West Papua Province). Some local traditional leaders known as *rajas* were also found ruling in Onin, Kowiai and the Raja Ampat Islands and were linked to the *rajas* of East Seram. Goodman (2006) argues that Seramese sailors were active in Papua for more than a half century, starting in Raja Ampat, moving to the MacCluer Gulf (also known as Geelvink Bay, now known as Teluk Cenderawasih) and then ending in Kowiai for trading activities. Many of the settled sailors married indigenous Papuans and developed a trade lingua franca by combining the Malay language and the local language, known as *Bahasa Onin* (Onin language). The inhabitants worked as gold collectors in the interior areas. Some coastal people worked as merchants, trading gold and *massoi* woods with fabrics, ironware, and weaponry from foreigners. Widjojo's (2009) study suggests that Onin was also notorious as a slave market for East Seramese traders. The local Seramese-Papuan traders later became an obstacle in early periods of the Netherlands power's claim to the region. Moreover, as Goodman (2002) notes, the Seramese relationship with Papuans was "known throughout the Indonesian archipelago long before the coming of the Europeans". In 1607, Luis Vaez de Torres, a Spanish explorer, wrote an account of his voyage to the southern coast of New Guinea. He recorded that Muslim traders were already actively introducing religion on the island (Osborne, 1985 p.6). According to Baal (in Sinaga, 2013 p.99), Merauke was already busy in 1903 with two European-owned shops, 12 Chinese-owned shops, some far Easterner people and a director of a general trade international Merauke company which had headquarters in Amsterdam. Later on, the Dutch brought the Moluccans, Kei,

and Manado people as teachers, church assistants, police officers, and military officers to West Papua in the 1920s.

Eurasian communities also existed in West Papua. The Indo-Dutch (Eurasian) community in Java established *Vereeniging Kolonisatie Nieuw-Guinea* (Colonisation Society of New Guinea) in 1926. A similar organisation, *Stichting Imigratieen Kolonisatie Nieuw-Guinea* (Foundation Emigration and Colonisation New Guinea), was established in 1930. These two organisations transferred Eurasian people from other Indonesia's islands to West Papua. The first group arrived in Hollandia and Manokwari in the same year after the Netherlands formally established West Papua as a colony for repatriated Indo-Dutch from Jawa following a world economic crisis (Klein in Sinaga, 2013 p.217). The Eurasian migrants were especially interested in farming colonisation, even though many eventually failed at the farming business. Until 1940, approximately 100 colonists resided in Manokwari, and 12 people resided in Hollandia (now Jayapura). The Eurasian people in West Papua were also active in politics. De Rijke, a lawyer by profession, was a prominent individual elected as a member of the New Guinea Council by the people's vote. He was also appointed by the governor to lead the Papuan National Committee (KNP: *Komite Nasional Papua*). KNP produced the political manifesto that was read at a ceremony on December 1, 1961, and was also believed to be the proclamation of independence of West Papua. All Eurasian people, however, were believed to have left the region to move to the Netherlands in 1962.

Javanese farmers also settled in Merauke during the Netherlands colonial period. A prisoner camp (exile camp/*interneringskamp*) for alleged communists from Java and Sumatera was established in Boven Digoel in the southern coastal region, the land of the Muyu tribe, in 1926. At this camp, there were 823 prisoners accompanied by 473 family members. When the camp was dissolved in 1943 due to the imminent war with Japan, the Netherlands government moved approximately 200 - ex-prisoners to Australia. Many, however, stayed in West Papua. During the Pacific War, allied forces that fought against the Japanese military recruited many Javanese and Sumatera people as police officers and sailors, and some were left behind after the war to reside in West Papua. Most of the non-indigenous people from the sixteenth century to the 1940s resided in the coastal areas. The interior highlands remained free from the non-indigenous communities until the late 1940s.

In the mid-1960s, the government of Indonesia executed a programme of so-called transmigration (*transmigrasi*). The programme was a government-sponsored migration programme aiming to control population distribution in the country. The programme actually followed a similar Netherlands' programme that was used during the colonial period in 1905. The Dutch moved people from densely populated Java and Bali to Lampung (currently Lampung Province) on Sumatera Island. The Indonesian government replicated the programme for a more political reason. The first transmigrants to West Papua were posted at Wamena of Jayawijaya, in 1965. The migration programme was called the Pioneer of West Irian's Development (PPIB: *Pelopor Pembangunan Irian Barat*). According to Darisman, one of the first migrants sent to Irian Barat, 50 families were registered for the programme. However, after many selection processes and interrogations, only 37 families were

admitted. After being trained in craftsmanship, farming, and clerical jobs in Jakarta for a few months, the transmigrants and their families were sent to Wamena. They were forced to sign an oath of not to leave Irian Barat/West Papua as the migration was a voluntary civic duty. Darisman and many other migrants and their descendants then lived in the region for the rest of their lives. In 2017, the first transmigrant families from the 1965 have reached their fourth generations.[18]

During President Suharto's period (1966–1998), the government was more enthusiastic about the transmigration programme. Apart from its aim to control population distribution from the densely populated areas of Java, Bali, and Lombok to "unused lands" in Sumatera, Kalimantan, Sulawesi, Maluku, and Irian Barat (West Papua), the programme also aimed to accelerate acculturation among Indonesians and as a national defence strategy. President Suharto declared the new aims of the transmigration programme in his presidential speech in front of the People's Consultative Assembly (MPR: *Majelis Permusyawaratan Rakyat*), which is the country's highest decision-making body, on August 16, 1975. Unfortunately, adaptation between the received and the receiver was not smooth. It caused not only the transmigrants were not equipped with adequate knowledge of the culture of their destinations, but also because the native people were unprepared to receive strangers. Exacerbated with poor service delivery of the government officials and the iron hand of the authoritarian regime, the natives started resenting the migrants. In most transmigration destinations, conflicts and feuds tainted the relationships between indigenous and migrant communities. Government-sponsored migration, however, was not the only source of migration in West Papua. Voluntary migrants were also flooding the region because West Papua is seen as the land of opportunities. The gap of culture, knowledge, skills, and resources between the natives and the migrants created an influx in society. Acculturation went slowly, even though many communities managed to share a peaceful coexistence in the region.

Due to the flood of migrants, the non-Melanesian inhabitants of West Papua were starting to be called *pendatang* (literarily means newcomers or migrants). The people in West Papua's non-indigenous communities started to be seen as non-Papuans, despite their long period of time residing in the region. During the Dutch colonialism, non-indigenous people were referred to as Amber or Amberi by people in the Biak and Bird Head areas, or as *pu-anim* by people in Merauke. As Papuan communities were traditionally characterised by divided communities, the race and ethnicity of non-indigenous communities also mattered as the markers of their existence. After the Papuan spring in 1998, ethnic politics rapidly took place that made ethnicity and racial identity became even more important in West Papua. In response, non-Melanesian ethnic groups in West Papua started to regroup under the banner of ethnicity. In almost all West Papua areas, institutions and organisations based on ethnicity and cultural origins exist today. In some districts, ethnic-based institutions have become central bodies to organise power and capital, and to enforce law and order.

[18]Recorded interview. Darisman, the first migrant who came to Wamena. September 6, 2012.

The exploitation of ethnicity to organise power and resource was apparent after 1998. Ethnicity also an important marker for non-indigenous groups to get recognizition from the government as the center of resources. Elites in each ethnic group compete to show the importance and the strength of their group in order to become a partner for the government. The partnership can be in the form of economic activities—government's suplier, construction projects—or in politics and security. In politics, ethnicity became the currency to assemble support. In Asmat District local election 2015, a candidate of vice-district head, a Torajan (an ethnic origin of South Sulawesi), received support from his fellow Torajans who are mostly working as doctors and nurses in local public hospitals, and civil servants in Asmat. In government offices, it is a common to have an ethnic group hold hegemonic power in a department.

Often, the local government compensates its low capacity of providing security to the people by "sharing" the responsibility of providing security with ethnic-based institutions. Such a case could be found in Sorong in August 2013. Sorong was tense because of a horrible crime committed by a member of an ethnic group towards children from another ethnic group. The two groups were on the brink of communal clash. To mitigate the iminent violence, the local police held a meeting between the chiefs of the two ethnic-based institutions and made a peace agreement. During the time, the police and the local government, actively encourage the people in Sorong to connect with people from the same ethnicity and building alliance to protect theirselves from unwanted problems. The authorities claimed that ethnic-based institutions had been useful in maintaining harmony and peace in Sorong. In Sorong, a Javanese can find herself/himself suddenly being under a new "tribe" by her/his city of origin; even though tribe system is unknown in Javanese culture. Categorisation based on ethnic and racial features, in fact, have enhanced the division and gap in the society.

6.6 Conclusion

The discussion shows that West Papua is a plural society. Indigenous people versus migrants, as the main paradigm in describing the West Papua society, may no longer be valid in the future. Intermarriages among ethnic groups have become common, and racial categorization have become blurred. While the members of the society become more diverse, pluralism is facing a new challenge due to political dynamics. Power struggles in politics has forced the people to regroup based on ethnicity. West Papua's plural society is now leading to a divided society with ethnicity and sectarianism as the boundaries.

The indigenous society of West Papua has experienced rapid transformation during the last century. The speedy adaptation to modernity and new civilisation has deepened the gaps among communities who experience different adaption processes and outcomes. As a result of the rapid transformation, few groups of the society are able to enjoy the benefit of modernisation, such as education and

economic power. Unfortunately, the majority of West Papua people are bound to be the sufferers of the excess of modernisation due to their inability to compete in a world with different rules. Also, the constant rapid change has forced indigenous communities to continuously format and reformat their identity that caused the loosening bond in the society due to the lessen commonalities. Most indigenous communities regress back to their ethnic and group identities to organise power in facing the new challenge. What comes next is not an organised protective power institution, rather, the exploitation of ethnic sentiment as a road to power by the local elite.

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Part II
Urban Development and Morphology

Chapter 7
Structural Model of Formation Factors of Tourism Policy in Nganjuk Regency: Tourists' Perspectives

Ismu Rini Dwi Ari, Kartika Eka Sari, Achmad Wicaksono, and Lupi Harisanti

Abstract Nganjuk is one among 29 regencies in East Java Province which has abundant tourism potential, in the form of both natural and man-made tourism objects. However, the number of both domestic and foreign tourists has not shown significant progress, as registered in the Statistical Data of Nganjuk Regency (2016). In addition, numbers of tourist decreased in 2014. As a consequence, this tourism sector has not made a significant contribution toward the local income of the regency. Based on that current situation, there are two main research aims for this study: (1) what are the influential factors toward tourism policy and (2) what are the interrelations between the influential factors toward tourism policy in Nganjuk Regency. There are three tourist destinations used as case studies, namely, Air Terjun Sedudo, Air Merambat Roro Kuning, and Air Terjun Singokromo. Input data was collected from 190 visitors and is analyzed by structural equation modeling (SEM). The estimation results of the modeling indicate that there are four factors that could have a significant influence on tourism policy in Nganjuk Regency – infrastructure, motivation, society, and marketing mix.

7.1 Introduction

The tourism sector is one of many potential regional income sources, and if it is well managed, it will increase the public welfare significantly. Nganjuk is one among 29 regencies in East Java Province which has abundant tourism potential, in both natural and man-made tourism objects. However, the number of tourists (both domestic and foreign) has not shown significant progress, as registered in the Statistical Data of Nganjuk Regency (2016). The statistics show that in 2011 the total number of tourists were 273,304 visitors, which then increased slightly in 2012

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and 2013 at an annual rate of about 1.31% and 4.45%, respectively (Culture and Tourism Board of Nganjuk Regency, 2007)). However, the total number of tourist decreased quite significantly in 2014 by about 9.51%. In addition, the number of foreign tourists is very low compared to domestic tourists – between 2011–2014, it was annually 17 (0.006%), 22 (0.008%), 13 (0.004%), and 5 (0.002%), respectively. As a consequence, the tourism sector could not give a significant contribution toward the local revenue of the regency. In 2010, the tourism sector only contributed 10% of Nganjuk's Regional Income, so if we compare this with other sectors such as infrastructure, agriculture, and industry, the tourism sector doesn't provide a significant contribution to Nganjuk's Regional Income, even though Nganjuk has a lot of tourism potential. Therefore, it is necessary to scrutinize how planning and management of the tourism sector in Nganjuk Regency has been conducted, to see how the situation may be improved.

Based on this current situation, there are two main research aims: (1) what are the influential factors toward tourism policy and (2) what are the interrelations between the influential factors toward tourism policy in Nganjuk Regency. The results of this research are expected to offer useful recommendations to develop a better tourism policy in order to increase the number of tourists and local revenue as well.

7.2 Research Method

Structural equation modeling (SEM) can be best described as an analysis that combines factor analysis, structural modeling, and path analysis. SEM is employed to identify the closeness influence of each factor on policy. Moreover, this model is also possible to draw a structural model of tourism policy in the research area. Connections and relationships between variables will be described through the model.

The SEM seeks to highlight which of the measured variables can best describe the variance in results, thereby indicating which of these variables might have the strongest influence. Once these variables are identified, they can be examined further as potential items to be focused on in the tourism policy.

Referring to Wijayanto (2008), the five steps of SEM in this research can be explained as follows.

1. Model specification

The formulation of the initial structural equation in order to attempt an estimation model is based upon preliminary theories or research. Four estimation models are used in this research.

2. Identification

There is no solution to review the possibility to obtain unique values for each parameter in the models and simultaneous equation (Figs. 7.1, 7.2, 7.3 and 7.4).

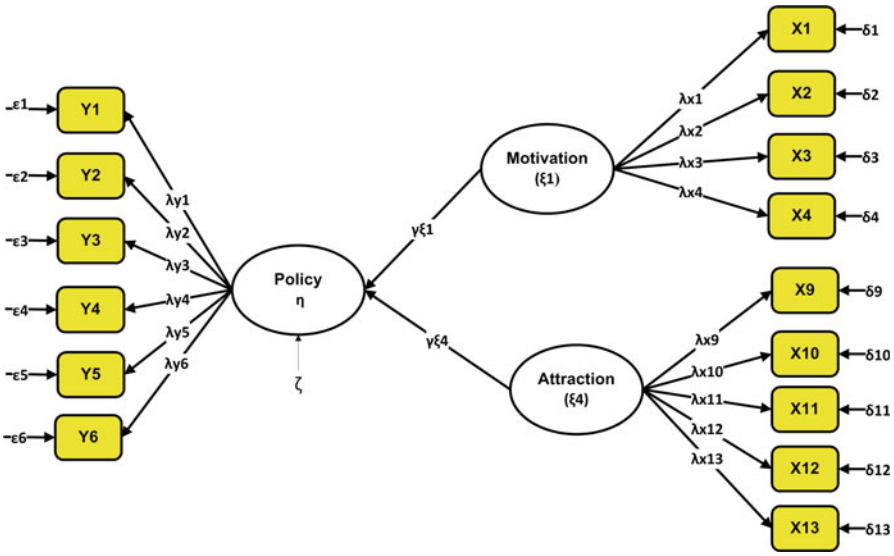

Fig. 7.1 Model specification and identification type 1

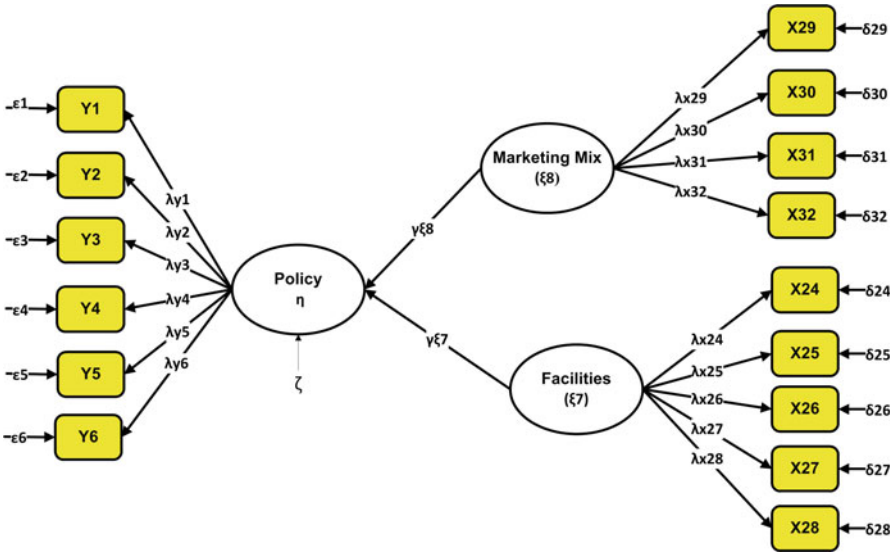

Fig. 7.2 Model specification and identification type 2

3. Estimation

This step is interrelated to the estimation of parameter values using one of the estimation methods available. The method designation is often based upon the variables being analyzed.

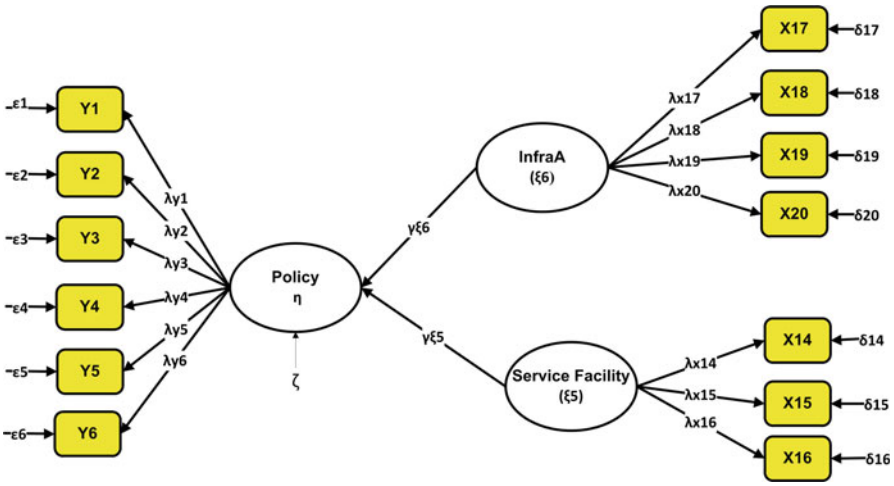

Fig. 7.3 Model specification and identification type 3

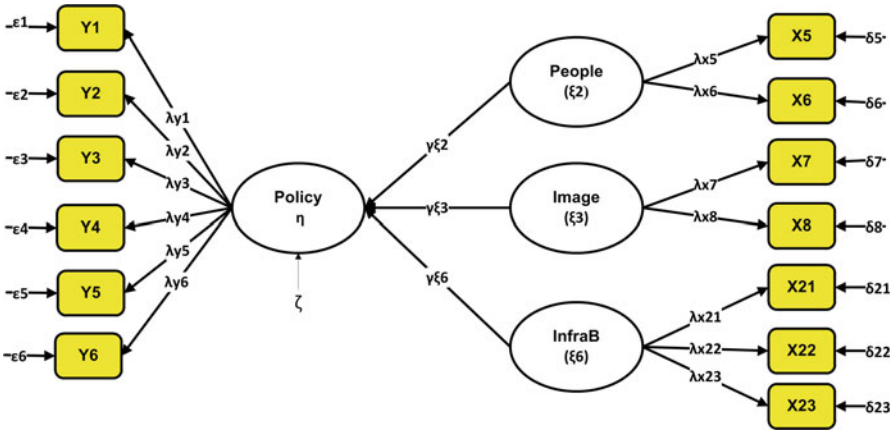

Fig. 7.4 Model specification and identification type 4

4. Assessment of model and model fit

The assessment of the model is done using a data set with several sizes of fit criteria.

5. Model Re-specification

This step is related to the modification of the model based upon the results obtained from the previous step: assessment of model and model fit.

In SEM analysis, each latent variable possesses observed variables known as indicators. Latent variable indicators used in this research are policy, image, attraction, and infrastructure (Alastair, 2002; Dunn, 2000). All variables used in model can seen in Table 7.1.

Table 7.1 Latent variable indicator

Type	Endogen	Indicator	Exogen	Indicator
1	Policy (η)	Effectiveness (Y1)	Motivation (ξ 1)	Physical motive (X1)
		Efficiency (Y2)		Culture motive (X2)
		Adequacy (Y3)		Social motive (X3)
		Equality (Y4)		Fantasy motive (X4)
		Responsiveness (Y5)	Attraction (ξ 4)	Natural beauty (X9)
		Accuracy (Y6)		Weather /climate (X10)
				Culture (X11)
				Safety (X12)
				Human resource (X13)
2	Policy (η)	Effectiveness (Y1)	Facility (ξ 7)	Main facility (X24)
		Efficiency (Y2)		Supporting facility (X25) service facility (X26)
		Adequacy (Y3)		
		Equality (Y4)		Management facility (X27)
		Responsiveness (Y5)		Complementary facility (X28)
		Accuracy (Y6)	Marketing mix (ξ 8)	Product (X29)
				Price (X30)
				Place (X31)
				Promotion (32)
3	Policy (η)	Effectiveness (Y1)	Tourism means (ξ 5)	Main tourism means (X14)
		Efficiency (Y2)		Complementary means (X15)
		Adequacy (Y3)		Supporting means (X16)
		Equality (Y4)	Infrastructure A (ξ 6)	Transport (X17)
		Responsiveness (Y5)		Travel cost (X18)
		Accuracy (Y6)		Communication infrastructure (X19)
				Utility group (X20)
4	Policy (η)	Effectiveness (Y1)	Society (ξ 2)	Characteristic of society (X5)
		Efficiency (Y2)		Culture of society (X6)
		Adequacy (Y3)		
		Equality (Y4)	Image (ξ 3)	Previous experience (X7)
		Responsiveness (Y5)		Source of information (X8)
		Accuracy (Y6)	Infrastructure B (ξ 6)	Health services (X21)
				Safety and hospitality (X22)
				Officer (X23)

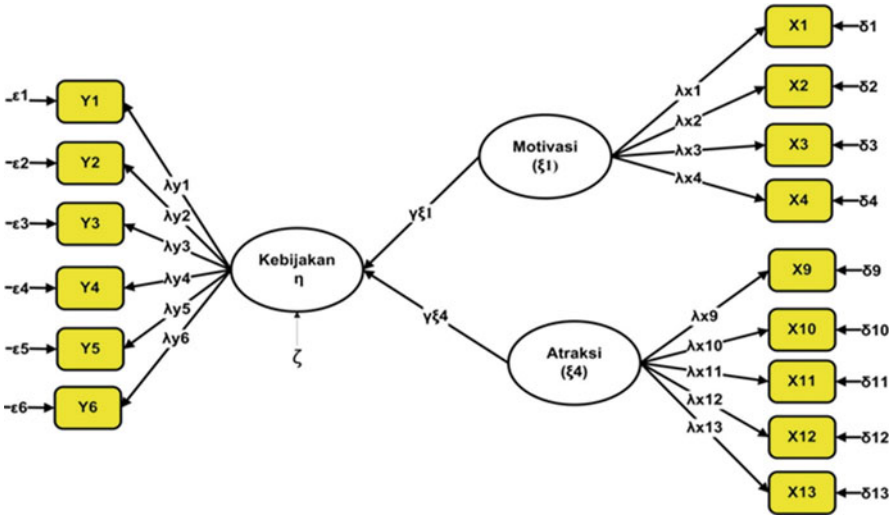

Fig. 7.5 Model specification type 1

The population in this study is the number of visitors in the three tourist destinations, namely, Air Terjun Sedudo, Air Merambat Roro Kuning, and Air Terjun Singokromo. With the number of observed variables being 38, thus the total number of samples required is 190 tourists. Based on observed variables, the model should be divided into 4 specification (Fig. 7.5).

7.3 Estimation Result

7.3.1 Model Estimation

Model specification type 1 shows that motivation (ξ1) and attraction (ξ2) have an influence on policy (π). This model will be used to identify the degree-of-freedom value to confirm whether the number of estimated parameters is less than the available data. Indicators of motivation that influence policy are physical, culture, social, and fantasy. Indicators of attraction that influence policy are landscape, weather, culture, safety, and human resources (Fig. 7.6).

Model specification type 2 shows that facilities (ξ7) and market (ξ8) have an influence on policy (π). This model is then used to identify the degree-of-freedom value as per model 1. Indicators of facilities that influence policy are main facilities, support facilities, tourist service facilities, complementary facilities, and management facilities. Indicators of market that influence policy are product, price, place, and promotion (Fig. 7.7).

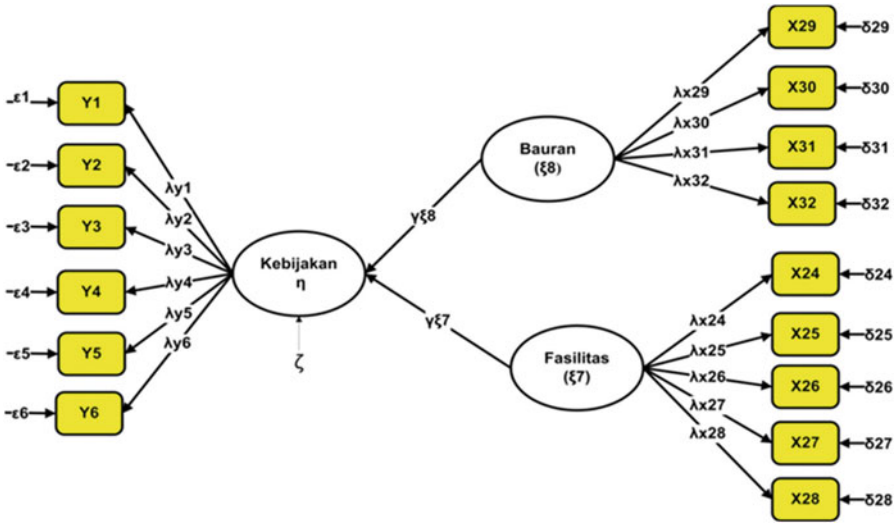

Fig. 7.6 Model specification type 2

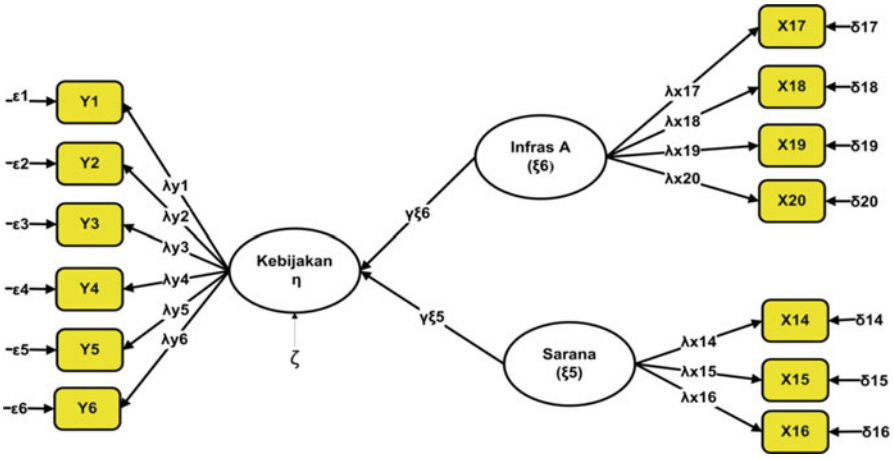

Fig. 7.7 Model re-specification type 3

Model specification type 3 shows that facilities (ξ5) and infrastructure (ξ6) have an influence on policy (π). As before, this model is used to identify the degree-of-freedom value to see if the number of the estimated parameters is less than the number of data points. Indicators of facilities that influence policy are main facilities, support facilities, and complementary facilities. Indicators of infrastructure that influence policy are transport, travel cost, communication infrastructure, community, health service, safety, hospitality, and government apparatus (Fig. 7.8).

Model specification type 4 shows that society (ξ2), infrastructure B (ξ6), and image (ξ3) have an influence on policy (π). Again, this model is assessed for

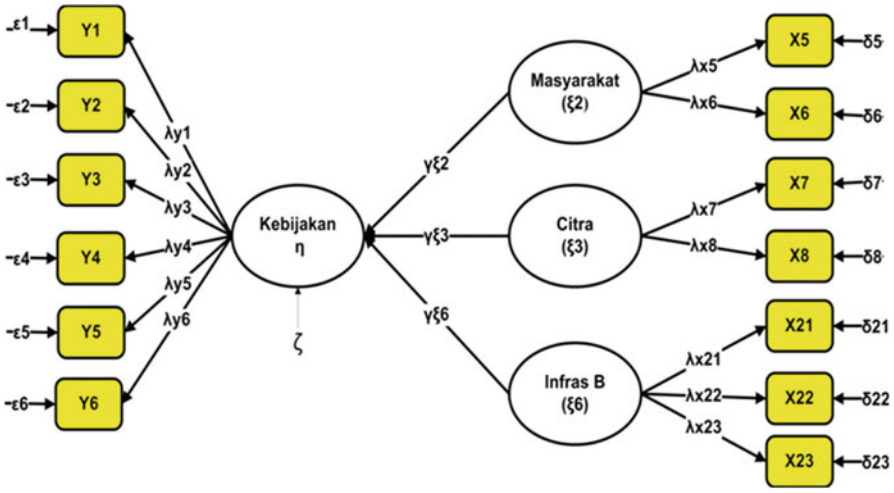

Fig. 7.8 Model re-specification type 4

degrees of freedom. Indicators of society that influence policy are community characteristic. Indicators of image that influence policy are culture, experience, and information resource.

7.3.2 Model Fit Test

This section provides the results of the model fit tests for each of the model types. These tests identify the reliability and validity of alternative parameters for use in the descriptive model.

Table 7.2 indicates that the model fit test for model type 1 for most values in the model's construct is valid and reliable so the structural model can be used to define the connection between tourism policy and motivation and attraction.

As illustrated in Table 7.3, the model fit test for model type 2 might indicate that most values in the model's construct are valid and reliable, so that the structural model can be used to define the connection between tourism policy and service and marketing.

Table 7.4 shows similar results for the model fit tests with the previous models; model type 3 also indicates that most values in the model's construct are valid and reliable so the structural model can be used to define the connection between tourism policy and facilities and infrastructure.

Table 7.5 indicates that model fit test for model type 4 also shows that most values in model's construct are valid and reliable so the structural model can be used to define the connection between tourism policy and society, image, and infrastructure.

Table 7.2 Model fit test – type 1

Variable	Construct reliability	Sig	Variance extracted	Sig	Analysis
Policy	0.8	0.7	0.4	0.5	CR is valid and reliable
Motivation	0.8		0.6		CR and VE are valid and reliable
Attraction	0.8		0.5		CR and VE valid and reliable

Table 7.3 Model fit test – type 2

Variable	Construct reliability	Sig	Variance extracted	Sig	Analysis
Policy	0.8	0.7	0.4	0.5	CR is valid and reliable
Service	0.9		0.5		CR and VE are valid and reliable
Marketing	0.9		0.6		CR and VE valid and reliable

Table 7.4 Model fit test – type 3

Variable	Construct reliability	Sig	Variance extracted	Sig	Analysis
Policy	0.8	0.7	0.4	0.5	CR is valid and reliable
Facilities	0.9		0.7		CR and VE are valid and reliable
Infrastructure	0.8		0.5		CR and VE valid and reliable

Table 7.5 Model fit test – type 4

Variable	Construct reliability	Sig	Variance extracted	Sig	Analysis
Policy	0.8	0.7	0.4	0.5	CR is valid and reliable
Society	0.6		0.5		VE is valid and reliable
Image	0.7		0.6		CR and VE valid and reliable
Infrastructure	0.8		0.6		CR and VE are valid and reliable

7.3.3 *Model Re-specification*

Figure 7.9 illustrates that

$$\text{Policy} = 1.23* \text{ Motivation} - 0.44* \text{ Attraction}, (\text{Errorvar.} = 0.26)$$

This means that model type 1 indicates that the motivation factor has a significant influence on tourism. In addition, sub-factors that also have a direct significant influence on motivation are physical, culture, social, and fantasy.

Figure 7.10 illustrates that

$$\text{Policy} = -0.026* \text{ Service} + 0.70* \text{ Marketing}, \left(\text{Errorvar.} = 0.54, R^2 = 0.46\right).$$

Meaning that model type 2 indicates that the marketing factor has a significant influence on tourism. Then, sub-factors that also have a direct significant influence to marketing are product, price, place, and promotion.

Figure 7.11 illustrates that

$$\text{Policy} = -0.0048* \text{ Facilities} + 0.70* \text{ Infrastructure}, \left(\text{Errorvar.} = 0.51, R^2 = 0.49\right).$$

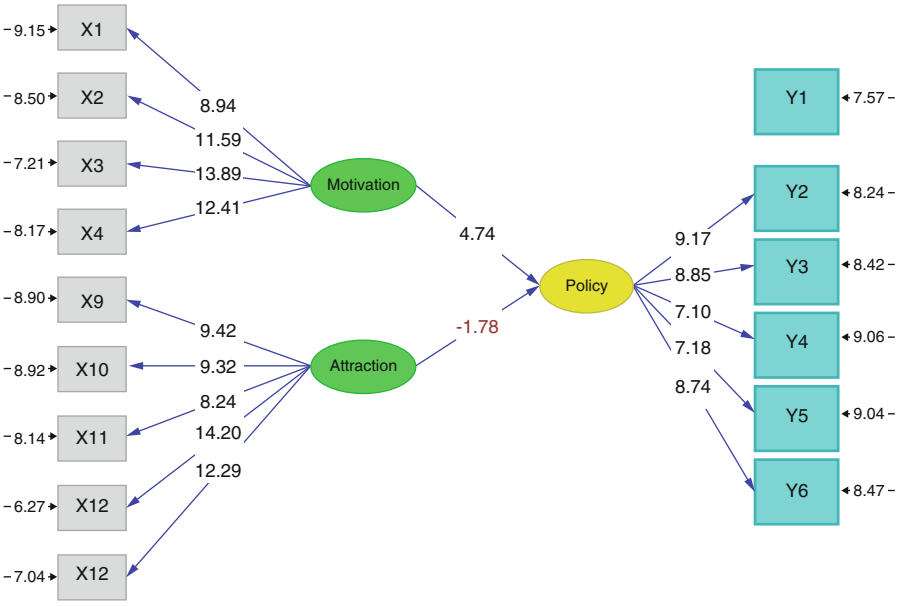

Fig. 7.9 Model re-specification type 1

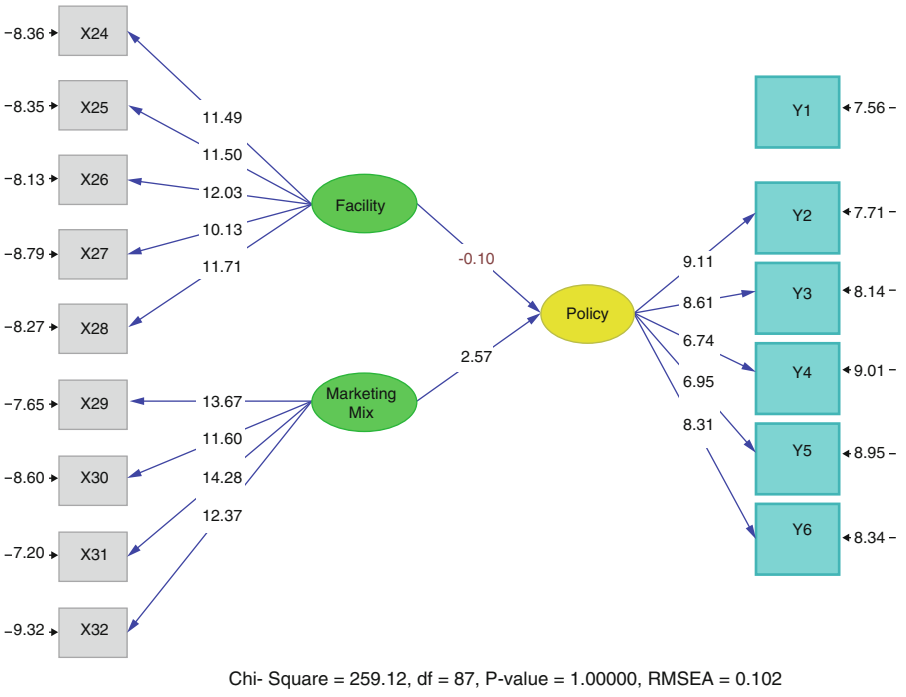

Fig. 7.10 Model re-specification type 2

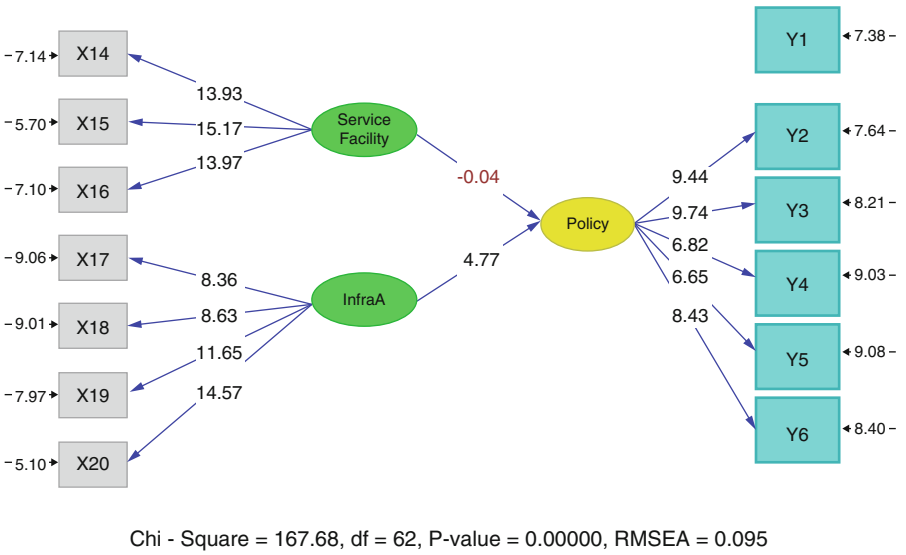

Fig. 7.11 Model re-specification type 3

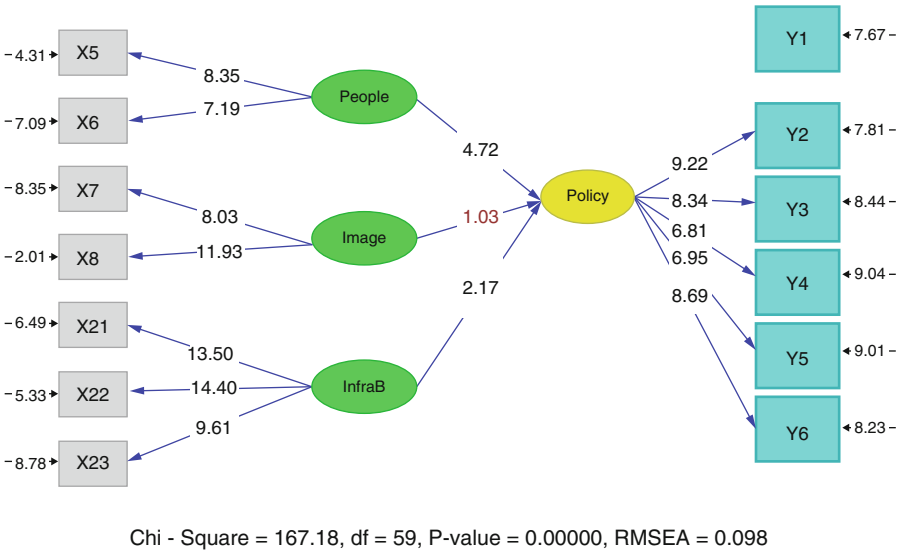

Fig. 7.12 Model re-specification type 4

This implies that the model type 3 indicates that the infrastructure factor has a significant influence on tourism. Sub-factors that also have a direct significant influence on the infrastructure are loading mobility, travel cost, communication infrastructure, and utility cluster.

Figure 7.12 illustrates that

$$\begin{aligned}\text{Policy} = {} & 0.49* \text{ Society} + 0.14* \text{ Image} \\ & + 0.33* \text{ Infrastructure}, (\text{Errorvar.} = 0.38).\end{aligned}$$

It can be observed that the model type 4 indicates that society and infrastructure factors have a significant influence on tourism. The image, however, has less influence. Sub-factors that also have a direct significant influence on society are society characteristic and culture; meanwhile, for infrastructure, these are health, safety, and hospitality infrastructure.

Figure 7.13 illustrates that the motivation factor covering physical, culture, social, and fantasy has a significant connection with tourism policy, and in Fig. 7.14, the factor with significant connection with tourism policy is the marketing mix factor – covering product, place, price, and promotion.

Figure 7.15 shows that the infrastructure factor consisting of loading capacity, travel cost, communication, and utility cluster has a significant connection with tourism policy. In the last model, Fig. 7.16 indicates that the infrastructure factor covering health, safety, and hospitality has also a significant connection with tourism policy.

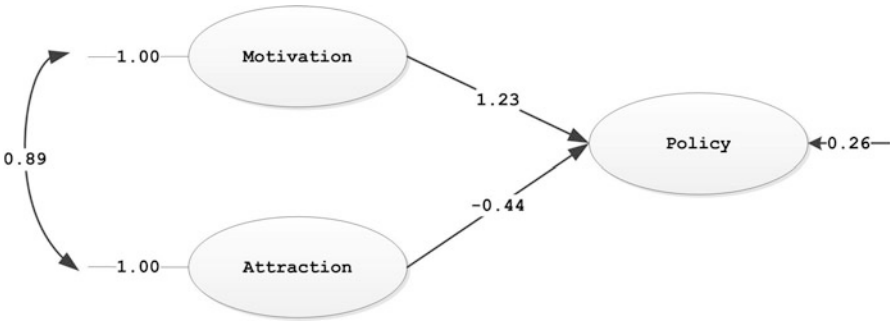

Fig. 7.13 SEM model type 1

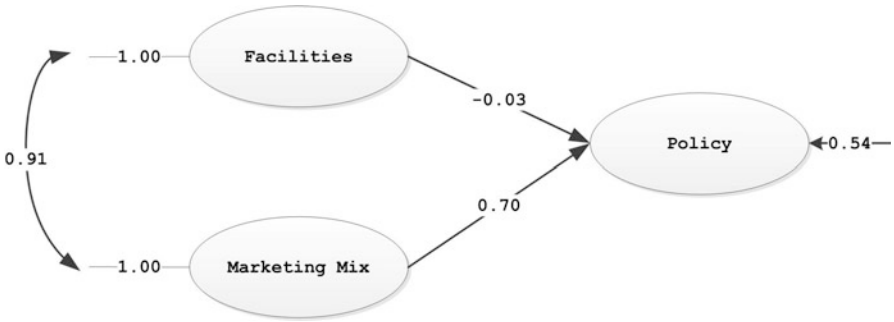

Fig. 7.14 SEM model type 2

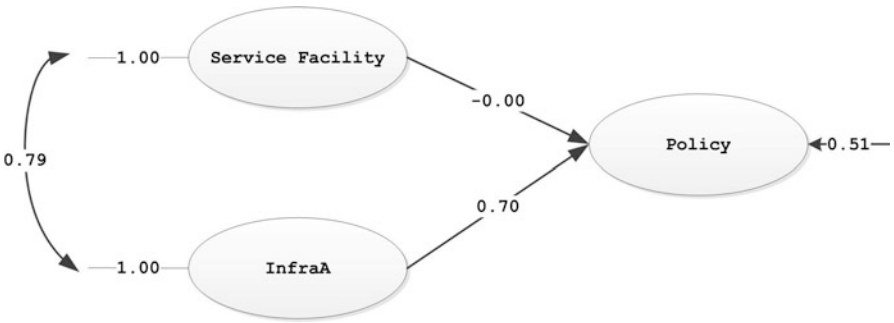

Fig. 7.15 SEM model type 3

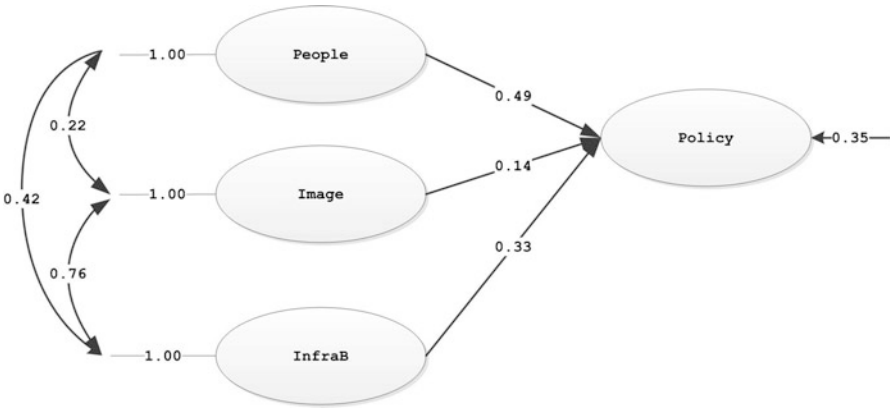

Fig. 7.16 SEM model type 4

7.4 Conclusion

Estimation results of SEM indicate that there are four factors that give significant influence toward tourism policy in Nganjuk Regency – infrastructure (*t*-value 4.77, estimation 0.70), motivation (*t*-value 4.74, estimation 1.22), society (*t*-value 4.72, estimation 0.49), and marketing (*t*-value 2.57, estimation 0.70).

Interconnectedness between factors that give significant influence toward the tourism policy are (a) motivation (influential factors: motivation of physical, culture, social, and fantasy), (b) marketing (influential factors: product, place, price, and promotion), (c) infrastructure (influential factors: transport, travel cost, communication infrastructure, and utility), and (d) society (influential factors: local characteristics and culture, health facility, hospitality, safety, and security).

In order to have better tourism development, it is necessary to improve the quality of the tourism masterplan for each tourist destination as well as the whole tourism masterplan of Nganjuk Regency, wherein the four factors (motivation, marketing, infrastructure, and society) are prominent to be considered. Also, these same four factors can be used to evaluate how deeply or focused Nganjuk's Tourism Policy is in its coverage of those four factors, because based on this research, marketing, motivation, infrastructure, and society have significant influence to tourism policy in Nganjuk Regency.

In order to develop tourism policy in Nganjuk Regency, several recommendations are given as follows:

1. Enhancing urban fabrics program through policy development and implementation of an evaluation phase.
2. Developing market and infrastructure as well as enhancing environment management through improvement of infrastructure. A better infrastructure can increase tourist's comfort and safety.

3. Developing market and investment through development of tourism product and promotion.
4. Developing product based on tourist motivation.

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Chapter 8
Good or Bad of Greening Effects on High-Density Urban Housing Air Quality

Chairul Maulidi and A.Wahid Hasyim

Abstract Green city initiatives are expected to continue growing as a strategic issue of urban development in Indonesia. This spirit is motivated by several factors that are namely, a rapid urban growth which ignores the ecological functions; followed by floods and landslide disasters; and is also strengthened by global warming issues and climate change. These aforementioned factors encourage cities to become clean and enter the race of the greening movement. With various species of flowers and shrubs planted, the urban housing in Malang City has become more beautiful and cooler. Through photosynthesis in daylight, plants absorb CO_2 and release O_2. On the other hand, plant respiration, in the night, absorbs O_2 and releases CO_2. This study aims to understand the relation of vegetation presence to CO_2 concentrations in dense urban housing. Through regression analysis, urban canyon ratio and vegetation densities are positioned as independent variables to find out how strong their contribution is to the level of CO_2 concentration during the day and nighttime. The research result show that at daytime, urban canyon ratio and vegetation density, collectively, give no significant contribution to CO_2 concentration flux. If we eliminate urban canyon ratio from the regression model, vegetation density has a significant effect (partially) on decreasing CO_2 concentration in the dense urban housing at day time. However it's not too high compared with the intercept factor (another variable that isn't examined in this research). At nighttime, urban canyon ratio and vegetation density, collectively, give significant contributions to CO_2 concentration flux. The urban canyon ratio has the most significant role in the regression model. Meanwhile, vegetation density has weak significance, but it doesn't undermine the regression model confidence. Therefore, we could determine that urban canyon ratio and vegetation, together, bring a significant effect to CO_2 concentration in dense urban housing at nighttime.

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8.1 Introduction

Green city initiatives have grown as a strategic issue of urban development in Indonesia. This spirit is motivated by several factors that include, rapid urban growth and ecological factors like floods, landslide disasters, and also global warming issues and climate change. These encouraged cities to become cleaner and actively take part in the greening movement. With the various species of flowers and shrubs planted, this has made urban housing in Malang City to become beautiful and cooler. Through photosynthesis in daylight, plants absorb CO_2 and release O_2. On the other hand, plants respiration, at night, absorbs O_2 and releases CO_2. This study aims to understand the correlation between the presence of vegetation and concentration of CO_2 in high-density urban housing, Kampung Glintung, in Malang City. The Kampung Glintung has implemented greening programs, having narrow streets with an average width of 1.5 m planted with various kinds of vegetables and flowers, and has become a pilot village for the urban housing greening program in Indonesia.

8.1.1 High-Density Urban Housing

Urbanization generates a higher density of living. A high-density urban living will continue to put pressure on city comfort, in both social and functional aspects. Urban spaces which are formed by building dimensions and spacing, are also changed by the characteristics of artificial surfaces and the amount of green space (Erell et al. 2011). Dimensional environment and high-density urban living, especially in tropical and subtropical climate zones are particularly susceptible to this threat. Urban space does not cause heat waves, but it strengthens them, in contrast to its surrounding rural areas in various patterns. Many of them are directly related to the surface energy balance and urban heat island (UHI) formation. The presence of high density urban space promotes the creation of UHI through a number of processes, for example, trapping of heat energy as a result of reflection and absorption urban canyons that is, usually, narrow and deep and a reduction of wind speed near the ground surface (Erell et al. 2011). The use of hard materials on buildings and land cover make urban areas to absorb and hold heat energy substantially than rural areas which are characterized by land and vegetation cover. Therefore, the main reasons for urban warming are not because of global warming itself, but by the replacement of pavement soil and vegetation (Stone 2012). Problems of heat, humidity, lack of lighting, solar access, and urban ventilation are topics of concern for city planners and government. It is apparent that there is a need to consider city design suitable for high-density living (Ng 2010). In cities with a high density, the most important thing is the influence of vegetation to

obstruct heating in urban canyons, reducing the absorption of heat radiation through shading and evapotranspiration.

8.1.2 Vegetation Role of Urban Landscape

Green area tends to reduce maximum daily temperatures and radiation on surface soil. Influences of vegetation on the heat island atmosphere are manifested not only indirectly, via the reduction of heat waves from a colder surface, but also directly via cooling from evaporation. In the high-density urban areas, availability of land is scarce and there is little available space for urban greenery. Integration of greenery on buildings also faces obstacles (Wong and Chen 2010). Therefore, with the progress of urbanization, vegetation is fairly rare in tropical cities. There is a tendency to replace permeable natural vegetation and soil with impermeable surfaces such as asphalt and concrete, which leads to the exacerbation of heat waves. Through the combined effects of shading and evapotranspiration, reduction of air temperatures by 1 to 3 degrees Celsius can be achieved. The role of vegetation to purify air quality is also important. From the perspective of greenhouse emissions, plant photosynthesis directly improves concentration of carbon gases. High-density urban living acts as a source of carbon emissions from its anthropogenic emissions, which endangers life. CO_2 also could be released from the ground, through natural process (ie., mantle degassing, thermal decarbonation) or by industrial processes (CO_2 geological storage in the ground). CO_2 gas is colorless and odorless, and is denser than air. The dynamic is governed by buoyancy and gas clouds, and can temporarily accumulate on the ground, which leads to the formation of "lake CO_2". Further, CO_2 is distributed by the wind and atmospheric turbulence (Gasparini et.al. 2016).

As with all organisms on earth, plants produce energy to live, grow, and reproduce. With the availability of light, during the day, plants produce energy from a photosynthesis process, and in the process converts water and CO_2 into glucose and oxygen. O_2 exhaled from the leaves and energy while glucose molecules is used by its whole plant body to grow, flowering, and bear fruit. While photosynthesis occurs, the leaves, roots and stems also perform respiration. Respiration processes do not require light, so they can take place in the afternoon and evening. Respiration absorbs O_2 in order to convert glucose for cell metabolism and release CO_2 and water. Many papers reported that plant respiration is partially and reversibly suppressed by the increase in atmospheric CO_2 concentration (Amthor 1997). Meanwhile, there is a significant debate about the validity to conclude that there is a duplicate interaction with CO_2 emissions due to dark respiration of plants (Bunce 2001). Doubts associated with the potential for some original experimental artifacts that may overlook the possibility of occurrence of dark CO_2 fixation

processes, which depends on the concentration of CO_2, have been expressed. Villar et al. (1995) concluded that in light and respiration in darkness are tightly coupled, with variation in respiration in darkness accounting for more than 60% of the variation in respiration in the light.

8.1.3 CO_2 Concentration

Carbon dioxide is a gas essential to life on the earth's surface even though it could be lethal for life if it is concentrated in high quantities in the atmosphere. De Lary et al. (2012) reported the impact of CO_2 concentration in the air for humans. Their conclusions show the influence on breathing as a function of the concentration and duration of exposure. A number of studies on the effect of exposure to CO_2 on respiration show hazardous levels of CO_2 concentration in the air for humans:

- 2–3% – Unnoticed, but can be marked with exertion more than usual and shortness of breath.
- 3–5% – Breathing becomes deeper and faster when resting.
- 5% – Breathing becomes draining, headaches, sweating, and depression.
- 7.5% – Rapid breathing, increased heart rate, headache, sweating, dizziness, muscle weakness, decreased mental ability, drowsiness, and ringing in the ears.
- 8–15% – Vertigo, vomiting, loss of consciousness, and the possibility of death if oxygen intake is not promptly obtained.
- 10% – Respiratory suppression occurred very rapidly continues with the loss of consciousness within 10–15 minutes.
- $>$ 25% – Shock occured and loss of consciousness occurs quickly after breathing a minute fraction.

Research published in the journal ASHRAE recommends that CO_2 level is maintained below 1000 ppm for living spaces. Schell and Int-Hout (2001) indicate that the effect of the increase in CO_2 levels in adult humans in good health can be summarized as follows:

- Normal outdoor level: 350–450 ppm
- Acceptable levels: $<$600 ppm
- Complaints of stiffness and odors: 600–1000 ppm
- General drowsiness: 1000–2500 ppm
- Adverse health effects expected: 2500–5000 ppm
- The maximum allowed concentration within 8 h working period: 5000 ppm
- Slight intoxication, increase in breathing and pulse rate, nausea: 30,000 ppm
- Above plus headache and sight impairment: 50,000 ppm
- Unconsciousness, further exposure will lead to death: 100,000 ppm

8.2 Methodology

High-density urban areas are characterized by deep and narrow canyons. Vegetation may be planted along the streets and street walls, such as pots and shrubs. Sensible ambient air quality is affected by these factors, which are selected as research variables. Soil cover and wall materials are overlooked due to the consideration of the entire area as having similar characteristics, i.e., pavement and brick wall. The dependent variable in this study is CO_2 concentration in the ambient air, while independent variables are vegetation density and urban canyon ratio.

8.2.1 Collecting Data

Vegetation density was obtained from the ratio of green vegetation volume and urban canyon volume. The urban canyon ratio is calculated from the width of the street divided by the height of the walls (both in metres). Location for measuring the CO_2 concentration considered the Standar Nasional Indonesia, SNI 197119.6-2005: Siting Sampling test ambient air quality monitoring, which is as follows:

1. In determining the location of sampling test, the data obtained should represent the area being monitored.
2. Avoid locations directly influenced by anthropogenic sources of CO_2 emissions (e.g., doors or windows positioned directly onto the kitchen) and locations where people gather and smoke, and keep away from highways, approximately 15 m from the source of emissions.
3. Probe held up at a height above the adult human head, 3 meters.

There are 24 measurement locations used in this study, each of them having variabilities in urban canyon ratio and vegetation density. CO_2 concentration measurements were carried out at daytime (11–12.00 am) and nighttime (10–11.00 pm). Both were performed in Ramadlan month (fasting month), when cooking (housing anthropogenic emission source) is minimum. CO_2 concentration measurement was made using CO_2 Probe Multinorm. The variability of the urban canyon and the vegetation density were measured using a laser distance meter (Fig. 8.1).

8.2.2 Regression Analysis

Statistical regression analysis is a method to determine the relationship between one variable with other variables. Regression analysis is also used to understand how independent variables are associated with the dependent variables and the relationship pattern. Further, it can be used to make predictions and forecasts. In doing

Fig. 8.1 Map of sample locations (*left*) and multinorm with CO_2 Probe (*right*)

regression analysis, the requirements that must be fulfilled include the following: variables are correlated using a linear regression and variations in the dependent variable data are strongly tied to data variation-dependent variable (Hartono 2008). To ensure linear relationships between the dependent variable (CO_2 concentration) and the independent variables (urban canyon ratio and vegetation density), tests were undertaken through scatterplot diagrams combined with ordinary least square (OLS) method. Visually this is seen as the sum of squared vertical distances between each data point in the set and the corresponding point on the regression line – the smaller the differences, the better the model fits the data. The resulting estimator can be expressed by a model of two predictors in the formula:

$$\hat{Y} = a + b_1 X_1 + b_2 X_2$$

When variable linearity has been proven, the assessment continues with a comparative analysis through multivariable analysis technique, ANOVA (analysis of variance). Comparative analysis techniques using a "t" test to determine if there is a significant difference of two means is only effective if the number of variables is only two. However, in this study the number of variables is three (two independent variables and the dependent variable); therefore the technique of comparative analysis ANOVA was utilized. There are two types of ANOVA which are both used in this study. ANOVA is used to identify the significance of the correlation between the urban canyon and the vegetation density ratio (simultaneously) to the CO_2 concentration. If it does not show a significant correlation, it is followed by one-way ANOVA to measure the significance of the partial correlation of independent variables to CO_2 concentration. Conditions used in this study include ANOVA

analysis of degree of freedom (df) and probability, both making reference to the values in F tables and t tables:

Probability: 5% and df: 23, then t table = 2.0686
Probability: 1% and df: 23, then t table = 2.8073
Probability: 5%, df1: 2, df2: 21, then F table = 3.4668
Probability: 5%, df1: 1, df2: 22, then F table = 4.3009

8.3 Results and Discussion

8.3.1 Urban Space Character and CO_2 Concentration

Kampung Glintung has dense vegetation, near Malang city center, covering an area of 43.538 m^2. As a "kampung" (urban housing) that has existed since the early development of the city, Kampung Glintung grew as urban high-density housing for 88 households or about 440 people, occupied by various age groups. It was a slum, but nowadays, it has been cleaned up and promoted as a best practices for greening programs. Independently, the community began to learn cultivation of vegetable crops and food crops. Under the guidance of BPTP East Java Province Government, many technologies have been applied, from the conventional way on land and in pots/polybags to a hydroponics system. Citizens select and apply the most appropriate techniques to their respective capabilities. The three photos in Fig. 8.2 show the condition of Kampung Glintung.

Public space is formed as a narrow road, large enough for walking, with a width of 1–2 m. The space forms a narrow street canyon defined by high walls on both sides. The presence of plants along the village road brings freshness, beauty, and a cool atmosphere in the middle of the narrow urban space. Urban canyon ratio (H/W) varies between 1.00 in the emptiest space and 9.20 for the deepest canyon, with an average of 3.85 canyon ratio. Vegetation densities are very diverse, depending on the preferences of citizens to plant, ranging from 0.50 to 56.20% and 23.51% in average (Table 8.1).

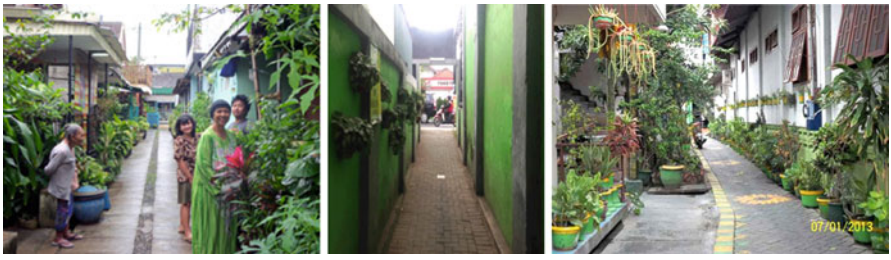

Fig. 8.2 Dense urban spaces in Kampung Glintung

Table 8.1 Urban canyon, vegetation, and CO_2 concentration measured at 24 sample locations

Sample location (CO_2 measurement)	Urban canyon ratio	Vegetation density (%)	CO_2 concentration (ppm)	
			Daytime	Nighttime
1	2.70	7.10	597	575
2	1.00	21.30	574	578
3	4.00	6.30	576	577
4	3.10	9.60	502	573
5	4.50	2.00	590	590
6	3.80	0.50	571	574
7	2.50	11.80	487	577
8	1.60	18.40	487	579
9	3.30	31.60	514	590
10	5.00	56.20	508	577
11	2.60	33.20	519	574
12	2.00	35.00	524	587
13	2.30	32.00	519	585
14	4.10	30.30	590	572
15	4.40	35.30	506	595
16	2.70	41.20	487	572
17	3.00	11.90	494	577
18	4.00	2.20	513	602
19	3.60	44.40	563	573
20	3.80	38.50	523	602
21	9.20	7.90	585	615
22	3.00	0.20	573	570
23	7.50	46.80	500	615
24	8.70	40.60	505	579

The CO_2 concentration was measured at 24 points, at the same location as the measurements of character and urban canyon vegetation. The CO_2 concentration at daytime was in the 487–597 ppm range. This concentration level is within acceptable levels for human health. Concentration levels at nighttime in most observed locations show fluctuations (572–615 ppm). Point location "23" had the highest increase, up to 115 ppm. On the other hand, point location "1" has decreased by 22 ppm. Nevertheless, most points increased in CO_2 concentrations by an average of 50 ppm.

8.3.2 Regression CO_2 Concentration Daytime

Scatterplots of CO_2 and measurements of space characteristic data show that CO_2 concentration figures at daytime correlate with the urban canyon ratio and

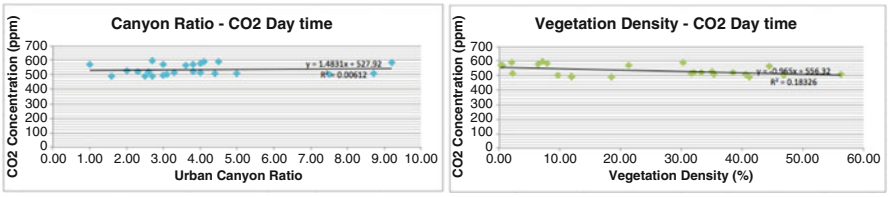

Fig. 8.3 Correlation of CO_2 concentration to dependent variables at daytime

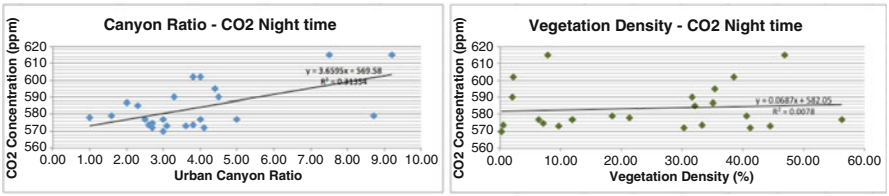

Fig. 8.4 Correlation of CO_2 concentration to dependent variables at nighttime

vegetation density; it is seen that the R^2 value is still greater than zero (0). However, this correlation is weak, especially between CO_2 concentration and urban canyon ratio in the daytime ($R^2 = 0.00612$). CO_2 correlation with R^2 vegetation density at daytime is seen to be better than urban canyon ratio ($R^2 = 0.18362$). Thus, two variables, urban canyon ratio and the vegetation density, may partially contribute to CO_2 concentration level at daytime (Figs. 8.3 and 8.4).

Regression statistics showed that the Multiple R and R-squared (0.45 and 0.20) value is greater than zero (0), which means that variables of urban canyon ratio and vegetation density simultaneously have an influence on the variety of CO_2 levels overall sample locations. This attachment shows a very convincing standard error (35.9%) which is far below the standard error that is used in the calculation (95.0%) (Table 8.2).

The validity of the regression model was tested by comparing F with F table. ANOVA F calculated results in the table above amounted to 2.7104 which is smaller than the corresponding value in the F table (3.4668). Fo < Ftab indicate that urban canyon vegetation density ratio and simultaneously provide no significant effect on the variation of CO_2 concentration level at daytime. To know more details of variables which do not contribute significantly, testing was done again partially, through one-way ANOVA (Table 8.3).

Analysis using one-way ANOVA between urban canyon CO_2 concentration ratio and daytime produced F (0.1354) smaller than the F table (4.3009) in a 5% probability. Similarly significance F (0.71) is greater than the probability (12.05),

Table 8.2 ANOVA result for CO_2 concentration daytime

Regression statistics					
Multiple R					0.452965418
R square					0.20517767
Adjusted R square					0.129480306
Standard error					35.95371614
Observations					24
	df	SS	MS	*F*	Significance F
Regression	2	7007.56121	3503.780605	2.710499514	0.08970892
Residual	21	27146.06379	1292.669704		
Total	23	34153.625			

Table 8.3 ANOVA result between urban canyon ratio and CO_2 concentration daytime

	df	SS	MS	*F*	Significance F
Regression	1	209.0372738	209.0372738	0.135480214	0.716334088
Residual	22	33944.58773	1542.935806		
Total	23	34153.625			

which means the urban canyon ratio does not give a significant impact on the variation in the level of CO_2 concentration at daytime (Table 8.4).

One-way ANOVA analysis between vegetation density and CO_2 concentration at daytime generates F equal to 4.9362. This figure is greater than the F table 8.3009, meaning that the vegetation density has a significant influence for a variety of numbers of daytime CO_2 concentrations. The t-test also showed that t stat (2.221) is greater than t table (2.068) and that the p-value (0.036) is smaller than the probability of 5% (0.05), reinforcing the notion that the vegetation density significantly influences variations of CO_2 concentrations at daytime. The t statistic is negative (−), meaning the vegetation density has the reverse effect: the higher the vegetation density, the lower the concentration of CO_2 at daytime. The regression model could be used to predict the concentration of CO_2 at daytime as follows:

$$\hat{Y} = 556.3 - 0.965X_{vd}$$

where

$\hat{Y}$: CO_2 concentration daytime (ppm)
X_{vd}: vegetation density (%)

Table 8.4 One-way ANOVA result between vegetation density and CO_2 concentration daytime

	df	SS	MS	*F*	Significance F
Regression	1	6258.931205	6258.931205	4.936296756	0.036896709
Residual	22	27894.6938	1267.940627		
Total	23	34153.625			

	Coefficients	Standard error	*t* Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	556.315	12.535	44.380	5.050E-23	530.318	582.311	530.318	582.3112162
Vegetation density	−0.965	0.434	−2.221	0.036	−1.865	−0.064	−1.865	−0.064241994

8.3.3 Regression CO_2 Concentration Nighttime

Scatterplots of CO_2 and measurements of space character data show the village space character variation of CO_2 concentration at nighttime correlated with urban canyon ratio and the vegetation density. This is evident from the value of R^2 which is still greater than zero (0). As for the independent variable correlation with CO_2 concentration at nighttime, the correlation is weak, particularly between the CO_2 concentration and vegetation density ($R^2 = 0.0078$). CO_2 correlation with canyon ratio had better linearity than the vegetation density ($R^2 = 0.31354$). Thus, two variables, urban canyon and the vegetation density ratio, may partially contribute to CO_2 concentration levels of nighttime.

Regression statistics show the results of ANOVA Multiple R and R-squared (0:55 and 0:31) value is greater than zero, which means that variables urban canyon ratio and vegetation density ratio, simultaneously, have a correlation with a variety of levels of CO_2 concentration over all sample locations. These relationships have a very convincing standard error (11.5%) which is far below the standard error that is set in the calculation (95.0%) (Table 8.5).

Comparison of the F from the ANOVA with the F table was conducted to find out the significance of the regression model. The ANOVA results F calculated in Table 8.5 amounted to 4.7959 which is greater than the F table (3.4668). This indicates that the urban canyon ratio and vegetation density, simultaneously, provide a significant influence on a variety of numbers of nighttime CO_2 concentrations. T test also showed that t stat of the canyon ratio (3.0582) is still greater than t table (2.068). However this is not the same with t for vegetation density

Table 8.5 ANOVA result for CO_2 concentration nighttime

Regression statistics							
Multiple R							0.559949949
R square							0.313543945
Adjusted R square							0.248167178
Standard error							11.51924672
Observations							24
	df	SS	MS	*F*			Significance F
Regression	2	1272.779387	636.3896937	4.79595365			0.019250135
Residual	21	2786.553946	132.693045				
Total	23	4059.333333					
	Coefficients	Standard Error	*t* Stat	*P*-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	569.5853	5.7499	99.0597	1.56E-29	557.627	581.542	557.627	581.542
Canyon ratio	3.6600	1.1967	3.0582	0.00596	1.171	6.148	1.171	6.148
Vegetation density	−0.0004	0.1423	−0.0029	0.99764	−0.296	0.295	−0.296	0.295

(0.0029) which is much smaller than the t table. Test p-values for the urban canyon ratio (0.005) are smaller than the 5% probability (0.05), and the *p*-value for vegetation density is larger than the 5% probability. Thus vegetation density is not a significant influence of CO_2 at nighttime, but its presence together with urban canyon ratio does not spoil the F significance and does not undermine the validity of regression model. T stat for vegetation is negative (−), which means that vegetation density also has a reverse effect on CO_2 concentrations at nighttime. Regression model is used to predict the CO_2 concentration at nighttime provides the following formula:

$$\hat{Y} = 569.6 + 3.6X_{uc} - 0.0004X_{vd}$$

where:

$\hat{Y}$: CO_2 concentration nighttime (ppm)
X_{uc}: urban canyon ratio (H/W)
X_{vd}: vegetation density (%)

8.4 Conclusion

This research was conducted on Kampung Glintung in Malang City Indonesia, a high-density urban housing area or "kampung." Statistical analysis was run for 24 measured locations' sample data. Urban canyon ratio and vegetation densities are positioned as independent variables to find out how strong their contribution is to the level of CO_2 concentration at daytime and nighttime (dependent variable). At 24 sample locations, urban canyon ratio (H/W) varies between 1.00 for the widest space and 9.20 for the deepest canyon. Vegetation density is diverse in the range 0.50–56.20%. CO_2 concentration at daytime ranged between 487 and 597 ppm and 572 and 615 ppm at nighttime. To understand the relations of urban canyon and vegetation to the concentration of CO_2, correlation and regression methods were used, using ordinary least squares (OLS) and analysis of variance (ANOVA):

1. OLS results indicate that CO_2 concentration levels at daytime and nighttime are scattered linearly with urban canyon ratio and vegetation densities values. Partially, they could be contributors to CO_2 concentration flux.
2. ANOVA analysis on CO_2 concentration at daytime shows that urban canyon ratio and vegetation density, collectively, give no significant contribution to CO_2 concentration flux. If we eliminate urban canyon ratio from the regression model, vegetation density has a trusted significant effect (partially) for decreasing CO_2 concentrations in dense urban housing at daytime. However this is not too high compared with the intercept factor (other variables that are not examined in this research).

3. ANOVA analysis on CO_2 concentration at nighttime shows that urban canyon ratio and vegetation density, collectively, give a significant contribution to CO_2 concentration flux. Urban canyon ratio has the most significant role in regression model. Meanwhile, vegetation density has weak significance, but it doesn't undermine regression model confidence. Therefore, we could define that urban canyon and vegetation, together, bring significant effect to CO_2 concentration in high-density urban housing at nighttime.
4. Lastly, the presence of vegetation inside dense urban housing is not proven to worsen air quality. Evidently, the high ratio of urban canyon is a variable which has a detrimental effect on high CO_2 concentration in dense urban housing at nighttime.

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Chapter 9
The Framework of Sustainable Temporary Public Open Space Concept (Case Study: Paseban Kampung, Jakarta, Indonesia)

Siti Sujatini

Abstract Population development and growth have triggered the need for public space. Unfortunately, the existence of public open space is increasingly neglected. Limited land also triggers the use of public open space for various activities depending on the need of the users who use the open space interchangeably. This type of open space is called temporary public open space. There have been many studies examining public space, where writers have focused on the presence of public space in the open space in their city for various activities. The phenomenon of the presence of temporary public open space is viewed from production space theory and the perspective of environmental science towards sustainability. The phenomenon of temporary public space in the city of Kampung Paseban is one example that has provided a larger negative impact than positive impact, resulting in exceeding the environmental capacity. The purpose of this research is to develop a framework of a sustainable temporary public open space concept that will not disturb the balance of ecological, social and economic aspects. This research applies qualitative methods, i.e. to understand the phenomenon in the field comprehensively by conducting observations and interviews with local people about the presence of temporary public open space. The results of this research indicate that the presence of temporary public open space is essential and is influenced by people's use of time and behaviour. To implement a sustainable temporary public open space, community empowerment is needed using cooperation between the public sector, private sector and community. A recommendation from this research is that the developed conceptual framework needs to be quantitatively analysed with SEM, to determine the influence of the involved variables.

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9.1 Introduction

Urban growth and development should be followed by a requirement or pressure on open space, since open space is an integral part of urban areas. Public open space is an open space that is accessible to the general public. Public space possesses three characteristics, i.e. it should be responsive, democratic and meaningful. Responsive means that the space can be used for various activities and broad interests. Democratic means that the public space can be used by the general public from various social, economic and cultural backgrounds and is accessible to various human physical conditions, whereas meaningful means the public space should have links between the man, space and world within the social context.

The challenges to be overcome because of urbanization include the occurrence of environmental problems while balancing aspects of ecology, social and economic (Tjahjati et al. 2011) (Golden et al. 2015).

The inclusion of personal interest into the public space can result in public space not being effective or not fun anymore if used by everyone. One example of the inclusion of the needs of the private into public open space is the presence of the informal markets or informal economic activities, such as the presence of street vendors or hawkers in public spaces.

The presence of urban public space in Indonesia has been more and more neglected by decision-makers and practitioners of regional spatial planning, so this vital space is decreasing. Public space that has become a place of public interactions, such as sporting fields, urban parks, recreational areas and art areas, has been disappearing and replaced by shopping malls, shopping centres and shops (Buletin Tata Ruang 2010). A lot of public spaces tend to be used as parking spaces and tourism and trade activities. Furthermore, various places in urban areas have been opened for the public and have come to be perceived as public property, such as restaurants, museums, libraries and movie theatres. These places hold important and significant roles. In a similar way as shopping centres which focus on trade, restaurants have their own specific function and operating hours limited by their own regulations.

Public open space is a public space where the community performs routine and functional activities which bind a community, whether it is a normal routine from daily lives or a periodic ceremony (Carr et al. 1992). Along with the development of the times, public open space then has a function as a place for meeting, gathering and social interaction, for religious, trade or governmental purposes. The presence of a public open space in an area of the city centre is vital since it is capable of improving the quality of urban life from the point of view of environment, community or city through spatial utilization that provides benefits such as sport, recreation and green open space. In developing public open space in the urban context, influential factors within it should be taken into consideration. As a public open space, its spatial utilization characteristics should be known in order to create an outer space responsive to the needs of the society.

Perceived from its function, public open space can be categorized into vehicle circulation space (freeway, artery road, etc.), public open space in commercial

centres (parking area, plaza and mall), open public space of industrial areas and commemorative open public space (Carr et al. 1992). Public open space is a space intended for public interests, and it is a way for the society to rediscover their humanitarian space. However, in certain cases, public open space tends to be neglected as a result of the complexity in urban spatial planning. However, not in all cases can strategies and facts be disentangled to find their causes. This might occur as a result of the incorrect selection of the approximation method.

High population growth as a result of urbanization has created problems for major urban areas in Indonesia. High urban population and its ever-growing numbers have had high impact on the pressure on urban spatial utilization which has resulted in the limitation of open spaces. This phenomenon occurs in Jakarta city of Kampung. Jakarta as the nation capital with the highest population in Indonesia has public open spaces accounting for approximately 10% of the total area or more or less 6874.06 ha which means that Jakarta is experiencing a 20% deficit of public open space according to Law Number 26 (2007) on Spatial Planning which states that each city in its regional spatial plan should allocate at least 30% of its area for public open space. This minimum condition is reflected in the social activities in some major cities in Indonesia such as Jakarta. Public space deficit in the form of playing parks and sporting fields can be perceived from children playing soccer, cycling or playing kites on the road median strip, under the flyover or on the river bank. This is the result of the lack of playing fields in their neighbourhood. The shift of land function or the disappearance of the function of public open space will cause more serious problems in the future.

A lot of public spaces have been utilized for private purposes with a reason that public space is a common space that can be utilized by anybody free of charge, so that many public spaces are no longer accessible to general public. The shift in this function of public space has reduced the presence of public space. This also happens in the city of Kampung, so that the community in city of Kampung utilizes the existing open space for various activities to fulfil their daily needs. This has damaged the environment from economic, ecology and social point of views. Paseban Kampung is one of the city of Kampungs in Jakarta in which this phenomenon has occurred as mentioned.

9.2 Literature Review

9.2.1 Public Open Space

Public open space is an open space that can be in the form of green or non-green area and can be used by anybody free of charge, regardless of time, and is located outside of a building (Carr et al. 1992). The function of an open space is for social interaction, relaxing and leisure. It is strategically located and can be in the form of a park, plaza, road or open area on the side of the road (Carmona et al. 2006).

9.2.2 Sustainable Development

Environmental problems occur as a result of a holistic and complex gap between phenomenon in the field and what is expected based on the existing theory. Environmental problems considered here are associated with the presence of temporary public open space that has caused environmental damage. As a consequence, the presence of a sustainable temporary public open space is needed, both at the present time and in the future; the presence of this temporary public open space should ensure that it does not disturb the balance of environment.

Sustainability in this context deals with three aspects, i.e. economy (increasing income and treating poor people as subject and not object), social (job opportunities) and ecology (healthy neighbourhoods) (Rogers et al. 2008).

According to Fig. 9.1, to retain existing resources, sustainable development must be achieved. Sustainable development should be taken into consideration in every construction activity which includes protecting the environment (environmental protection), increasing potential elements of the society in order to create a strong and independent society (society development) and harmonizing well-being through increase in income that will create a strong and independent community (economic development). The spatial framework used to represent social, economic and physical values should include stakeholders' views in finding solutions. It has also been argued that 'civic engagement' is essential for a resolution in the issue of sustainability (Miller 2004).

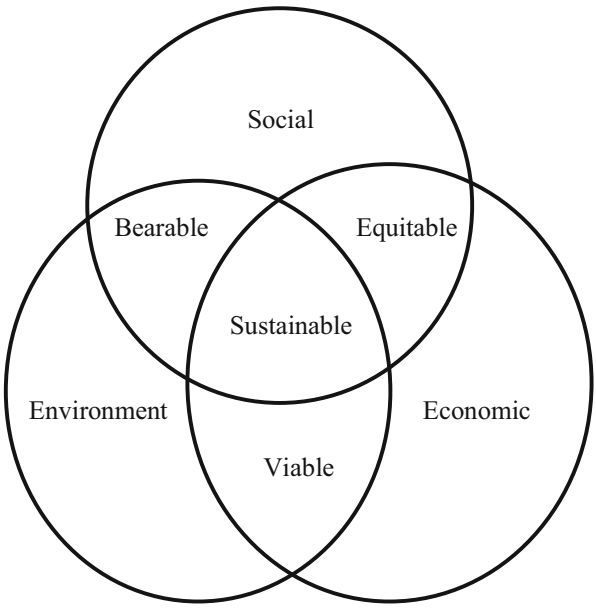

Fig. 9.1 Sustainable development scheme

9.2.3 *Theory of Space Reproduction (Lefebvre 1991) and Theory of Third Space (Soja 1996)*

Space and time are inseparable from the perspective of planning. Changes in time will form a new spatial architecture. The author argues that place is a space that has a meaning for someone. Space is unlimited, place is limited and the formation of place needs time. Time and human behaviour affect the function of a place. Human needs on place vary, depending on social, cultural, economical, political, demographical and geographical aspects, etc. (Lefebvre 1991).

The 'third space' is a space formed as a product of space reproduction (lived space), i.e. a product of a combination process between perceived and conceived space (concept of space as a place) (Soja 1996).

9.2.4 *Temporary Public Open Space*

Temporary public open space is an open space that occurs as a product of social interaction and community needs along with the passing of time (Carmona et al. 2006). Temporary public open space is called the third space – a space formed as a product of space reproduction (lived space), i.e. a product of a combination process between perceived and conceived space (concept of space as a place). This idea is one approach within view, to understand a spatial system as well as provide opportunities as possible methods, on how the world is depicted, mapped and displayed. Based on Foucault's approach and an understanding of the nature of dismantling the dichotomy space, this framework is used to explore the corners of the city of Los Angeles. The idea of the third space in the urban context gives more attention to the definition of a space into a place (place making) for a given society. Spatiality is the result of community social relationships which become style-forming social life. Meaning space is a medium of social life and products (Soja 1996). According to researchers, public temporary open space is public room which is present in open space, present because of social interaction and needs of society at any time in line with the passing of time.

9.2.5 *Human Behaviour*

The community in the city of Kampung tends to make the function of public and private spaces unclear. Then, the space territory is divided into three groups, i.e. primary, secondary and tertiary (Marcella 2004).

9.2.6 *Community Empowerment*

Empowerment means to make something empowered or have power. Community empowerment is expected to guarantee the sustainability of the utilization of temporary public open space. The main approximation in the empowerment concept is that community will not become the object of various development projects, but rather they will be the subject of the development process itself. The cooperation between the government and private sector and corporate social responsibility (CSR) are two schemes of financing with different characteristics but with the same objectives, i.e. to improve community welfare. Cooperation between the government and private sector is one of the financing schemes mostly relied on by developed as well as developing countries (Sumodiningrat 2002).

From the various definitions mentioned above, a conclusion can be made that community empowerment is an effort to enable and to make the community self-sufficient or in other words how to enable the community to help themselves.

9.3 Method

The analysis of journal articles and theories related to environmental science and the topic of temporary public open space has been utilized by the author to produce the framework of sustainable temporary public open space concept. The research methodology applied a qualitative approach, understanding the phenomena that occur in the field in a comprehensive manner by means of observation and interviews with local residents about the presence of temporary public open space. Based on some literature and the related public space and environmental sciences, as well as a result of observation and interviews, the framework was then built to examine temporary public open space using sustainability concepts, as required for the present time and in the future as well.

9.4 Results and Discussion

Paseban Kampung is located in Central Jakarta. Paseban Kampung is an area of settlement, trade and office, with a population of 29,227, population density of 532 people/ha and a broad area of 57.1 ha (2013). 2007–2013 showed an average increase of 18.66% in population; population growth is expected to be very significant, so in recent years the need for land has become very urgent; because of this, land for public space has been neglected; and the public open space that is available cannot function as public space again.

The focus of this study is the presence of temporary public open space in Paseban Kampung, Senen, Central Jakarta. As a result of growth, land has become

expensive, and public space which is available is not functioning as a public space again. Kampung kota is a village located in the large, high population density, with bad house quality and environment. Paseban area, Senen, Central Jakarta, was selected purposively as the research site with consideration as follows:

- Population growth continues to rise, and population density now is 531 persons per hectare.
- Researchers held counselling and research associated with public space and obtained problems associated with public space. Researchers obtained information about house growth and simple and healthy environment in the location and problems experienced that were related to the need for public open space (2010).
- Researchers held research with the aim to influence participation and identify the social typologies of the healthy and environmentally sound settlement growth, in Paseban, Jakarta, identifying that public participation was needed to achieve this (2011).
- Researchers held research with the aim to analyse the needs for public space in terms of behaviour in Paseban, Senen, Central Jakarta (2012), and showed how behaviour in using public open spaces for various activities could be increased.

As shown in Fig. 9.2, the boundaries of Paseban Kampung are as follows: the north is Kramat area, the south is Palmerah area, the east is Johar Baru di Rawasari area, and the south is Kenari area.

As shown in Fig. 9.3, Paseban Kampung has only one available open space in the form of a badminton sports field, located in front of a kindergarten, and this is used not only for exercise but also for other activities such as selling and social

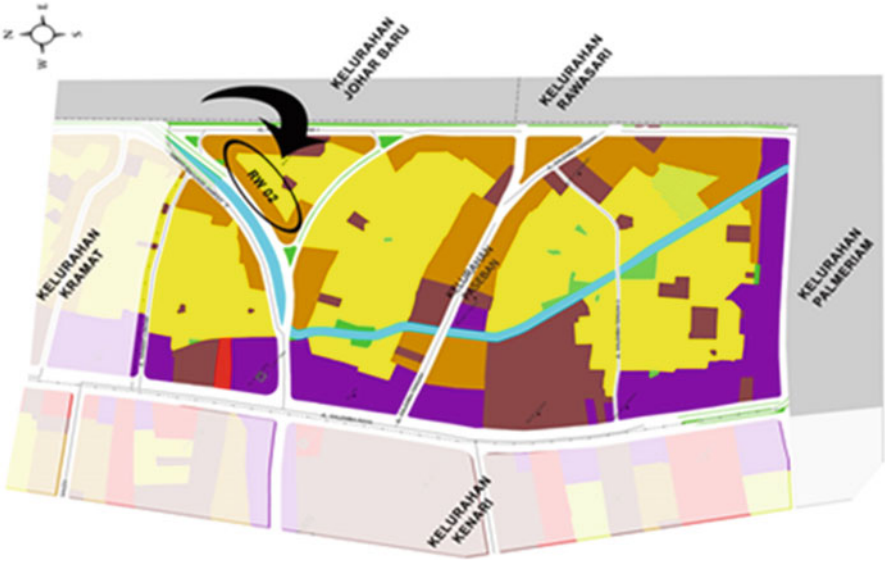

Fig. 9.2 The administrative boundaries of areas Paseban, Jakarta, Indonesia

Fig. 9.3 Land use as public space in Paseban (*Source*: Processed by the author)

interaction. Some members of the public used the area for interaction, play and others; other areas such as the side of a river, the railway, a small way or alley and small sports fields were also used.

As shown in Fig. 9.4, due to the limited area of the open space, some activities were expanded to some open space areas used as a temporary basis, such as (1) the main road on the river bank or the area next to the railway track which is used for playing, buying and selling, social interaction and car park (2) roads or small alleys are used as children's playgrounds, selling area, socialization/interaction area among the neighbours, motorcycle parking and service areas and for household activities.

Characteristics of people, which include home status and income, affect the utilization of temporary public open space. Time and human characteristics affect the utilization of public open space. Community empowerment variables are considered to be able to accelerate the realization of a sustainable public open space. In this case, the participation of the community is expected to optimize the use of public open space in Paseban Kampung. In the case of Paseban Kampung, human characteristics have an effect on temporary public open space variables. Temporary public open space and community empowerment are simultaneously impacting on sustainable public open space.

As shown in Table 9.1, in the phenomenon of this temporary public open space, there is a correlation between space and time or a space that is formed in conducting daily activities related to public open space. Social interaction activities in open spaces invite interaction and activity, temporarily, and when the time duration ends, the space will return to its original function. Activities can bring the place different meanings and bring the community closer. With social network stimulation and the diversity of individual experiences, different Kampung activities can be created.

Fig. 9.4 (**a**) Street space is used as service and interaction area, (**b**) street space is used as street market, (**c**) street space is used as playing area, (**d**) street space is used for social interaction, (**e**) sport field is used as social interaction area, (**f**) sport field is used as playing area

Based on the understanding of the theory of environmental science and other theories supporting this research topic, a conceptual framework can be formulated. The background concept of this research is the presence of neglected public open space as a result of the growing city of Kampung's population density. The growing population density of the city of Kampung is also a result of the increase in urbanization. High levels of urbanization have caused environmental problems,

Table 9.1 The presence of temporary public open space on the open space in the city of Kampung, Paseban, Jakarta

Typologies of open space	Identification of the presence of temporary public open space	The impact of the presence of temporary public open space as space reproduction
The small road	Time of usage: Daily, certain times	Positive impact
	The activity taking place: Circulation of pedestrians, bicycle and motorcycle, area for socialization between neighbours, area for children's play	Diversity activities in the open space
		Accommodate all the needs of space
	Users: Occupant of the city of Kampung, citizens	Heterogeneity in diversity of social life
	The quality of public open space: The width of the road 0.80–2.00 m, pedestrian, there are no trees and no green area, much used for motorcycle parking, selling and service area	Item: The use of the area by informal sector of the economy
Sports field	Time of usage: Daily	Negative impact
	The activity taking place: Sport, interaction, selling and meeting area	Privatization of open space for private activities
	Users: Occupant of the city of Kampung, vendors	Without control and arrangement will result in environmental degradation (social conflict, noise, channel clogged, dirty)
	The quality of public space: Square of sport field 15.00 × 15.00 m^2, paving block road, there are no trees and no green area	
		The reduction of social life by informal sector of the economy
		Reduced open spaces for social life
The main road on the side of a river	Time of usage: Daily, weekend, certain time	
	The activity taking place: Interaction between neighbours, playing and parking area, circulation of cars and motorbikes	
	Users: Occupant of the city of Kampung, vendors	
	The quality of public space: The width of the road 15.00 m, paving block road, there are no trees, no seating and no green area	
The main road near the street or railway	Time of usage: Daily, weekend, certain time	
	The activity taking place: Interaction between neighbours, playing and parking area, circulation of cars and motorbikes	
	Users: Occupant of the city of Kampung, vendors	
	The quality of public space: The width of the road 15.00 m, paving block road, there are no trees, no seating and no green area	

Source: Processed by the author

so the challenge is to overcome the environmental problems from ecological, social and economical aspects. Population increases, while land area remains the same, so the presence of public open space is neglected. As a result, the inhabitants in the city of Kampung use the existing public open space for various purposes, and the space is used interchangeably according to the needs that in the end produce temporary public open space. Temporary public open space is a public open space used for various activities and is used interchangeably according to the needs, and it is temporary. The presence of this temporary open public space has some positive and negative impacts. The positive impact of this temporary public open space is its capability to accommodate all activities of the inhabitants according to the needs regardless of the limited land area.

On the other hand, the negative impacts are traffic congestion, pollution, flood, dirty facilities, inter-resident conflicts, unhealthy environment, etc. Apparently, the negative impacts are bigger than the positive impacts since negative impacts will trigger environmental damage. To prevent the presence of this temporary public open space from damaging the environment, it should be managed to make it sustainable.

This study was started from the presence of temporary public open space in the city of Kampung, as a result of the availability of land and overcrowding which is increasing, that led to the environmental capacity being exceeded. The analysis of problems was analysed using production theory of space (Lefebvre theory), and the analysis of environmental impact resulting from the production of space was analysed by sustainability theory (Roger theory).

Based on a theoretical review, the state of the art for this research required:

- Observation on the presence of temporary public open space in the city of Kampung
- Identification of the presence of temporary public open space based on the perspective of environmental science, i.e. ecology, social and economy
- Analysis to implement a sustainable temporary public open space

Temporary public open space is the product of social interactions through perceived space and conceived space processes. Space is created as a result of the needed activities which ended with the development of additional functions of open space that attracts many visitors. Here we can find the meaning of space, the production of space and the correlation between human and space. Time and human behaviour – human as inhabitants or public space users – are very influential in the presence of temporary public open space. The spaces created in the public space in the city of Kampung or temporary public open space is a space that fulfils the needs of the inhabitants to increase their income, to gather with their communities and to relax. This temporary public open space is also called the third space as in Soja's theory (1997).

An increase in income is the primary necessity so that the Kampung inhabitants can open up their business activities in front of their houses. These business activities will trigger the presence of other spaces such as social interaction with the neighbours, space for children to play and space for food vendors from outside

the city of Kampung area. Space is produced socially and formatted by the human mind (*The Production of Space* from Lefebvre). 'Produced' here means that it is a process involving a variety of works and forms. In this case, production is a social interaction that creates space with human as the actors. Space production has begun when human being has a social interaction in a similar space which then will be used by other human beings. The present space is not only a thing of the past or present, but it is also a future imagination.

Along with population growth and development, the need for space for human activities is becoming more complex, while the presence of public open space is becoming more limited. The phenomenon of temporary public open space in Paseban Kampung and other cities of Kampung can be perceived as a deviation from the real function of residential spatial plan in urban space. However, this can become a critique and input for users and planners to give meaning to public open space as a place essential for us and people surrounding us.

Observation in Paseban Kampung revealed that the community of the city of Kampung is a marginal community which still needs public open space for sport, recreation, gathering and interaction without any social, economy and gender constraints. The marginal community in this city of Kampung always increases their daily activities related to business to increase their income. This gives new understanding in the problems of the city of Kampung which are part of the city.

As time goes on, the need for space increases too, so that the presence of temporary public open space often occurs. The third space or temporary public open space appears in public space in accordance with the community perception that public space belongs to everybody and can be used according to community needs. Field observation shows that the presence of temporary public open space has produced more negative impacts than the positive ones, so that control is needed to prevent the negative impact from spreading even wider.

Then, the following aspects must be taken into consideration:

- Understand the process of the formation of practice space of Lefebvre's theory or the third space of Soja's theory in the research area.
- Sustainability and partnership among the development actors, i.e. public sector, private sector and community, are the right mechanism to achieve the goal of sustainable development.
- Partnership pattern among government, private sector and community is a concept of community empowerment in implementing sustainable temporary public open space as applied in Bandar Lampung in waste management integrally and holistically.

As shown in Fig. 9.5, variables used in the concept are human beings, time, temporary public open space, sustainable temporary public open space and community empowerment. To implement sustainable temporary public open space, community empowerment is needed using cooperation between government, private sector and community.

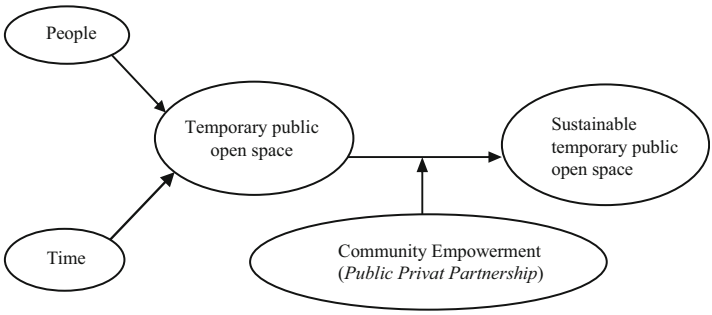

Fig. 9.5 Conceptual framework (*Source*: Processed by the author)

9.5 Conclusion

The framework for sustainable temporary public open space in the city of Kampung concept (Paseban Kampung, Jakarta) has five (5) variables: time, human behaviour, temporary public open space, sustainable temporary public open space and community empowerment. Time and human behaviour affect the presence of temporary public open space. To implement sustainable temporary public space, community empowerment is needed so that the space can accommodate community activities for the present time and in the future as well, not disturbing the balance of economic, social and ecologic aspects.

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Chapter 10
Ethnic Differences in Satisfaction with the Attractiveness of Tropical Urban Parks

Huda Farhana Mohamad Muslim, Noor Azlin Yahya, Shinya Numata, and Tetsuro Hosaka

Abstract Urban park area is a potential resource for urban populations to experience nature in cities, including tropical cities. Differences in interests among people of different ethnicities have been debated in tropical multi-ethnic countries during the early stages of outdoor recreation research. However, the extent to which ethnicity is related to satisfaction with components of urban park environments remains unclear. In this study, we investigated the satisfaction of different ethnic groups with natural components of tropical urban parks. A total of 2110 respondents from three main ethnic groups (Malay, Chinese, and Indian) were surveyed based on non-probability convenience sampling at six major urban parks in Peninsular Malaysia. Our results showed that park features and several environmental factors affected their satisfaction with the urban parks. All ethnic groups in the urban parks shared a common pattern of park use. However, there were significant differences in the effects of natural landscapes on visitor satisfaction. The necessity of having upgraded facilities in natural landscapes indirectly suggests the importance of balancing nature conservation with green spaces in urban landscape design. This study contributes to the theoretical discussion on green spaces in urban cities and balancing nature conservation with green spaces in urban landscape design.

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10.1 Introduction

Green spaces are defined as areas reserved for public gardens, public spaces, playgrounds, and recreational areas that are either openly accessible or restricted to certain parties. Green space is an important feature in urban development, and the provision of adequate green space contributes to better living environments. Green open spaces for public use benefit social, economic, environmental, health, and psychological aspects of societies (Bedimo-Rung et al. 2005; Orsega-Smith et al. 2004; Gobster 2002), and the benefits of nearby natural components, including urban parks, to communities were recently highlighted (Woolley 2003). However, disparities in environmental settings across socio-demographic groups may arise due to green space development, specifically in urban park planning and systematic management. For example, urban park accessibility may result in differences in physical activities and types of leisure pursuits among various subpopulations (i.e. different age, ethnocultural, and socioeconomic groups) (McCormack et al. 2010).

Urban parks are the most readily accessible resource for interactions with nature across ethnic groups in many urban cities, including tropical cities. A new paradigm for urban parks calls attention to the broader contribution of knowledge to park management, especially in understanding the satisfaction level of urban park users. In this study, we focused on applying this concept to urban parks in a tropical country. Individuals decide whether to use urban parks based not only on their features but also on the condition of their environments and facilities. However, existing green spaces in many cities, such as those in Malaysia, are often endangered by urban encroachment and challenged by rapid population growth and urbanisation. Furthermore, increasing infill and population density contribute to problems related to the loss of green space, increased pollution, and other challenges of urban parks. In part, due to these challenges, many people comment that urban parks have undesirable landscapes and poorly maintained facilities (e.g. Mazlina et al. 2012).

Park managers must balance the physical and social factors that fulfil park users' needs to offer a satisfying experience (Hoots and Buist 1982). Meeting these objectives is difficult, particularly in urban settings where park space is restricted, use is high, and users have diverse interests. Urban parks have been suggested to facilitate social interactions and cohesion by creating spaces for social groups to gather in urban environments (Burgess et al. 1988; Kweon et al. 1998), allowing people to feel a sense of place and belonging among other residents (Woolley 2003; Kaplan 1995; Chiesura 2004). The quality of park features affects user enjoyment indirectly, as it affects the opportunities offered to various social groups from distinctive ethnicities to gather, mingle, and interact socially. Information gained by determining park users' satisfaction, measured in terms of perceived natural and environmental quality, can be used to identify their preferred landscape within a park area (Jorgenson et al. 2002; Oku and Fukamachi 2006; Özgüner and Kendle 2006; Thompson 2002).

Research in various countries, such as Japan (Oku and Fukamachi 2006), the United Kingdom (Özgüner and Kendle 2006), China (Jim and Shan 2013), the United States (Mustafa 1994), and Malaysia (Mazlina et al. 2012; Abdul Malek and Mariapan 2009; Abdul Aziz 2012, 2014), has revealed that the relationships between individual factors (e.g. age, education, gender, race/ethnicity, personal experiences, and companions) and environmental factors (e.g. physical, cultural, and political environment) can influence park visitor satisfaction (Giles-Corti 2006). Elements of natural spaces (e.g. trees, seating, and overall attractiveness) are important attributes of urban parks that encourage people to visit, relax, and have new experiences, while allowing others to enjoy more active activities (Jorgenson et al. 2002). Therefore, the relationship between park users' activities and the environmental settings of urban parks influences social interactions. Although there is increasing interest in urban recreation areas, some visitors provide negative feedback about these areas, for example, that the area is untidy, facilities and plant maintenance are lacking, it is unsafe for women, and it is crowded at certain times (Jorgenson et al. 2002; Jim and Shan 2013). Moreover, some park users may be dissatisfied with the noise produced from urban activities, which interrupts their concentration while visiting parks. In the majority of US cities, green spaces are inadequate and ineffectively maintained in areas where minority groups are concentrated (Wolch et al. 2005). In Florida, white residents reported having more vegetative cover, tree diversity, and greater energy savings from trees, while black residents reported the lowest scores for most factors (Flocks et al. 2011). Studies have found that associations between recreational motives (e.g. relaxation, freedom, proximity to nature, and seeking happiness) and socio-demographic variables (e.g. age, gender, and education level) can influence visitor satisfaction with parks (Chiesura 2004; Home et al. 2012; Lee et al. 2002). People have various motives for visiting parks and different perceptions of their restorative benefits. In addition, individuals from different socioeconomic backgrounds have assorted needs and expectations from urban parks. Many studies have attempted to determine how to increase visitor satisfaction in parks that fail to fulfil individual expectations in order to prevent urban parks from becoming leftover spaces. However, park attendance by urban residents can only be ensured after determining the individual drivers that influence leisure behaviour and indirectly increase visitor satisfaction.

10.2 Significance of Study

Several studies have examined urban green space use and its related health benefits, as well as attitudes towards littering, physical experiences associated with social interactions, vandalism, and safety (Mazlina et al. 2012; Abdul Malek and Mariapan 2009; Abdul Aziz 2012, 2014; Flocks et al. 2011; Home et al. 2012; Lee et al. 2002; Matsuoka and Kaplan 2008). However, addressing environmental perceptions and preferences is equally important to understanding how parks in

tropical cities can better function for a diverse range of racial and ethnic groups. Many tropical countries in Southeast Asia have multi-ethnic populations. Differences in cultural and ethnic backgrounds and motives for visiting urban parks can influence visitors' aesthetic perceptions, preferences, uses, and experiences in parks (Kaplan and Talbot 1988). Studies that have evaluated landscape preferences have consistently identified cultural (Kaplan and Talbot 1988; Herzele and Wiedemann 2003; Kaplan and Herbert 1987) and ethnic (e.g. Özgüner and Kendle 2006; Kaplan and Talbot 1988; Peters et al. 2011) differences. The availability of attractive landscapes and lively parks with properly designed and maintained green spaces that can help support the cultural identity of an area, bring the community together, and foster neighbourhoods has increasingly declined, especially in urban areas.

Furthermore, relationships between the socioeconomic characteristics of individual visitors with the physical characteristics of urban parks are diverse, and these can influence the relationships between people and parks (Bedimo-Rung et al. 2005; Abdul Aziz 2012; Giles-Corti 2006; Herzele and Wiedemann 2003; Giles-Corti et al. 2005). Satisfaction with tropical urban parks may vary according to socio-demographic characteristics. The literature suggests that race is the strongest determinant of preferred recreation activities in parks and of attitudes among city residents (Payne et al. 2002). In general, the quality and condition of park features are unequal across areas of varying income and racial/ethnic composition (Suminski et al. 2012; Vaughan et al. 2013; Bruton and Floyd 2014; Kamel et al. 2014). Therefore, high-quality landscape design and management is needed to ensure the full use of parks since they are major contributors to urban environments and effective media of urban conservation. Empirical research may help to clarify the needs of communities and inform political processes to improve strategies for urban park conservation management.

10.3 Research Objectives

Several studies have focused on urban and public parks in Malaysia. However, these studies were restricted to analyses of specific age groups, small samples sizes, or specific states or regions of the country (Mazlina et al. 2012; Abdul Malek and Mariapan 2009; Abdul Aziz 2012, 2014); therefore, the results are inconclusive or not broadly applicable. This study overcomes some of these limitations, as it is based on a larger sample size. In this respect, this study may be useful for other populations in tropical regions to explain ethnic differences related to urban park research. Public spaces should be designed to attract all races and cultures and provide areas that allow for various uses. Such spaces benefit many people, and their designs can be replicated in other public parks. A major problem faced by urban designers in Malaysia is the fact that there are three major ethnic communities, Malay, Chinese, and Indian, each with its own distinct culture and traditions related to the use of public parks. However, studies on ethnic differences in tropical and multi-ethnic countries are limited. Therefore, it would be useful to examine

access to nature in urban parks from a cultural perspective in the context of a multi-ethnic country. Moreover, it is important to understand the factors that influence the use and perception of a specific urban green space before planning any physical changes (Chiesura 2004).

People with distinct socio-demographic backgrounds harbour different needs and anticipations for urban parks, and urban parks must offer positive elements to serve as vital recreation resources for the wellbeing of all urban inhabitants. Urban parks are an important resource, allowing different ethnic groups to mingle (Peters et al. 2011) and connect directly to nature (e.g. Chiesura 2004; Özgüner and Kendle 2006; Herzele and Wiedemann 2003; Jim and Chen 2006). The research area of physiological behaviour design, which is the concern of this study, relates to the design of public parks in the context of multi-ethnic societies. The goal of this research was to closely examine differences in urban park visitor satisfaction among different ethnicities in a multi-ethnic country. To address this goal, we posed three questions with respect to Malaysian urban park visitors: (1) Do people of different ethnicities have different definitions of what constitutes a satisfying interaction with nature? (2) Do environmental factors (e.g. park characteristics and physical environment) or recreation activities influence the use of urban parks? (3) If environmental factors influence the use of parks, what are the interactions among the factors?

10.4 Research Methodology

10.4.1 Study Sites

This study was conducted in central, south, north, and east Peninsular Malaysia, the four main regions in the area. We selected six main urban parks for study: Shah Alam Lake Garden (Selangor), Kuala Lumpur Botanical Garden (Kuala Lumpur), Taiping Lake Garden (Perak), Penang Municipal Park (Penang), Gelora Park (Pahang), and Mutiara Rini Urban Forest Park (Johor). Peninsular Malaysia has a typical tropical monsoon climate characterised by a sunny climate, with temperatures ranging from 23 to 32 °C (Wikipedia, https://en.wikipedia.org/wiki/Geography_of_Malaysia). Malaysia is a multi-ethnic country. The majority of people in Peninsular Malaysia are ethnic Malays, predominantly Muslim, although there are also large Chinese and Indian populations. We selected parks in each political region (north, south, east, and central Peninsular Malaysia) that receive many visitors each year, are publically accessible, and are important sources of recreational activities in their communities. The six urban parks were selected to represent the range of public parks managed by local municipal councils that are available to urban populations. In addition, the parks had natural features and seminatural (i.e. built environment) characteristics, such as green spaces, lakes, artificial ponds, playgrounds, sitting areas, football fields, and amphitheatres.

10.4.2 Questionnaire Design

We focused on the three main ethnic groups in Malaysia (Malay, Chinese, and Indian) as our respondents. Park users were questioned on their satisfaction with the attractiveness of natural elements of the park environment. First, the questionnaire asked for participants' degree of satisfaction with various natural elements. Participants responded using a 5-point scale, where 1 = not at all satisfied and 5 = extremely satisfied (Vagias 2006). The natural elements included recreation activities, attractiveness of the landscape, peacefulness, and amount of shade (Gobster 2002; Chiesura 2004; Özgüner 2011). Then, activity preferences were quantified based on closed-ended questions (yes or no) related to the preferred activities that drew the individual to that particular park, including stationary and recreational activities. The activity criteria were based on Gobster (2002) group variations in passive (stationary) and active (recreational) categories. Regardless of race or ethnicity, understanding patterns of outdoor activity participation may help address cultural differences as they relate to other pastimes.

10.4.3 Questionnaire and Interview Survey

During February to June 2013, we conducted face-to-face interviews following an eight-page structured questionnaire. Non-probability convenience sampling for the surveys was done using the structured questionnaire. The questionnaire was written in English and Malay and included questions related to the park users' trip, motives for visiting, park use patterns, satisfaction related to natural attractiveness, and the respondents' ethnicity. Other socio-demographic characteristics included in the questionnaire included the respondents' gender, age, monthly gross income (Malaysian Ringgit (MYR)), marital status, and education level. The dominant groups in the urban parks were Malay, male, youth (15–24 years old), single, and of lower income (<MYR 3000), and the majority of respondents had university and high school education levels. A total of 2139 respondents completed the interviews. However, because we only included the three main ethnicities of Malaysia (Malays, Chinese, and Indian), only 2110 responses were used for further analysis. We purposefully selected these ethnicities to identify potential differences in visitor satisfaction and ethnicity-specific characteristics. Table 10.1 shows the number of respondents and the physical environment characteristics of the study sites in this study. Descriptive and quantitative data analyses were performed using R statistical software (R ver. 3.1.2).

Table 10.1 Characteristics of the six urban parks in Peninsular Malaysia

Region	Local authority	Park	Size (ha)	[a]Distance from town (km)	Respondents ($n = 2139$)
North	Penang Municipal Council	Penang Municipal Park, Penang	70	6	352
	Taiping Municipal Council	Taiping Lake Garden, Perak	68	2	471
Central	Kuala Lumpur City Hall	Kuala Lumpur Botanical Garden	43	3	330
	Shah Alam City Council	Shah Alam Lake Garden, Selangor	72	2	321
East	Kuantan City Council	Gelora Park, Kuantan, Pahang	24	3	289
South	Johor Bahru City Council	Mutiara Rini Urban Forest Park	24	19	347

[a]Source: Actual Survey 2013 and Municipal Council 2014

10.5 Results

10.5.1 Ethnicity of Urban Park Users

Table 10.2 shows the ethnic composition of the respondents in the six urban parks. Overall, the majority of respondents were Malay (82%), but the ethnic composition ratios varied among the six parks. There were significant differences among the parks in ethnic composition; the composition ratio for the Malay group was highest in Gelora Park and lowest in Penang Park. The Chinese and Indian groups had the highest proportions in Penang Park and lowest proportions in Shah Alam Lake Garden (Chinese) and Gelora Park (Indian).

10.5.2 Urban Park Use Patterns

We categorised park use activities as either recreational (active) or stationary (passive) (Gobster 2002; Özgüner 2011). Stationary activities included leisurely routines and sightseeing, such as sitting, relaxing, taking fresh air, people-watching, talking, socialising, dating, picnicking, and barbequing. Recreational activities included more active activities, such as walking, jogging, running, bicycling, skateboarding, exercising, and other individual or group sports activities. Both stationary and recreational activities were statistically consistent across parks. Assessment of activity participation patterns in terms of user preference showed that ethnicity was not significantly related to preferred activity. However, visitors indicated that the available park elements were likely to motivate them to engage in particular activities (Table 10.3). While continuing debates focus on why such

Table 10.2 Ethnic composition of respondents in six urban parks ($n = 2110$)

Parks	Pearson's chi-squared test ($F = 227.96$, p-value <0.000)					
Ethnicity	Penang Municipal Park	Mutiara Rini Urban Forest Park	Kuala Lumpur Botanical Garden	Taiping Lake Garden	Gelora Park, Kuantan	Shah Alam Lake Garden
Malay	215 (55)	245 (84)	280 (88)	328 (83)	340 (85)	295 (94)
Chinese	137 (35)	39 (13)	28 (9)	50 (13)	51 (13)	9 (3)
Indian	39 (10)	8 (3)	9 (3)	19 (5)	9 (2)	9 (3)
Total respondents	391	292	317	397	400	313

Source: Actual Survey 2013
Note: Figures in parentheses refer to percentage value

Table 10.3 Urban park use patterns ($n = 2110$)

	Park	Ethnicity	Interaction			
Activities	F-value ($df = 5$)	p	F-value ($df = 2$)	p	F-value ($df = 10$)	p
Stationaries	29.26	<2e−16***	0.45	0.64	1.16	0.31
Recreation (physical)	29.26	<2e−16***	0.45	0.64	1.16	0.31

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

differences exist in urban settings with high demands for use, park managers should instead focus on the physical environment of parks.

The three ethnic groups shared common patterns of urban park use. However, patterns of use can be influenced by park design, as parks have unique design features and characteristics (McCormack et al. 2010), and various designs facilitate certain activities while potentially limiting others. Park size and the number of facilities were closely related to activity participation. In addition, proximity to recreational facilities and amenities appeared to influence participation in physical activity (Kaczynski and Henderson 2007). In another study following a socioecological approach (Giles-Corti 2006), environmental factors influenced visitor behaviour. For example, environmental factors such as the amount of green space, presence of facilities, and space for activities are thought to affect visitor satisfaction in urban green spaces (Bedimo-Rung et al. 2005; Herzele and Wiedemann 2003; Talbot and Kaplan 1984).

10.5.3 Differences in Satisfaction with Park Elements

We assessed visitor satisfaction with various park elements, including recreation (outdoor activities and facilities), natural landscapes (attractiveness, design, landscape and environment features, water, and vegetation), peacefulness (tranquillity,

Table 10.4 Interaction effect of park and ethnicity on satisfaction with park elements (two-way ANOVA; $n = 2110$)

Activities	Park	Ethnicity	Interaction			
	F-value ($df = 5$)	p	F-value ($df = 2$)	p	F-value ($df = 10$)	p
Recreation	33.28	$<2e-16^{***}$	0.15	0.86	0.80	0.63
Natural beauty of landscape	18.28	$<2e-16^{***}$	3.87	0.02^{*}	1.59	0.10
Peacefulness	22.84	$<2e-16^{***}$	0.23	0.79	1.12	0.34
Shady	37.44	$<2e-16^{***}$	0.23	0.79	1.13	0.34

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

crowdedness, quiet, and traffic), and amount of shade (tree cover, vegetation and plants, and green coverage). The results of a two-way analysis of variance (ANOVA) showed significant differences among the parks in all park elements and a significant difference among ethnicities in satisfaction with the landscape (Table 10.4).

There were no significant interactions between levels of satisfaction with park elements and ethnicity. Therefore, park features or other environmental factors may be primary determinants of visitor satisfaction independent of ethnicity, even though the ethnic composition of park visitors was unequal. Malay and Chinese people were shown to prefer visiting parks in the morning (Mazlina et al. 2012). Therefore, the frequency of visits might differ among ethnic groups in tropical urban parks; this should be further investigated, as it may be related to facility use at urban parks. Park characteristics are the primary determinants of visitor satisfaction, as different parks have different primary functions. Parks provide leisure space (Kaplan and Kaplan 1989), and visitors may use parks not only for their facilities but also based on their environmental characteristics and their condition.

Enhancing natural landscape features such as space, trees, water bodies, and overall attractiveness should be considered a priority, as these encourage people to visit, relax, and try new recreational activities (Gobster 2002; Kaplan and Kaplan 1989; Nasution and Zahrah 2012). One study found a difference among ethnic groups in satisfaction with the environmental settings of neighbourhood urban parks, which indirectly increased social interactions (Kaplan and Kaplan 1989). Parks should offer a pleasant space for neighbourhood residents, and satisfaction levels may vary for different natural features. A study of Kepong Metropolitan Park in Malaysia underlined the importance of using natural elements to measure differences in visitor satisfaction (Mohamed and Othman 2012). Terms that fostered visitors' becoming closer to nature were associated with certain characteristics of physical elements, such as "beautiful", "cooling", "well-maintained", and "organised" (Mohamed and Othman 2012), and were related to the value placed on the area (e.g. peaceful, quiet, and stress-relieving). In addition, visitor satisfaction influenced the maintenance and management of the park (Mohamed and Othman 2012).

10.5.4 Factors Explaining Differences in Satisfaction Among Parks

While satisfaction levels did not generally differ among the ethnic groups, suggesting that this was a less important determinant of satisfaction, there were significant differences in the satisfaction with park elements among parks, and the differences were consistent among the elements. These results indicate that the physical condition of parks might be more a more important determinant of visitor satisfaction than is visitors' ethnicity. In a previous study, there were no significant interethnic interactions in the satisfaction with the attractiveness of the natural setting among urban residents from distinct multi-ethnic backgrounds, as they valued being in parks together (Peters 2010).

Satisfaction with tropical urban parks may be influenced by other socio-demographic characteristics. For example, the similarities in satisfaction among ethnic groups in this study, especially with respect to attractiveness, should be taken as new information that seems to show an absence of conflicts in interests based on the ethnicity of park users. As important as the socio-demographic factors affecting landscape preferences were personality, gender, age, previous experience, familiarity, and the opinions of experts and non-experts (Mustafa 1994). In addition, environmental factors, such as park size, proximity, location, and frequency of use, should be considered along with safety, park features, frequency of visits (e.g. Peters 2010; Schipperijn et al. 2010; Dallimer et al. 2014), and individual factors such as age, education level, and marital status (Bedimo-Rung et al. 2005; Jim and Shan 2013; Abdul Aziz 2012; Giles-Corti 2006). These factors warrant further investigations for their influences on park visitor satisfaction.

10.6 Conclusion

In this study, we investigated differences among ethnic groups in visitor satisfaction with urban parks in Malaysia, a multi-ethnic country. In addition, we identified environmental factors that influenced the patterns of urban park use. We collected primary data via face-to-face interviews in six urban parks in Peninsular Malaysia, yielding 2110 usable responses. The following conclusions can be drawn from the results. The physical condition of the park may be more a more important determinant of park visitor satisfaction than is ethnicity. The ethnic composition of visitors, park use patterns, and satisfaction with various park elements differed significantly among the six parks. Nevertheless, there was no difference in park use patterns among the ethnic groups. Finally, there were differences in satisfaction with the urban park landscapes. Similar to other countries, Malaysians gain a sense of relaxation, quiet, and peace from green environments while using urban parks for leisurely pursuits such as picnicking, relaxing, and spending time with family. The key conditions that attracted strong satisfaction were related to the environmental

elements of the park. Visitors were most concerned with the management, landscape, design, and proper development of the parks. In addition, there were no conflicts of interest among urban inhabitants from distinct ethnic backgrounds, as they value being together (Dallimer et al. 2014) in urban parks. This study indicated that most users were similarly satisfied with park attractiveness, regardless of ethnicity. Our results indicated that ethnicity is not an important determinant of visitor satisfaction and that park managers should focus on maintaining and conserving the natural elements of parks to increase visitor satisfaction. In addition, the results highlighted the importance of satisfaction with natural beauty of landscapes in tropical urban settings. Considering the passive nature of engaging with parks, parks are vital to offering easily accessible contact with nature (Payne et al. 2002; Todorova et al. 2004). It is important that parks are designed to be suitable for passive recreational use, places where some visitors can observe nature and take in fresh air while others can pursue active recreational activities, such as using playgrounds and participating in sports. Since parks support many diverse activities, park managers should focus on their maintenance. Finally, urban park management should integrate elements of natural landscapes, such as vegetation, trees, ornamental plants, and green coverage, which contribute to the setting.

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Chapter 11
Identifying Slum Area Spread Based on Multi-temporal Imagery Data

Abdul Wahid Hasyim and Chairul Maulidi

Abstract A settlement is one of the vital necessities of human life besides food and clothing. The quantity and quality of settlements are an indicator of well-being. Moreover, at a broader scale, it is an indicator of a city's welfare. The strong attraction of a growing city generates urbanization flowing from its surrounding villages. Poor people tend to be marginalized, living crammed in frail spaces or in illegal areas such as riverbanks and the periphery. Without drainage and waste services, these settlements will be transformed into a slum area. In this study, satellite imagery analysis is applied to identify the spread of slum area more efficiently. This research is a preliminary step in determining the slum area based on geographic imagery patterns and physical characteristics of Paser Regency. The results of this study are considered to be useful as basis data for determining preventive action to manage the slum area growth in the Paser Regency. Slum-level assessment is assigned through a scoring analysis of the character of every district over slum criteria. "Temporary building criteria" is no longer relevant to Paser Regency cases according to the AHP analysis result. Muara Langon and Uko villages are categorized as villages with low slum level. This study indicates that the villages having a moderate level include Muarakomam, Uko, Busui, Songka, Batu Kajang, Sungaiterik, Klempangsari, Keluanglolo, Sempulang, Janju, Tepian Batang, Kendarom, Modang, Sandeley, Semuntai, Lombok, Pait, Longikis, Krayan Bahagia, Kayungo, Busui, Krayanjaya, Long Kali, and Sebakung villages. The villages that can be categorized as a high slum level from this study are Kuaro, Tanah Grogot, Sungai Tuak, Tanah Periuk, Padang Jaya, and Rangan villages.

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11.1 Introduction

Settlements are one of the primary needs of human life besides food and clothes. House ownership can enhance people's dignity in their social milieu. The quantity and quality of housing are a parameter of well-being, and on a greater scale, they serve as an indicator of a city's welfare.

A city's growth and its economic and social dynamics have put settlement as an economical commodity, while land resources in the urban area are very limited. Growing cities strongly attract urbanization from surrounding villages. Land demand in Indonesia's urban areas is provided through the free market mechanism, so its price increases every year and it is largely owned by the high-income community who have been the winners in land market trading. Meanwhile, people who lose in land market trading tend to be marginalized and crammed, in the periphery, even in illegal areas such as riverbanks and other restricted areas without public utility services. Then, these areas develop into a slum settlement. Therefore, city government strives with improving the quality of life and urban settlements in order to achieve a prosperous city status.

Paser Regency is located in the southern part of East Kalimantan Province. Various urban infrastructures, i.e., roads, bridges, and others, have been built to generate economic development together with aesthetical improvement in the city. Those efforts are directed to achieve the development vision of the Paser Regency, namely, "Towards a Religious, Prosperous, and Cultured Paser Regency." One of those development missions is to improve infrastructure services in reducing the development gap among districts in the regency, especially in remote areas that are particularly at risk to transform into a slum area. Referring to the vision and mission of Paser Regency, an important effort should be taken to identify slum areas in the Paser Regency.

Slum area spreading can be identified manually through field observation, but it would require a lot of time and efforts. Another way to identify slum areas efficiently is through satellite imagery processing. Therefore, this study is conducted as a preliminary step in determining slum areas based on the geographic pattern of Paser Regency. Furthermore, this study provides the basis data for determining the preventive programs needed for managing the growing slum areas in the Paser Regency.

11.2 Methodology

11.2.1 Population and Samples

The surveys covered all variables of slum identification criteria. Each variable was assigned by a measurable parameter that enabled acquisition of primary data so that identification process, either manually or computerized, could yield a significant

result, i.e., slum areas. The population of this study includes all administrative districts in the Paser Regency. Due to the limited time available, several districts were chosen as samples. There were two district groups as samples, i.e., rural district, which has agrarian character, and urban district which has non-agrarian character. Uko, Kuaro, and Long Kali villages were classified as a rural district, while districts along Kusuma Bangsa street, Noto Sunardi street, and Ahmad Yani street were characterized as an urban district.

11.2.2 Imagery Process

Satellite imagery processing was carried out on multi-temporal Landsat imagery in 7 years, between 2000 and 2014. Landsat imagery processing flowchart is shown in Fig. 11.1.

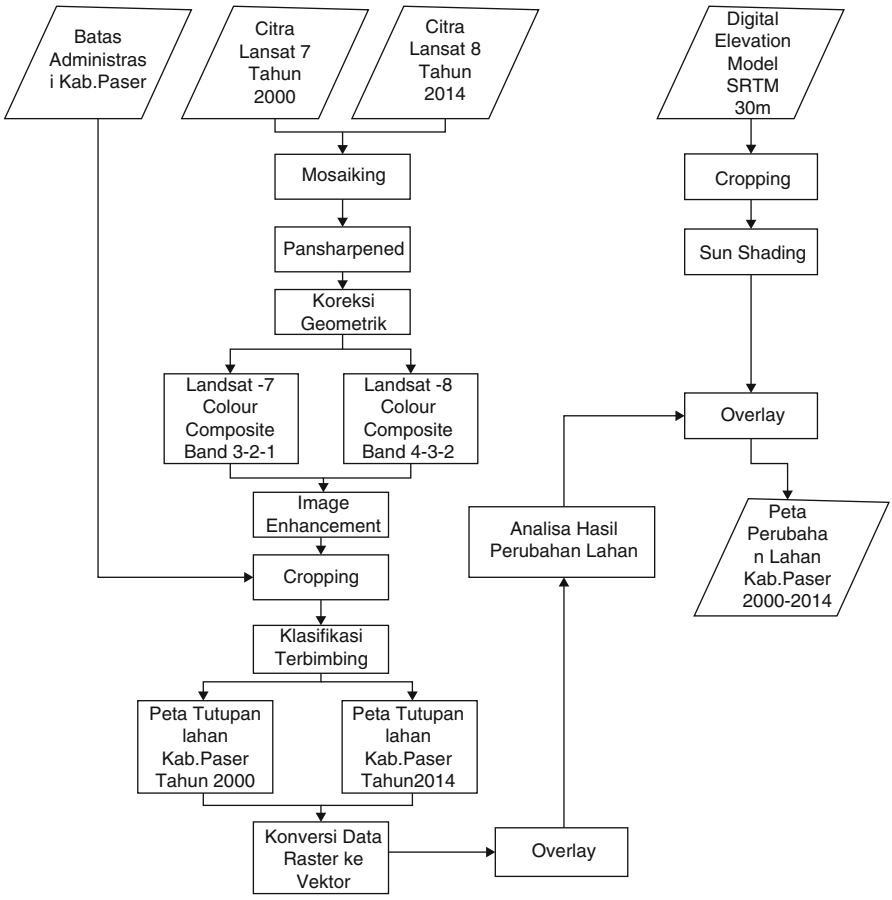

Fig. 11.1 Landsat image processing

11.2.3 Identifying Settlement Character

Settlement character was identified through field observation and walk-through technique. Settlement character data as phenomenological facts were then compared with secondary literature on traditional Borneo settlement models in order to obtain the typical characteristics of the settlement. The weight of each parameter was then categorized according to the strong or weak influence of these variables in turning an environment into a slum. The weighting process was conducted by consensus of a team of experts through the analytical hierarchical process (AHP).

11.2.4 Determining Slum Settlement

This study used a modified weighting system that can give convenience in carrying out an assessment of the criteria for determining slum areas in accordance with the character of Paser Regency. Assessment of a weighting system for each criterion is generally intended that each criterion has different influences. Furthermore, determining the weight criteria is relative and depends on the influence of each criterion in forming slum areas in Paser Regency.

The final assessment of the slum area identification was performed as the accumulation of the results of criteria calculations. The total maximum and minimum values of each variable criterion were obtained from the addition of various variables. The assessment process used a threshold which is categorized into:

- High category
- Moderate category
- Low category

The results of the assessment based on the above categories were classified by calculating the accumulation of weight that has been carried out with a simple Sturgess formula, namely:

- Calculating coefficient threshold interval (range) by subtracting the highest scores and the lowest score from the total score and then dividing it into 3 (three).
- Coefficient threshold range as a deduction from the highest score will produce a bottom limit of the highest value.
- For the next category, one point reduction to the lowest limit will produce the highest limit for medium category and so on.

11.3 Results and Discussion

11.3.1 Slum Settlement in Surveyed Districts

11.3.1.1 Rural Settlement

Rural areas in this study are the area of Paser Regency located outside the downtown area of Tanah Grogot. The surveyed sample location used in this study is the village of Uko and Kuaro (see Fig. 11.2). Uko village grows as a cluster of settlements with approximately 27 units of a wooden house. Some units are in damaged and untreated condition because they are not occupied anymore. Houses in Uko village have the form of a stilt house, with wood as the main material and asbestos or tin roof. There is a rectangular mass observed in the rear part of the building similar to traditional houses in South Kalimantan. Most of the buildings have a façade which resembles a modest contemporary house in Java Island, namely, using glass windows, and the frame of the front door window is integrated.

Settlements in the city center of Kuaro grow in a linear pattern, extending on either side of the road district. Such pattern is similar to the character of the people's occupation in the city center area, namely, in trade and services, which requires locations along the street. However, it still can be observed clearly that each city center, which plays a role as node (crowd center), is separated from each other by empty land, gardens, and/or protected forests. The growth of illegal buildings and illegal clearing of protected land are visible issues for the development of Paser Regency.

11.3.1.2 Urban Settlement

Tanah Grogot is the government and economic center of Paser Regency. It covers an area of approximately 335.58 km^2, and various urban functions and activities (nonfarming) take place in this area. Settlements in Tanah Grogot have been served by the city's public infrastructure such as clean water, electricity, telephone, and drainage.

Cable and telephone poles/electricity are lined up on the road. In some places, they look neat, but they look like a mess in other corners of the city. Each housing unit has an average width of 70 m^2, with a semi-stilt building made of wood, typical of Kalimantan buildings. Yard (open land/garden) is available in the front and on the side of the building. In many residential houses as in Mangku Kusumo street, Ikhlas alley, Padat Karya street, and Senaken street, the yard is commonly used to put away unused stuff, such as damaged chairs and cupboards, unused pieces of wood, etc. (see Fig. 11.3). There are empty lands overgrown with shrubs which become a place to hoard junk. Other unhealthy neighborhoods in urban areas are settlements in an area with a puddle and houses on stilts standing above a puddle, and there is also a terrace of a house flooded by the overflowing gutters. Drainage seems to be the problem in most urban areas of Paser Regency. Sewers are buried

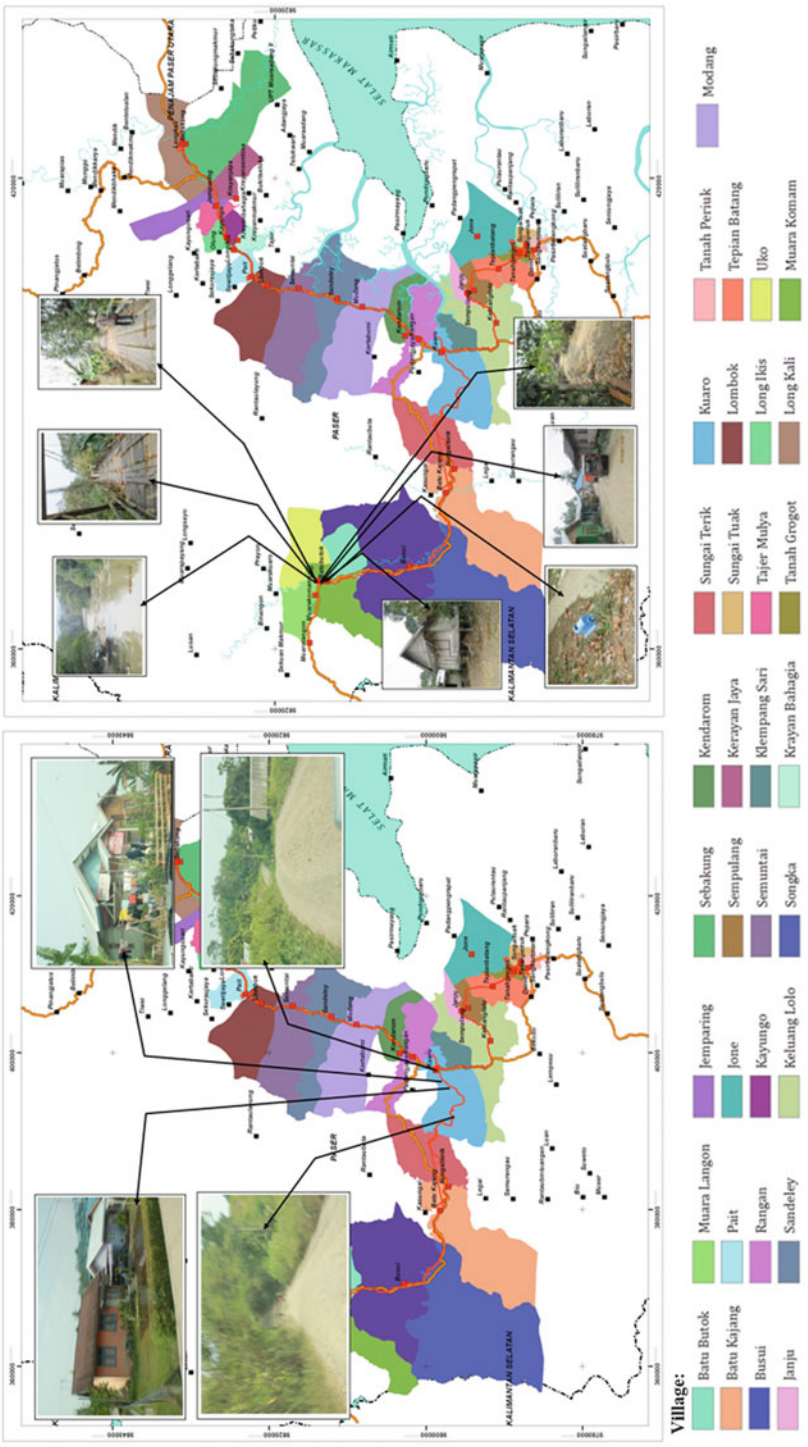

Fig. 11.2 Photo mapping in the village of Kuaro (*left*); photo mapping in the village of Uko (*right*)

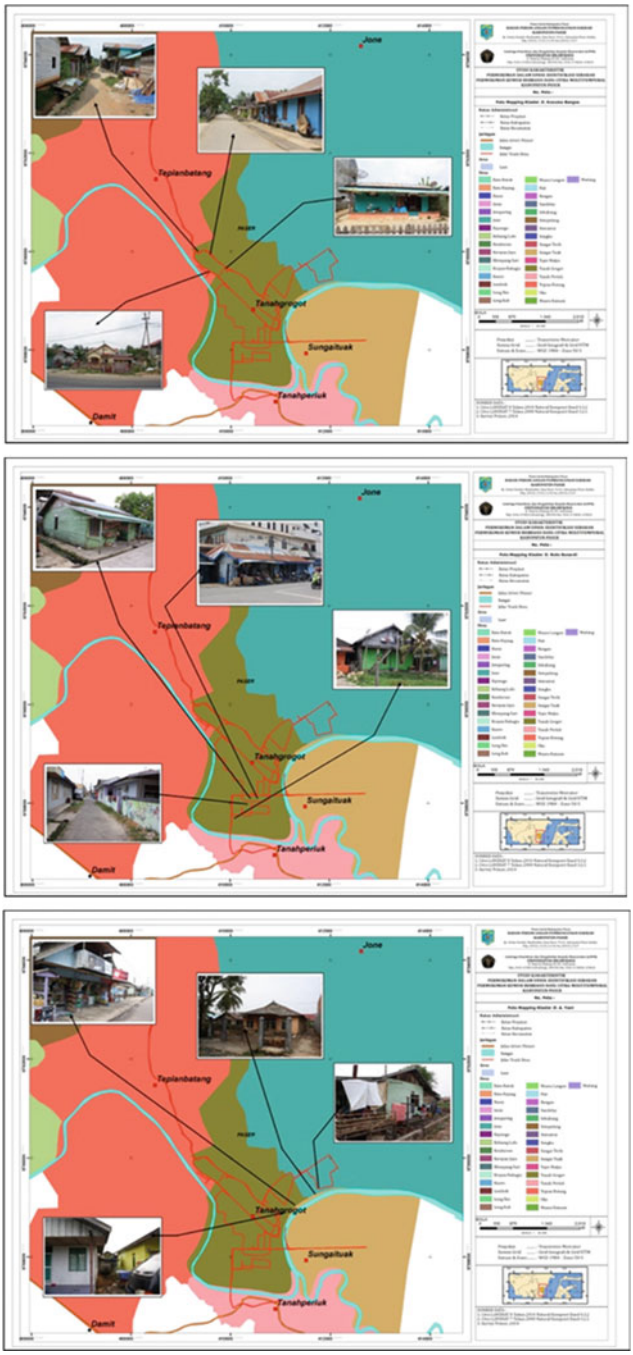

Fig. 11.3 Photo mapping in Kusuma Bangsa street (*top*); photo mapping in Noto Sunardi street (*middle*); photo mapping in Jend. A. Yani street (*bottom*)

by rubbish and sand; water is not flowing and inundating yards as in Padat Karya street. In addition to the drainage problems, piles of garbage often come into sight with puddles and overflowing sewage in the neighborhoods.

11.3.2 Slum Settlement Criteria

The character of the settlements in Paser Regency, i.e., wooden house, which is commonly categorized as a nonpermanent house, is a typical character that grows in harmony with local tradition. In some other locations such as Noto Sunardi street, wooden houses are inhabited properly and surrounded by a beautiful yard. Hence, it can be said that it is invalid if a nonpermanent house is used as an indicator of slums. This is also similar to income. Income factors are not the cause of slums in Paser settlements. Some houses seem to have a luxurious private vehicle, but the neighborhood and the house look dirty. From field observation, uninhabitable settlements at Paser Regency can be seen from the piles of garbage in the yard, yard flooded with overflowing gutters, and narrow spaces between buildings which are commonly used to hoard junk.

Slum criteria in Paser Regency are determined by the most influential indicators in creating slum neighborhoods in Paser Regency. It is conducted by using AHP analysis on the criteria mentioned in the guidelines on slum identification issued by the Ministry of Public Works. Respondents or informants chosen to fill the questionnaire are a team of experts consisting of experts in town planning, experts in city infrastructure, experts in transport planning, and experts in regional planning at the Department of Urban and Regional Planning University of Brawijaya.

Based on Table 11.1, it can be seen in the eigenvectors above that the most influential indicator in the emergence of slums is waste conditions (10.6), drainage condition (10.5), neighboring function (7.5%), and topography (7.4%). A significant weight is on the criterion "temporary building," which has eigenvectors = 0. The entire team of experts assessed that the condition of temporary buildings in Paser Regency does not affect the appearance of the slums. Therefore, based on the above consideration, the criterion "temporary building" is not used in the determination of slum areas.

11.3.3 Pattern and Spreading of Slum Settlement

Slum-level assessment is done through the scoring technique of each village situation, on the established criteria of the slum. The criterion "temporary building" is not used because based on AHP analysis, this criterion is not relevant to the

Table 11.1 Weighted for each criterion

Slum criteria	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	…	Eigen vector
x1	0.00	0.17	0.33	0.17	1.00	0.67	0.17	0.67	0.00	0.17	….	4.1
x2	0.83	0.00	0.50	0.50	1.00	0.17	0.50	0.83	0.33	0.50	….	7.4
x3	0.67	0.50	0.00	0.50	1.00	0.83	0.50	0.50	0.50	0.33	….	6.6
x4	0.83	0.50	0.50	0.00	1.00	0.83	0.17	0.17	0.67	0.33	….	6.5
x5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	….	0.0
x6	0.33	0.83	0.17	0.17	1.00	0.00	0.00	0.83	0.83	0.33	….	4.3
x7	0.83	0.50	0.50	0.83	1.00	1.00	0.00	0.67	0.83	0.33	….	6.8
x8	0.33	0.17	0.50	0.83	1.00	0.50	0.33	0.00	1.00	0.17	….	5.9
x9	1.00	0.67	0.50	0.33	1.00	0.17	0.17	0.00	0.00	0.17	….	4.9
x10	0.83	0.50	0.67	0.67	1.00	0.67	0.67	0.83	0.83	0.00	….	7.5
x11	0.00	0.00	0.00	0.17	1.00	1.00	1.00	0.17	0.00	0.00	….	2.6
x12	0.83	0.33	0.67	0.17	1.00	0.67	0.67	0.83	0.83	0.83	….	7.6
x13	0.17	0.17	0.17	0.17	1.00	0.33	0.17	0.67	0.83	0.17	….	4.2
x14	1.00	0.83	0.83	1.00	1.00	1.00	0.83	0.83	0.83	1.00	….	10.5
x15	0.17	0.00	0.17	0.17	1.00	0.17	0.33	0.33	0.33	0.17	….	4.0
x16	0.83	0.50	0.50	0.50	1.00	0.83	0.33	0.50	0.50	0.17	….	6.6
x17	0.50	0.50	0.83	0.67	1.00	0.83	0.67	0.67	1.00	0.50	….	10.6
Sum	9.17	6.17	6.83	6.83	16.00	9.67	6.50	8.50	9.33	5.17	….	100

x1 Spatial planning, *x2* Topography, *x3* Development, *x4* Building density, *x5* Tempo, *x6* Tapba, *x7* Antr, *x8* Population density, *x9* Strategic location, *x10* Livelihood, *x11* Sekit, *x12* Road, *x13* Drainage, *x14*, Water, *x15* Sanitation, *x16* Waste

context of the settlements in Paser Regency. The assessment can be seen in Table 11.2 with intervals:

- Interval value from 178.7 to 259.1: low slum
- Interval value from 259.1 to 339.6: moderate slum
- Interval value from 339.6 to 420.0: high slum

Villages with low slum intensity are among others: Muara Langon village and Uko village. Villages with a level of a moderate slum are Muarakomam, Uko, Busui, Songka, Batu Kajang, Sungaiterik, Klempangsari, Keluanglolo, Sempulang, Janju, Tepian Batang, Kendarom, Modang, Sandeley, Semuntai, Lombok, Pait, Longikis, Krayan Bahagia, Kayungo, Jemparing, Krayanjaya, Long Kali, and Sebakung. Meanwhile, villages with high slum are among others: Kuaro, Tanah Grogot, Sungai Tuak, Tanah Periuk, Padang Jaya, and Rangan villages.

The level of slum intensity is mapped in Fig. 11.4.

Table 11.2 Level of untidiness

No	District	X1 (4.1)	X2 (7.4)	X3 (6.6)	X4 (6.5)	X5 (4.3)	X6 (6.8)	X7 (5.9)	X8 (4.9)	X9 (7.5)	X10 (2.6)	. . . . .	Value
1	Muara Langon	82	222	132	130	129	204	118	245	225	78	. . ..	178.7
2	Muarakomam	82	222	132	400	900	204	400	245	225	78	. . ..	261.4
3	Uko	82	148	132	400	900	204	400	245	150	52	. . ..	253.1
4	Batu Burok	82	222	132	400	1500	340	400	245	225	78	. . ..	290.0
5	Busui	82	148	132	400	1500	136	400	245	225	52	. . ..	293.4
6	Songka	82	222	132	400	900	136	1000	147	150	52	. . ..	291.9
7	Batu Kajang	82	148	132	400	900	340	1000	245	225	78	. . ..	312.5
8	Sungaiterik	82	148	198	400	900	136	1000	147	150	52	. . ..	294.6
9	Kuaro	82	148	330	400	1500	204	1000	245	375	78	. . ..	372.8
10	Klempangsari	82	222	132	400	1500	204	400	245	375	78	. . ..	324.1
11	Keluanglolo	82	222	132	400	900	204	400	245	225	78	. . ..	282.5
12	Sempulang	82	222	132	400	900	204	400	245	225	78	. . ..	282.5
13	Janju	82	148	132	400	900	136	400	245	225	78	. . ..	273.6
14	Tepian Batang	82	222	132	400	900	204	400	245	225	78	. . ..	282.5
15	Tanah Grogot	82	222	132	600	1500	340	600	245	375	78	. . ..	342.7
16	Sungai Tuak	82	222	132	900	2500	204	900	245	375	78	. . ..	420.0
17	Tanah Periuk	82	222	132	900	2500	204	900	245	375	78	. . ..	420.0
18	Padang Jaya Rangan	82	222	132	900	2500	204	900	245	375	78	. . ..	420.0
19	Kendarom	82	148	198	600	1500	204	600	245	375	52	. . ..	337.8
20	Modang	82	148	198	400	900	204	400	245	375	52	. . ..	276.3
21	Sandeley	82	148	198	400	900	204	400	245	375	52	. . ..	276.3
22	Semuntai	82	148	198	400	900	136	1000	245	375	52	. . ..	309.5

23	Lombok	82	148	132	400	900	204	1000	245	375	52	. . ..	309.6
24	Pait	82	222	132	400	900	204	400	245	375	52	. . ..	276.8
25	Longikis	82	222	132	400	900	204	400	245	375	52	. . ..	276.8
26	Krayan Bahagia	82	222	132	400	900	204	400	245	375	52	. . ..	276.8
27	Kayungo	82	222	132	400	900	204	400	245	375	52	. . ..	276.8
28	Jemparing	82	222	132	400	900	204	400	245	375	52	. . ..	276.8
29	Krayanjaya	82	222	132	400	900	204	400	245	375	52	. . ..	276.8
30	Long Kali	82	222	132	600	900	204	400	245	375	52	. . ..	289.3
31	Sebakung	82	148	132	600	900	204	400	245	375	52	. . ..	273.0

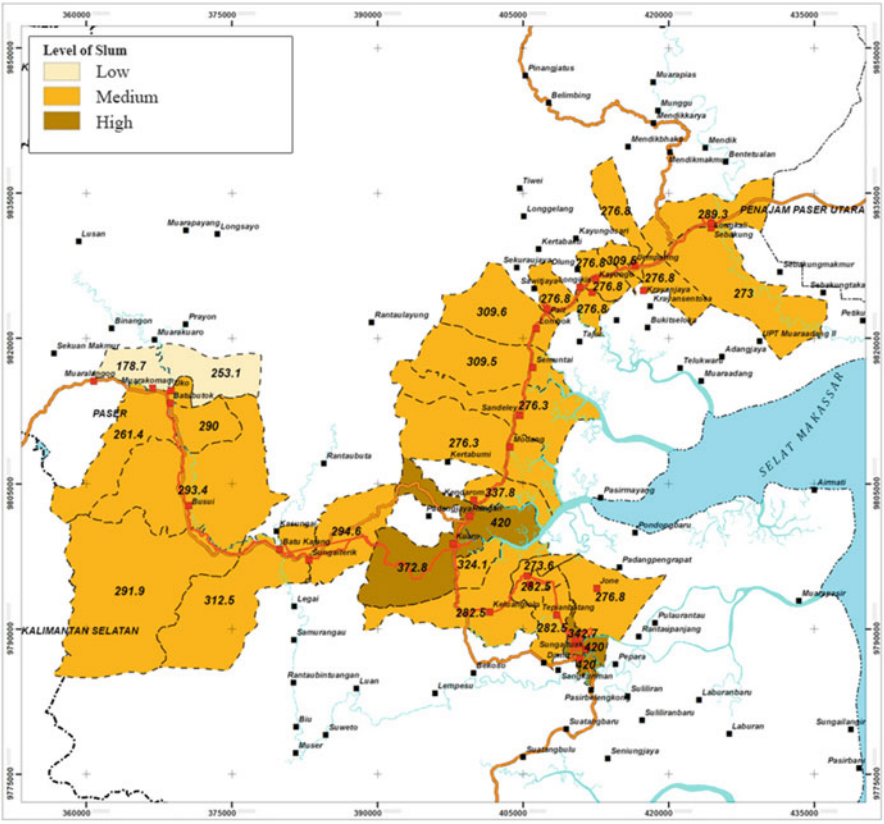

Fig. 11.4 Classification level of a slum

11.4 Conclusion

Settlements in IKK Kuaro and other IKK grow into a linear pattern, extending on either side of the road district. Such pattern is similar to the character of the people's occupation in IKK area, namely, in trade and services, which requires locations along the street. However, it can still be observed clearly that each city center which plays a role as node (crowd center) is separated from each other by empty land, gardens, and protected forests. The growth of illegal buildings and illegal clearing of protected land are visible issues for the development of Paser Regency.

IKK or district capital is usually provided with good road access, electricity, water supply, waste disposal, and adequate drainage. Settlements in Tanah Grogot have been served by public infrastructure such as clean water, electricity, telephone, and drainage. Cable and telephone pole/electricity are lined up on the road. In some places, they look neat, but they look like a mess in other corners of the city. Each housing unit has an average width of 70 m^2, with a semi-stilt building made of wood, typical of Kalimantan buildings. Yard (open land/garden) is available in

the front and on the side of the building. In many residentials as in Mangku Kusumo street, Ikhlas alley, Padat Karya street, and Senaken street, the yard is commonly used to put away unused stuff, such as damaged chairs and cupboards, unused pieces of wood, etc. There are empty lands overgrown with shrubs and become a place to hoard junk. Other unhealthy neighborhoods in urban areas are settlements in an area with a puddle and houses on stilts standing above a puddle, and there is also a terrace of a house flooded by the overflowing gutters. Drainage seems to be the problem in most urban areas of Paser Regency. Sewers are buried by rubbish and sand; water is not flowing and inundating yards as in Padat Karya street. In addition to drainage problems, piles of garbage often come into sight with puddles and overflowing sewage in the neighborhoods.

Slum-level assessment is done through the scoring technique of each village situation, on the established criteria of the slum. The criterion "temporary building" is not used because based on AHP analysis, this criterion is not relevant to the context of the settlements in Paser Regency.

Villages with low slump are among others: Muara Langon village and Uko village. Villages with a level of moderate slum are Muarakomam, Uko, Busui, Songka, Batu Kajang, Sungaiterik, Klempangsari, Keluanglolo, Sempulang, Janju, Tepian Batang, Kendarom, Modang, Sandeley, Semuntai, Lombok, Pait, Longikis, Krayan Bahagia, Kayungo, Jemparing, Krayanjaya, Long Kali, and Sebakung. Meanwhile, villages with high slum are among others: Kuaro, Tanah Grogot, Sungai Tuak, Tanah Periuk, Padang Jaya, and Rangan villages.

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Chapter 12
Sustainable Well-Being Objective Indicators: Basic Necessities, Complementary Needs and Desired Opportunities

Aisyah Abu Bakar, Mariana Mohamed Osman, Syahriah Bachok, and Alias Abdullah

Abstract *Abstract Purpose*: This study assesses the theories and approaches to sustainable well-being in developing objective social indicators to recognise the all-inclusive wellness of Malaysians. *Problem*: Currently, in Malaysia, well-being is measured by the Economic Planning Unit (EPU) Malaysia through the Malaysian Quality of Life Reports and Malaysian Well-being Report. The reports cover the social progress of Malaysians through a set of indicators categorised under economic well-being and social well-being. The three main issues found in the current approach include (1) a lack of output indicators for some components, which makes it impossible to interpret the true performance of well-being, (2) the absence of a hierarchy of needs to identify more prioritised components and indicators, and (3) a narrow understanding of progress due to a strong reliance on the correlation with GDP growth. *Approach*: This study employs a literature review and document analysis. *Findings*: A new approach is necessary to improve the current approach to measuring well-being in Malaysia. Based on the theory of the hierarchy of needs, the objective indicators are categorised into specific components of three dimensions of sustainable well-being – necessities, complementary needs, and desired opportunities. Through reconsideration and re-coordination of the existing indicators and selected additional indicators, the elements that constitute well-being as well as the data appear consistent and transparent. *Significance*: Sustainable well-being indicators will prioritise what is most important to the citizens. The model recognises the progress of the survival requirements of human beings, the moral basis of happiness, and the greater life prospects of Malaysians.

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12.1 Introduction

The Economic Planning Unit (EPU) Malaysia, the principal government agency in the prime minister's department, handles the preparation and publishing of the Malaysian Quality of Life Reports (MQLR) and Malaysian Well-being Report (MWR). The first report published by the EPU to gauge the selected social indicators was MQLR 1999. The second report was MQLR 2002, followed by MQLR 2004 and MQLR 2011. MWR 2013 was the latest report published. MQLR and MWR represent the EPU's committed approach to measuring the impact of economic development on Malaysia's social progress through a set of social indicators categorised under economic well-being and social well-being. The number of indicators and components used from the earliest to the latest reports has been ever changing. In the latest report, 14 components were used to demonstrate the different aspects of social development in Malaysia. Five of the components – transport, communication, education, income and distribution, and working life – represent the economic well-being. The remaining indicators – housing, leisure, governance, public safety, social participation, culture, health, environment, and family – represent the social well-being. However, the selection of the indicators in representing the components of well-being in terms of the appropriateness and comprehensiveness is still questionable. Additionally, the EPU's supposition that the sustainability of social development highly depends on the increase in GDP is somewhat arguable. This study responds to the uncertainty of the EPU concerning what matters most to the citizens mentioned in one of the latest MWR presentations as well as in some of the published quality of life and well-being reports.

The first objective of the study is to explore the theories and current approaches to measuring sustainable well-being through social indicators. The second objective is to develop sustainable well-being objective indicators for Malaysia. This chapter discusses the boundaries of the three dimensions of sustainable well-being and attempts to show the components and objective social indicators suitable for Malaysia.

12.2 Issues in the Malaysian Quality of Life Reports and Malaysian Well-Being Report

Issues are identified in the selection of indicators and the understanding of economic growth and sustainability of social progress. Arguably, four issues are found in the quality of life and well-being reports.

12.2.1 There Is an Absence of Output Indicators in Some of the Well-Being Components

The selection of the type of indicator in some of the components results in questionable data or information gained to represent the well-being components (refer to Table 12.1).

The latest report, MWI 2013, shows that some of the components in the MWI, particularly the housing component, are lacking output indicators. As a result, the data generated to demonstrate the progress of the housing component appear questionable and incomplete. Currently, the indicator being used to indicate housing ownership progress is the provision of low-cost houses to serve the bottom 40% income group. The first issue raised from the indicator selection and the indicator is an input indicator that only represents the resource provided or programme implemented. The result or the outcome of the resource provided is not demonstrated in the report. Secondly, the indicator is preferential to low-income earners

Table 12.1 Dimensions and influencing factors of HIE

Types of indicator	Types of measurement	Results	Measurement items	Examples from MWI
Input indicators	Measure quantity of services or resources provided based on the goal setting of a certain programme	Initiated resources	Human and financial resources, physical facilities, equipment, and supplies	Graduate teachers in secondary schools
Process indicators	Progress (number and type) of the implemented programme	Progress of resources	Programme is being carried out as planned and how well programme activities are being carried out	Secondary school participation rate
Output indicators	Measure quantity, quality, and timeliness of the products that results from the programme or immediate achievements of the programme	Short-term results	The results of programme efforts at the programme level which informs the direct products or deliverables of programme activities	Secondary education survival rate
Outcome indicators	Measure the change of a condition or behaviour as a result of the programme	Medium-term results	The programme's level of success in improving service accessibility, utilisation, or quality	National average grade (SPM)
Impact indicators	Consequences (quality and quantity) generated by programme outputs reflected in social, physical, or environmental aspects	Long-term results	Cumulative effects of programmes over time on the larger social system or on a population's health and well-being	Literacy rate

and neglects citizens who are middle-income and high-income earners. A report titled 'Making House Affordable' by Khazanah Research Institute suggests how housing ownership is considered a welfare issue by the Malaysian government. Middle-income earners are ineligible for the low-cost housing scheme and, at the same time, unable to afford houses supplied by the private housing developers.

Based on MWI 2013, the supply of low-cost housing to the bottom 40% income group has improved since the year 2000 (MWI 2013). However, unfortunately, the indicator cannot confirm if the housing ownership issues are improving or worsening. An alternative or additional indicator that is better able to indicate the result of the housing supply is the 'housing ownership rate', which, presently, is unavailable in the report.

The selection of indicators is vital to highlight not only the improvement achieved but also the issues facing the nation. The data highlights or serves as guidance for policymakers to take appropriate action in addressing malfunctions in the social conditions.

12.2.2 There Is a Lack of Clarity Concerning the Priority of Social Development

The absence of a hierarchy of needs in structuring the objective indicators has clouded priorities in fulfilling well-being and sustainability.

The components and indicators of the MQLI and MWI reports across the years have been ever changing in terms of quantity and measurement. Although the efforts of the EPU to revise the components and indicators from time to time are creditable, without recognising what is most needed by the nation, the priorities of the efforts in gauging well-being progress seem unclear.

The EPU defined QoL as an improvement in the standard of living that exceeds the contentment of basic needs and psychological needs towards achieving well-being. In MWI 2013, well-being refers to the acquired benefits and life satisfaction associated with the social, environmental, and economic aspects that elevate the quality of life. If both definitions are put together, it becomes the improvement in the standard of living by balancing the resources and basic needs towards achieving positive attributes of social, environmental, and economic aspects. In an attempt to achieve this aspiration, the components and indicators are increasing across the reports.

Since the decisions concerning the selection of indicators are only based on three intertwining criteria, importance, accuracy, and data availability, the number of components and indicators will continually grow in the future reports as more data become available. Hence, if there is no control over which indicators are recognised, (1) survival needs, (2) enhancement to sustain QoL, and (3) conditions to which the nation can reach its full potential, the future assessment of well-being will not realise the stage of fulfilling the more prioritised needs of the nation.

12.2.3 There Is an Absence of Subjective Indicators

The absence of reliable subjective well-being indicators that can capture nonquantifiable aspects of well-being has meant that the intangible aspects of well-being are ignored.

Well-being is currently measured through the material goods and services provided. The satisfaction of the citizens is often neglected. Surprisingly, in MQLI 2002, subjective indicators were supplemented by the government to provide transparent information to the public. However, out of 59 subjective indicators, only 4 indicators recognised satisfaction in the quality of life related to the environment (rivers, forests, air, and drinking water). Consequently, the notion of sustainability was somewhat biased towards societal well-being (Hezri 2004). The sustainable well-being theory on subjective well-being suggests that personal well-being exists in interconnectedness with humans and interconnectedness with the environment. Sustainable well-being is more than just satisfaction with the environment or the material goods; rather, it is the collective balance of fulfilment shared with other human beings and the environment.

12.2.4 There Is a Narrow Understanding of Economic Growth and Social Progress

Due to the claim that the sustainability of social progress is due to economic growth, the understanding of sustainability and progress is limited.

The EPU claims that fluctuations in the well-being indices in MQLI and MWI arise from the economic growth and higher levels of income. Due to this notion, the progress of every well-being component in MWI is observed as good when they are positively correlated with the GDP. If the component is negatively correlated with GDP, it is considered to be a deterioration. In other words, improvement in social development is due to an increase in GDP. This has led to a narrow and misleading understanding of social and economic progress.

The typical measurement of GDP is by adding (1) national personal consumption expenditure, that is, the payment by households for goods and services; (2) government expenditure, that is, the public spending on the provision of goods and services, infrastructure, debts, and others; and (3) net capital formation, that is, the increased values of the nations' total stock of monetised capital goods. Since the establishment of GDP, economists who are familiar with GDP have long emphasised that GDP is only a measure of the progress of economic activity and not economic well-being. Additionally, many economic activities are still excluded from GDP. This includes the depletion of natural resources, volunteer work, social capital formed through a healthy family unit, cost arising from crime, and many more.

Additionally, out of 14 components for well-being in MWR 2013, the family life component and environment component negatively correlate with GDP. In addition, the social participation component and health component did not show a strong positive or negative correlation with GDP. Although economic growth partially contributes to an improvement in well-being, GDP is unlikely to be the best representation of economic growth.

The issues found in the reports require immediate attention for improvement. Hence, there should be a clear understanding concerning what economic growth and social progress represent. The report should also clarify those components that are more important than others. Finally, selection of the indicators needs to show the true progress of the country and the citizens.

12.3 Literature Review

The literature review discusses the development and history of social indicators and the theory of the hierarchy of needs towards developing potential sustainable well-being objective indicators for Malaysia.

12.3.1 The History and Development of Social Indicators

For some researchers, any practical social statistic or any observation on social affairs is a social indicator. The term social indicator is the fashionable alternative to the old-fashioned term 'social statistic'. However, for many other writers, social indicators are the data that directly exhibit the most significant features of social change. They serve as an explanatory tool to the whole complex of social changes steered by key mechanisms, trends or practices implemented administratively, governmentally or internationally (Miles 1985; Rapley 2003).

The movement to explore social indicators can be tracked down to the late seventeenth century (Leiby 1960; Cobb and Rixford 1998). Historical events relating to the social indicator movement that occurred from the late seventeenth century to the late eighteenth century provided significant contributions to the understanding of how social indicators are recognised at present (Cobb and Rixford 1998). The lessons from history identified four conflicting principles in managing social indicators (Baird 2011; Bauer 1966; Campbell et al. 1976; Cobb and Rixford 1998). The first principle recognises the distinction between prescriptive indicators and descriptive indicators. Prescriptive indicators refer to indicators that provide guidance for improvement, whereas descriptive indicators refer to indicators that highlight conditions that are possibly overlooked. The second principle recognises the distinction between the deductive method and the inductive method. The deductive method produces indicators on an abstract model for a testable hypothesis, while the inductive method compiles the data on the condition of the society before

resulting to generalisation. The third principle recognises the distinction between an impartial process, also known as a non-partisanship approach, and an ideological process, also known as a partisanship approach. The impartial process, popularly known as pseudo-objectivity, suggests that the data gathered from the social indicators are solely the result of experimentation and are not inclined to any feelings or opinions. The ideological process suggests that the data presented favours one interpretation of the efforts or opinions and disregards other possibilities that may contribute to the social condition. The fourth principle recognises the distinction between two purposes of the social indicators as the tools for understanding and tools for practical action. Academicians utilise social indicators as tools for understanding and, hence, believe that the data must be compiled for a certain period. For academicians, data that are released before the allocated time frame are premature. In contrast, practitioners need to make a judgement, and, thus, regardless of being impatient, the up-to-date or allegedly premature data are useful (Campbell et al. 1976; Cobb and Rixford 1998; Land 1999).

Common yet important doubts need to be resolved for the selected indicators to be acceptable, measurable, and valuable to the current condition. These doubts include:

1. Whether the indicator is able to exhibit the expected result or condition
2. Whether the data are available for the indicator
3. Whether the data for the indicator will be obtained by the same method over time
4. Whether the desired data are currently being collected and, if not, is there a cost-effective instrument to do so
5. Whether the indicator is important to the majority of people
6. Whether the indicator is sufficient and able to convince supporters and sceptics
7. Whether the indicator is quantitative or qualitative, and, objective or subjective

The development of social indicators is a two-way process. Although the indicators stem from policy objectives, they also concretise and shape the policies. Therefore, developing indicators cannot be a purely technical or scientific process; rather, it should be an open communication and policy process. For indicators to be suitable for the components that they are measuring, they must be simple and directionally clear. To be simple, the number of indicators must be limited, and the method of calculating them must be transparent. Directionally clear means that they should indicate items and trends that are obviously relevant in terms of their importance for sustainability and sensitivity and their ability to signal progress or the absence of progress (Baird 2011; Bauer 1966).

Studies on social indicators or development indicators found that the dimension of indicators exists in two ways – objective indicators and subjective indicators. Both objective and subjective indicators are measured quantitatively or qualitatively based on the nature of the data and the purpose of the measurement (Rapley 2003; Haworth and Hart 2007). Subjective well-being indicates a system of decisions and causes that enables researchers to observe, predict and manipulate the consequence of the changes in the environment of the social aspects (Rapley 2003).

Indicators can be direct or indirect. Indirect indicators are also known as proxy indicators. Direct indicators correspond to the programme outcome precisely at any performance level. For example, the housing ownership rate is a direct measure of low-cost housing programmes. Alternatively, indirect or proxy indicators are utilised to show changes or results when direct measures are not achievable. For example, the number of cinema goers is an indirect measure of leisure activities (Land 1999).

The broad selection of indicators can vary from qualitative or quantitative indicators, direct or indirect indicators, and input, process, output, outcome, or impact indicators. The selection of the indicators depends on the availability of data and the specific problems addressed. There are five levels of measurement that performance indicators can demonstrate. At the bottom of the hierarchy are the input indicators that only measure the resources provided by a programme or a component, such as the percentage of graduate school teachers. Process indicators measure the progress of activities in a determined programme and the way the activities are carried out, such as the school participation rate. Output indicators recognise the quantity, quality, and timeliness of the products, goods, or services of the implemented programme, such as school survival rate. Outcome indicators indicate the intermediate results generated by the programme outputs, such as the national average grades for UPSR, PMR, or SPM. They usually correspond to any change in people's behaviour as a result of a programme. Finally, at the top of the hierarchy are the impact indicators that measure the long-term results from the output of a certain programme or component, such as the literacy rate. Whether to utilise input or output indices depends on the availability of data and the specific problems to be addressed. Table 12.1 indicates the understanding for each type of indicator (Stern et al. 2014).

12.3.2 Hierarchy of Needs

The hierarchy of needs, which was introduced by Abraham Maslow in 1943, identifies the stages of human growth. The stages of human growth are often depicted in a hierarchical pyramid that recognises the five levels of motivational needs. The five motivational needs are also categorised under basic needs and growth needs. The basic needs, also known as deficiency needs, refer to the biological and physiological needs, safety needs, love and belonging needs, and esteem needs, arranged from the most urgent to fulfil. The growth needs refer to self-actualization. In order to motivate people, the basic or the deficiency needs must first be fulfilled. The longer the duration that the deficiency needs are denied, the more urgent it becomes to fulfil them. For a person to progress to the higher level of the hierarchy of needs, the lower level of the basic needs has to be fulfilled. Once the person is satisfied with the fulfilment of the lower level of the deficiency

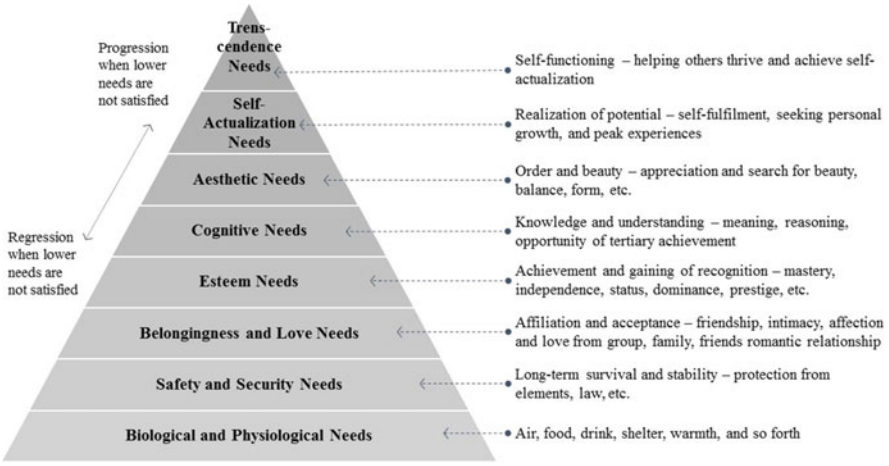

Fig. 12.1 Maslow's hierarchy of needs

needs, he or she can progress to the next level and, ultimately, to the growth needs, that is, self-actualization (Maslow 1970). During the 1960s and 1970s, the five stages of hierarchy needs were extended to eight stages of hierarchy needs. Maslow slotted in cognitive needs and aesthetic needs, respectively, between deficiency needs and growth needs. Later Maslow added transcendence needs as the eighth and final stage to the hierarchy of needs (Maslow 1970). The full pyramid of Maslow's hierarchy of needs can be viewed in Fig. 12.1.

12.3.3 Social Progress Index

The Social Progress Index (SPI) is a commendable example of international social indicators that are modelled based on the hierarchy of needs. Social progress is *...the capacity of a society to meet the basic human needs of its citizens, establish the building blocks that allow citizens and communities to enhance and sustain the quality of their lives, and create the conditions for all individuals to reach their full potential...* (Stern et al. 2014; The Social Progress Imperative [SPI] 2014). The Social Progress Index (SPI) was developed by an organisation called Social Progress Imperative. Social Progress Imperative is a non-profit nongovernmental organisation established in 2012 in the United States.

The SPI is the aggregated indices of social and environmental indicators. The indices represent the outcome of success and not the extent of effort that the country makes. An example would be the achieved health in a country instead of how much the country spent on health.

In developing the social indicators for SPI, three meaningful questions should be answered: (1) Does a country provide for its people's most essential needs? (2) Are the building blocks in place for individuals and communities to enhance and sustain well-being? (3) Is there an opportunity for all individuals to reach their full potential? The three dimensions of SPI, (1) basic human needs, (2) foundation of human needs, and (3) opportunity, represent the components and indicators of SPI.

Although the Social Progress Imperative claimed that SSI complements economic growth, they do not include indicators of economic growth, such as gross domestic product and employment rate. The SSI skipped most of the common economic indicators to avoid the utilisation of economic proxies. The aim of SSI is to exclusively measure social progress through a combination of social and environmental indicators for given dimensions.

The indicators in the social progress are organised under 12 components, which, in turn, are classified under three dimensions. Basic human needs refer to the rights to basic survival. This implies being able to live in security, shelter, with sufficient water food and basic medical care to be able to survive to maturity. The foundation of well-being refers to the moral basis of happiness, which highly relates to basic knowledge, health and balanced ecosystem. Finally, opportunity refers to the equality of opportunity to all citizens. Equality of opportunity is also a key element in freedom and liberty (SPI 2014).

12.4 Findings

The eight levels of the hierarchy of needs suggest three strong dimensions of human growth for sustainable well-being. The dimensions are useful to truly recognise social development in Malaysia independent from economic growth (refer to Table 12.2).

The first dimension is basic necessities, which is represented by the first level and second level of the hierarchy: (1) biological and physiological needs and (2) safety and security needs. Basic necessities refer to the important resources for basic survival. Without the resources, the whole living system will be disrupted.

The second dimension is complementary needs, which is represented by the third, fourth, and fifth levels of the hierarchy: (1) belongingness and love needs, (2) esteem needs, and (3) cognitive needs. Complementary needs refer to the means that support the basic well-being of humans. Without the means, the living system will not be disrupted, but lives would be difficult.

The third dimension is desired opportunities, which is represented by the top three levels of the hierarchy: (1) aesthetic needs, (2) self-actualization needs, and (3) transcendence needs. Desired opportunities are the aspects of life that support self-fulfilment and self-functioning. Without these aspects, the living system is not

Table 12.2 Components of sustainable well-being

Hierarchy of needs	Components for sustainable well-being	Dimensions
Biological and physiological needs	Nourishment and essential care	Basic necessities
	Water and sanitation	
Safety and security needs	Shelter and housing	Without it, living system is disrupted
	Safety and security	
Belongingness and love needs	Health and basic well-being	Complementary needs
	Social acceptance	
Esteem needs	Information transmission and communication	Without it, living system is not disrupted but lives would be difficult
	Access to elemental education	
Cognitive needs	Access to advanced education	Desired opportunities
Aesthetic needs	Sustainable environment	
Self-actualization needs	Personal rights	Without it, living system is not disrupted, and lives would not be difficult
Transcendence needs	Freedom of choice	

disrupted, and life is not difficult. However, in the long run, these aspects strongly complement the ability of humans to be helpful and supportive of one another.

12.5 Synthesis

Table 12.3 shows an attempt to reposition the available social indicators in the latest Malaysia Well-being Report through a set of dimensions and components based on the hierarchy of needs. However, the social indicators are selective, and some of the indicators in the Malaysia Well-being Report are excluded.

Three dimensions of well-being exist that need to be recognised in gauging the performance of a nation. They are the (1) basic necessities, which measure the survival resources of the nation; (2) complementary needs, which measure whether the society is able to improve and sustain their lives; and (3) desired opportunities, which measure whether the citizens have the opportunity and freedom to make their own choices. The three dimensions of sustainable well-being provide a better focus in fulfilling the necessities of the citizens. Fulfilment of the basic or survival necessities of the nation enables citizens to attempt to shift their priority from focusing on material fulfilment to focusing on sustainable livelihoods.

Table 12.3 Potential objective indicators for sustainable well-being based on available indicators in MQLI and MWI

Components	Potential indicators from existing indicators of MWI and MQLR
Nourishment and essential care	Life expectancy at birth (+)
	Infant mortality rate (per 1000 live births) (−)
	Maternal mortality rate (per 100,000 live births) (−)
Water and sanitation	Percentage of housing units with piped water (+)
	Percentage of housing units with treated water (+)
	Percentage of households with garbage collection services (−)
Shelter and housing	Average housing price (−)
	Average price of medium-cost house to average household income (−)
	Percentage of low-cost houses to total low-income households (+)
	Percentage of low-cost housing units to bottom 40% (+)
	Percentage of housing units with electricity (+)
	Crowdedness (no. of persons per room) (−)
Safety and security	Crime rate (per '000 population) (−)
	Road accidents (per '000 vehicles) (−)
Health and basic well-being	Non-communicable disease cases ('000 population) (−)
	Number of beds in hospitals (per '000 population) (+)
	Doctor to population ratio (−)
	Hospital waiting time for out-patients (minute) (−)
Social acceptance	Divorce rate (% of population aged 18 and above) (−)
	Domestic violence cases ('000 population) (−)
	Juvenile crimes (% of population aged 10–18) (−)
	Dependency ratio (−)
Information transmission and communication	Fixed and mobile telephone line subscriptions (+)
	Internet subscribers (per '000 population) (+)
	Number of hotspot locations (+)
	Number of domain name (per '000 population) (+)
Access to elemental education	Primary and secondary school teacher-student ratio (−)
	Pre-school participation rate (+)
	Primary and secondary school participation rate (+)
	Literacy rate (+)
	Percentage of graduate teachers in primary and secondary schools (+)
	National average grade (UPSR and SPM)(+)
	Primary and secondary education survival rate(+)
Access to advanced education	Tertiary education participation rate (+)
	Number of lecturers with PhD (+)
Sustainable environment	Air quality (percentage of station with API < 50) (+)
	Water quality (percentage of clean river monitored) (+)
	Percentage of forested land (+)

(continued)

Table 12.3 (continued)

Components	Potential indicators from existing indicators of MWI and MQLR
	Quantity of scheduled waste generated (tonnes/year) /population (−)
	Maximum mean temperature (°C) (−)
Personal rights	Number of registered non-profit organisations (per '000 population) (+)
	Number of registered residents' associations (+)
	Membership of selected voluntary organisations; Malaysian red crescent society and St. John Ambulance Malaysia (per population aged 18–50) (+)
	Membership in RELA and rakan cop (per '000 population) (+)
Freedom of choice	Percentage of registered voters (+)
	Percentage of corruption cases prosecuted (+)
	Number of e-payment transactions (million) (+)
	Percentage of cases solved by Biro Pengaduan Awam (+)
	Percentage of e-filing users (+)

Note: The indicators are selected from MQLR (2002, 2004, 2011) and MWI (2013)

12.6 Conclusion

This chapter revises the current approach to measuring well-being in Malaysia. The four major issues discovered in the MWI are:

1. Lack of output indicators for some components, which result in the questionable interpretation of the progress of the components
2. Absence of hierarchy of needs to recognise more prioritised components and indicators
3. Absence of reliable subjective well-being indicators that can capture nonquantifiable aspects of well-being
4. Narrow understanding of progress due to strong reliance on correlation with GDP

A potential alternative is proposed as a complementary viewpoint for understanding the nation's progress. It is believed that social growth sustains economic growth, rather than the other way round, which is how the reports have interpreted it for over a decade. Social development can play an important part in long-term economic success. The future direction of the study is to revise and improve the potential alternative and discover the subjective social indicators in realising sustainable well-being.

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Chapter 13
Assessing Disparities in the Urban-Rural Service: A Case of Public Bus Services in Peninsular Malaysia

Zakiah Ponrahono, Syahriah Bachok, Mansor Ibrahim, and Mariana Mohamed Osman

Abstract An understanding of bus service disparities between urban and rural settlements is necessary to provide the best approach to improving and providing an efficient public transportation system in the country. An efficient public transportation system will contribute towards sustainable economic growth and healthy social development of the district, which, in turn, will ensure human security in respect of the mobility of goods and services for today's and future needs. However, limited studies that analyse the service gap and local demand for the public bus service in Peninsular Malaysia have been conducted. The improvement in bus service reliability depends on several parameters including the route coverage and schedule. This study presents an empirical analysis of the fixed-route hour level of service (LOS) for urban and rural bus services to understand the level of reliability and quality of the service provided. A field survey was conducted to collect the secondary data concerning the bus routes and schedules from the local bus operators. Through a sampling survey of bus lines in selected urban and rural settlements in Peninsular Malaysia, service reliability based on the fixed-route hour service is evaluated. A total of nine (9) bus companies with a total of 48 routes were selected to represent nine (9) bus terminals operating in Johor, Penang, Pahang and Perak. Johor represents the southern states, while Penang represents the northern states. For the east-coast states, Pahang is selected, while Perak represents a still developing state, which is yet to reach the advanced level of large conurbations. The distance of a bus route from the origin to the destination is also analysed. A standard service quality measure is referred to in determining the level of service (LOS) and for identifying the service disparities between urban and rural

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settlements. The results indicate that the LOS for the fixed-route hour of bus services in the rural areas range from C to D and B to E in the urban settlement. The recommendations put forward include the improvement of real-time scheduling of buses, expansion of service hours and revised fare systems to ensure the future sustainability of the urban and rural bus services in Malaysia.

13.1 Introduction

For sustainability to be realised, the growth of cities and towns must be accompanied by a corresponding growth in accessibility and mobility. In the past decade, the Malaysian population grew by almost 2% per annum (Department of Statistic Malaysia 2014) with the expansion of the city or urban boundaries being double this rate (Federal Department of Town and Country Planning Ministry of Housing and Local Government of Malaysia 2010). Similarly, the number of vehicles registered increased almost 6% annually (annual average of 1.3 million new registrations, with a total of 23.7 million registered vehicles per 29 million population in 2013) (Ministry of Transport Malaysia 2014). Meanwhile, private car ownership was rated at 378 per 1000 households in 2011, surpassing neighbouring nations (151, Singapore; 69, China; 69, Indonesia) and only exceeded by more developed countries (370, South Korea; 516, the UK; 703, Australia; 588, Japan; 786, the USA) (The World Bank 2014). In light of these unsustainable trends and patterns of mobility, the Malaysian government through various economic transformation packages, including Vision 2020, the Malaysia Five Year Plan, National Key Results Areas (NKRA) and Government Transformation Programmes (GTPs), has propagated a reversal in the public transportation image and dwindling annual patronage (Federal Department of Town and Country Planning Ministry of Housing and Local Government of Malaysia 2010; Malaysia Economic Planning Unit (EPU) 2014; PEMANDU 2012, 2011). Various improvements have been implemented in city and rural bus systems, including programmes undertaken recently in Kuantan, Ipoh, Georgetown and Johor Bahru.

13.2 Literature Review

The demand for transportation will have direct economic, social and environmental impacts (Zegras 2005). Regardless of the importance of the urbanisation process, the major concern of sustaining the city development through a high-quality and systematic public transportation system is vital (Kenworthy 2006). Many of the current practices of transportation activities have a major impact on the economy, society and environment in terms of the depletion of non-renewable resources and the widening of

social disparity (Litman and Burwell 2006). Consequently, a good private-public transportation system is required with public transport as the key driver to maximise the resources with less impact on the environment, society and the economy (Ho Chin Siong and Muhammad Zaly Shah Muhd Hussein 1998). Hence, a sustainable transportation system is vital to ensure the balance of resource availability and a reserve for future needs. Contemporary studies (Bailey 1986; Chen et al. 2009; Dandapat and Maitra 2014; Ibeas et al. 2010; Odeck and Alkadi 2004; Perugia et al. 2011; Santoso et al. 2012) found that urban and rural public bus services have great potential for sustaining an efficient and reliable regional mobility system. Looking at the present public transportation system in Malaysia as a whole, it can be described as poor in respect of service quality (Almselati et al. 2011). Although the public transportation system in Malaysia has existed since the early 1960s, after independence, the quality of public services is considered low and has encouraged more people to drive their own vehicles within the city (Zakaria et al. 2010a). This scenario can be clearly seen in the recent number of private vehicles registered, which increased by 1.35% – from 20,944.496 in 2012 to 21,516,181 in 2013 (Ministry of Transport Malaysia 2014). Most citizens contend that the system is inconvenient and unreliable. This is normally related to the poor infrastructure and failure to abide by the time of bus arrival/departure (Too and Earl 2010). In addition, the public are not motivated to use public transport because the system is not flexible, takes a longer travel time and is less safe compared to using a private vehicle (Ismail et al. 2012). The poor public transportation system in Malaysia presents tremendous challenges to the public transport authorities, such as Land Public Transport Commission (SPAD) and local councils in providing a better infrastructure and high-quality public transport services to fulfil the needs of the local people (Jayaraman et al. 2011). Hence, an assessment of the quality of the bus services is necessary. An assessment of the quality of bus services can be rendered using the standard level of service (LOS) measures and the passengers' responsiveness dimension (Ismail et al. 2012; Napiah et al. 2010; Suwardo et al. 2008a; Too and Earl 2010; Zakaria et al. 2010b).

13.3 Methodology

The methodology for an onboard survey was adapted from the successful adoption of this method in the contemporary literature (Kamaruddin et al. 2012; Napiah et al. 2010; Suwardo et al. 2008b, 2009; Yaakub and Napiah 2011). Many studies have adopted secondary data and site visits or observation methods for obtaining bus service data and information (Napiah et al. 2010; Suwardo et al. 2008a, b). In this study, the standards (Tables 13.1, 13.2 and 13.3) for level of service (LOS) developed by the Transportation Research Board (2003) are referred to in assessing the bus services provided in selected urban and rural areas of Peninsular Malaysia.

Table 13.1 Fixed-route hour of service LOS

LOS	Hours of service	Remarks
A	19–24	Night 'owl' service provided
B	17–18	Late evening service provided
C	14–16	Early evening service provided
D	12–13	Daytime service provided
E	4–11	Peak hour service only or limited midday service
F	0–3	Very limited or no service

Source: Transportation Research Board (2003)

Table 13.2 Fixed-route service frequency LOS

LOS	Average headway (min)	Vehicle per hour	Remarks
A	<10	>6	Passengers do not need schedules
B	10–14	5–6	Frequent service, passengers consult schedules
C	15–20	3–4	Maximum desirable time to wait if bus/train missed
D	21–30	2	Service unattractive to choice riders
E	31–60	1	Service available during the hour
F	>60	<1	Service unattractive to all riders

Source: Transportation Research Board (2003)

Table 13.3 Passengers loading LOS thresholds

LOS	Passengers/seat	Remarks
A	0.00–0.50	No passenger needs to sit next to another
B	0.51–0.75	Passengers can choose where to sit
C	0.76–1.00	All passengers can sit
D	1.01–1.25[a]	Comfortable standee load for urban transit
E	1.26–1.50[a]	Maximum schedule load for urban transit
F	>1.50[a]	Crush load

Source: Transportation Research Board (2003)
[a]Approximate values for comparison

13.3.1 Case Studies

Four states (Fig. 13.1) in Peninsular Malaysia were selected as case studies for this study. The urban settlements of Georgetown, Kuantan and Johor Bahru were selected based on regional conurbation definition and zones with a population of 1–2 million people in the 2020 projection and Ipoh as an urban settlement under the state growth conurbation (Federal Department of Town and Country Planning Ministry of Housing and Local Government of Malaysia 2010) of the four states

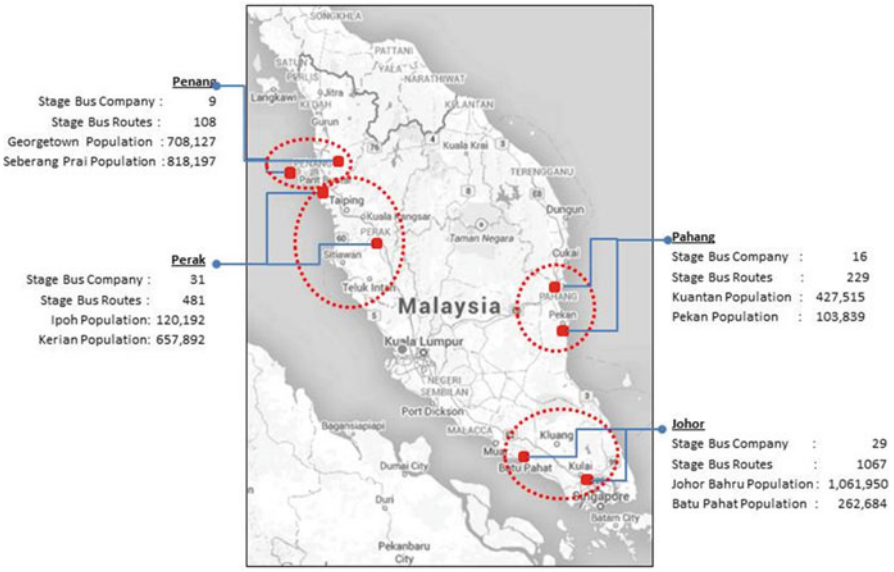

Fig. 13.1 Case study area

selected. The present population of these four urban settlements are Georgetown with 708,127 people, Kuantan with 427,515 people, Johor Bahru with 1,061,950 people and Ipoh with 120,192 people (Department of Statistic Malaysia 2014). According to the records (Suruhanjaya Pengangkutan Awam Darat (SPAD) 2014), nine (9) bus operators with 108 routes were registered as operating in Penang state in 2012. In the same year, Pahang had 16 bus operators with 229 routes, Johor had 29 bus operators with 1067 routes, and Perak had 31 bus operators with 481 routes. Seberang Perai with a present population of 818,197, Pekan with 103,839, Batu Pahat with 262,684 and Kerian with a population of 657,892 were selected as the sampling frame for rural settlements. The definition of rural settlements according to NPP2 is where the population is below 10,000 people (Federal Department of Town and Country Planning Ministry of Housing and Local Government of Malaysia 2010). However, for this study, the population of Seberang Perai, Pekan, Batu Pahat and Kerian is not identified or categorised in the sampling frame for rural settlements. In this study, the determining sampling frame for rural settlements refers to the geographical location of the area that satellites with rurality characteristics, has a single bus operator with conventional system, has poor condition of fleet and is not supported by other public transportation systems except paratransit, such as rental car ('kereta sapu'). The determination of the sampling frame in Seberang Perai, Pekan, Batu Pahat and Kerian is based on the following criteria:

1. Pekan, Batu Pahat and Kerian are under the jurisdiction of the District Office (Pekan District Office, Batu Pahat District Office and Kerian District Office), which represent the case studies centred on small or intermediate towns.

2. Batu Pahat is included in the zone of Muar-Batu Pahat-Kluang District Growth Conurbation in NPP2 (Federal Department of Town and Country Planning Ministry of Housing and Local Government of Malaysia 2010).
3. The Seberang Perai bus route coverage includes suburb and small villages in Penang.

13.3.2 Onboard Transit Survey

An onboard intercept face-to-face questionnaire survey method was utilised to capture the passengers' demographic and travel characteristics. The onboard transit survey is the most accurate form of survey for obtaining reliable and detailed information (Yaakub and Napiah 2011). The passengers' satisfaction and aspiration survey was deployed during the onboard survey. Standard questions about the respondent's background concerning age, ethnicity, gender and group were asked of those respondents who made themselves approachable and volunteered to give feedback during the onboard survey. Systematic coding consisting of the category of respondent's background in terms of age, ethnicity and gender was applied and recorded by the enumerators. The questionnaire was categorised into two (2) sections:

- Section A consisted of questions regarding the purpose of ridership and trip characteristics.
- Section B posed questions about the level of satisfaction with the current bus services with the aim of capturing the data concerning the passengers' preferences and aspirations.

13.3.3 Sampling Unit

The population for sampling comprises all bus users in Peninsular Malaysia. However, the sampling frame was limited to a minimum of 100 respondents for each selected case study. The target respondents were onboard passengers ranging between 15 and 55 years old. This age range was selected because, in common travel behaviour, these users have commuted routinely using a public bus service (Ismail et al. 2012). A total of 1130 survey questionnaires were distributed and collected using the convenience sampling method. The distribution of respondents according to the urban-rural centre is presented in Table 13.4.

Table 13.4 Distribution of sampling unit for onboard survey

Centre	Terminal	No. of respondents	Percentage %
Kerian, Perak	Parit Buntar	100	9.3
Ipoh, Perak	Medan Kidd	105	8.9
Seberang Perai, Penang	Penang Sentral	101	8.8
Georgetown, Penang	Jetty Terminal	100	9.6
Kuantan, Pahang	Hentian Bandar	130	5.3
Pekan, Pahang	Pekan	108	17.7
Johor Bahru, Johor	Larkin Terminal	60	8.8
	Johor Bahru Sentral	200	11.5
Batu Pahat, Johor	Batu Pahat	226	20
Total		1130	100

13.4 Findings and Discussion

The findings from the study indicate the fixed-route hour service LOS disparities between urban and rural settlements in the different states. The urban stage bus service in Penang and Johor corresponds to LOS B and C, while the urban stage bus service in Pahang corresponds to LOS B to E, and Perak corresponds to LOS C and D. In contrast, the rural stage bus in Penang and Perak corresponds to LOS C and D. The Johor rural stage bus corresponds to LOS D, and the Pahang rural stage bus is the lowest with LOS E. The findings of the LOS for selected urban and rural stage bias in this study are summarised in Table 13.5.

Overall the findings (Table 13.6) indicate that the quality of stage bus services has many aspects that need improving as the quality is yet to be categorised as excellent. The findings concerning the fixed-route hour service show a significant difference between urban and rural areas, in that the urban stage bus corresponds to LOS B to E and the rural stage bus corresponds to LOS C to E. Most of the urban stage buses are operated from 6.00 am to 10.00–11.00 pm, whereas the rural stage buses are operated between 6.00 am and 7.00–8.00 pm only. The summary of the fixed-route service frequency LOS disparities between urban and rural bus services in this research shows that the urban stage bus corresponds to LOS B to E and the rural stage bus corresponds to LOS C to F.

From the number of passengers recorded onboard, each stage bus service experiences the crush load category, especially during the peak hour trips. The summary of passenger thresholds shows that the passenger load for selected urban and rural areas corresponds to LOS A to F. Most of the LOS F occurred during the peak hour trips, and the LOS A occurred during the off-peak and, normally, in rural areas or social obligation route categories, such as Route 102 Permatang Badak in Kuantan. During the onboard survey, the researcher also found that the crush load situation occurred for the last bus trip service in Penang. The crush load situation creates an uncomfortable and inconvenient riding experience for the passengers. This situation becomes even worse during public holidays or special events/occasions when the traffic volume is overloaded and severe traffic congestion occurs.

Table 13.5 Summary of LOS

Indication	Urban public bus	Rural public bus
Fixed-route hour service LOS	Corresponds to LOS B, C and D	Corresponds to LOS C, D and E
	Only one bus route 201 Taman Gelora in Kuantan corresponds to LOS E	
Frequency LOS	Corresponds to LOS B, C, D and E	Corresponds to LOS C, D, E and F
Passenger threshold LOS	Corresponds to LOS A to F for weekdays and weekends	Corresponds to LOS A to F for weekdays and weekends
Stage bus speed	Mostly below 50 km/h	Mostly above 50 km/h
Boarding and alighting	The crowd reached more than 100 on certain routes during the first and last trip	The crowd reached more than 100 on certain routes during the first and last trip

The travel time becomes longer, and the last trip is sometimes cancelled by the operator because they reach the maximum operation hours. In this study, most of the bus speeds recorded in urban settlements and rural areas are below 50 km/h. The study also identified the occurrence of a bus speed of 90 km/h in the rural bus services. The appropriate bus speed will determine the travel time, waiting time and punctuality of the arrival time. The operating bus speed can be outlined and monitored through the implementation of a dedicated bus lane (Patrick 2004; Santoso et al. 2012; Zito and Salvo 2011). This is part of the strategy to increase the frequency and reliability of the services as well as the punctuality of arrival at the service destination. The patterns of passenger boarding and alighting in the selected case studies are also recorded to understand the current demand for the bus services. From the findings, the number of passengers for bus services in urban areas is encouraging and indicates a high demand, particularly for the college and worker groups. In contrast to the rural area, the demand is seen to be higher among school children. The study on passengers boarding and alighting is important to forecast future demand (Chen et al. 2009).

From the survey, the categories of respondents are mostly passengers on a commuting trip that use bus services as the mode to travel between locations repeatedly. From the total of 1130 respondents, 42.3% are from the working age (25–54 years old) group, and 28.1% are from the college age (18–24 years old) group, followed by 19.6% from the student age (15–17 years old) group and 9.9% from the retired (above 55 years old) group. The distribution of respondents (Table 13.7) in the urban area is larger than for the rural passengers because the designated routes are determined by the operators giving permission to conduct surveys on their buses. The overall distribution (Table 13.7) of respondents' ethnicity in this study is dominated by Malay with 65%, followed by Chinese with 13.7%, Indian 13.6% and other races with 7.7%. Clearly, the percentage of Chinese, Indian and other races is higher among the urban respondents compared to

Table 13.6 Assessment of the level of service (LOS) of selected urban and rural bus services

Routes	Level of Service (LOS)																	
	Fixed-route hour service						Frequency						Passenger Threshold					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
R3 Kuala Kurau																		
R5 Tanjung Piandang																		
R8 Taiping																		
601 Kepala Batas																		
602 Tasek Gelugor																		
603 Kuala Muda																		
604 Desa Murni																		
605 Pekan Darat																		
608 Penaga																		
701 Bukit Mertajam																		
702 BM Plaza																		
703 Seberang Prai																		
709 Macahang Bubuk																		
801 Nibong Tebal																		
Kuala Pahang																		
Tg. Agas																		
Johore Motor BP-Kluang																		
CausewayLink BP-Ayer Hitam																		
114 Ampang													Data Not Available					
94 Gunung Rapat																		
113 Ipoh Garden																		
91 Pasir Putih																		
117 Bercham																		
116 Aman Jaya																		
101 Teluk Bahang																		
201 Terubong																		
204 Penang Hill																		
302 Batu Maung																		
401 Balik Pulau (e)																		
502 Terminal Balik Pulau																		
100 Gambang Resort																		
101 Indera Sempurna																		
102 Permatang Badak																		
200 Teluk Chempedak																		
201 Taman Gelora																		
300 Taman Impian																		
302 Indera Mahkota																		
303 Kuantan Terminal Sentral																		
400 Pekan																		
401 Kampung Ubai																		
500 Sg. Lembing																		
601 POLISAS																		
208 Terminal Larkin-Terminal Masai																		
227 Terminal Larkin-Kota Tinggi																		
BET1 Wong Ah Fook-Kulaijaya																		
Bextra 2 JB Sentral-Ulu Tiram																		
221 Wong Ah Fook-Bukit Indah																		
23 JB Sentral-Permas Jaya																		

the rural respondents. The respondents are also divided into male, 36%, and female, 64%, with respondents from the urban for both genders being higher than for the rural respondents.

In analysing the passengers' level of satisfaction among the urban and rural respondents (Table 13.8), it was found that there was a higher dissatisfaction with the bus services among the rural passengers (62.5%) compared to the urban passengers (58.4%) from the total of 1130 respondents. Clearly, the percentage of

Table 13.7 Respondents' demographic analysis

Demographic profile	Urban frequency	%	Rural frequency	%	Total (frequency)
(a) Age					
School (15–17 years old)	81	36.5%	141	63.5%	222 (19.6%)
College (18–24 years old)	181	56.9%	137	43.1%	318 (28.1%)
Working (25–54 years old)	272	56.9%	206	43.1%	478 (42.3%)
Retired (above 55)	62	55.4%	50	44.6%	112 (9.9%)
Total	595	52.7%	535	47.3%	1130 (100%)
(b) Race					
Malay	337	45.9%	397	54.1%	734 (65%)
Chinese	104	67.1%	51	32.9%	155 (13.7%)
Indian	103	66.9%	51	33.1%	154 (13.6%)
Others	52	59.8%	35	40.2%	87 (7.7%)
Total	595	52.7%	535	47.3%	1130 (100%)
(c) Gender					
Male	227	55.8%	180	44.2%	407 (36%)
Female	369	51%	354	49%	723 (64%)
Total	595	52.7%	535	47.3%	1130 (100%)

Table 13.8 Summary of passengers' satisfaction and their aspiration

Satisfaction level	Locality	Punctuality & Frequency	Comfort & Cleanliness	Safety & Reliability	% Within Satisfaction Level According Locality
Dissatisfied	Urban	141 (40.6%)	50 (14.4%)	156 (45%)	347 (30.7%)
	Rural	166 (49.6%)	75 (22.4%)	94 (28.1%)	335 (29.6%)
Between satisfied and dissatisfied	Urban	52 (45%)	27 (18.3%)	70 (36.7%)	149 (13.2%)
	Rural	47 (34.9%)	12 (18.1%)	34 (47%)	93 (8.2%)
Satisfied	Urban	32 (50.5%)	25 (12.9%)	42 (36.6%)	99 (8.8%)
	Rural	52 (48.6%)	21 (19.6%)	34 (31.8%)	107 (9.5%)
% within aspiration towards service improvement	490 (43.4%)	210 (18.6%)	430 (38%)	1130 (100%)	

satisfied passengers is very low with only 20% of rural respondents and 16.6% of urban respondents being satisfied. However, 25% for the urban respondents and 17.4% for the rural respondents were neither satisfied nor dissatisfied with the services. Aside from that, the overall findings of the study indicate that there is a higher inclination towards dissatisfaction with the bus service with 347 (30.7%)

urban respondents and 335 (29.6%) rural respondents being dissatisfied with the existing services. Clearly, the respondents also have an issue with the punctuality and frequency of the service (43.4%), comfort and cleanliness of the service (18.6%) and safety and reliability of the service (38%) and aspire to have a better service in terms of these aspects. Less than 20% of the respondents were 'between satisfied and dissatisfied' with the service. In addition, a small percentage (below 50%) from a total of 242 respondents had issues with the punctuality and frequency of the service, comfort and cleanliness of the service and safety and reliability of the service. The percentage of respondents who were satisfied with the existing bus services in their area is very low. Although 8.8% of the urban respondents and 9.5% of the rural respondents were satisfied with the current services, they were still concerned about the punctuality and frequency of the service, comfort and cleanliness of the service and the safety and reliability of the service.

The higher inclination towards dissatisfaction with the existing bus services indicates the low and poor quality of the services provided. The findings also show a significant difference in the percentage between urban and rural respondents, which explains the services gap found in the level of service (LOS) assessment.

13.5 Conclusion

The bus service issues in selected urban and rural areas of Peninsular Malaysia revolve around poor fleet condition; low quality in reliability, punctuality and frequency; unsystematic bus trip system; inconvenience and uncomfortable trip; low quality of waiting facilities; and poor infrastructure of bus services facilities. The findings highlighted in this study also indicate that the existing bus services in the selected urban and rural areas of Peninsular Malaysia are still poor. Most of the urban and rural bus services correspond to LOS B to F in respect of the fixed-route hour service, fixed-route frequency and passenger load. The passenger satisfaction survey also shows a higher inclination towards dissatisfaction with the bus services. It is the goal of the Malaysian Government Transformation Programme to achieve a 60:40 modal split favouring public transportation by the year 2020. Hence, it is recommended that the outlined programmes for improvement be promoted in a timely manner for such a target to be achieved in 6 years' time. This research presents the overarching findings and way forward for urban buses in Malaysia. The primary lesson to be learned from this study is that although the demand for the public bus service is high, the current service has many aspects that need to be improved to achieve a high level of service and sustainable system. The findings from this study can be used as a benchmark for bus service improvement programmes for the future public transportation system. In essence, the sustainability of public transportation in Malaysia can be achieved by an assessment of the system through systematic and coherent LOS and passengers' satisfaction survey and addressing the issues raised accordingly.

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Part III
Building Science

Chapter 14
The Effect of Supplementary Cementitious Material Using Thermal Method

Suharman Hamzah and Evi Aprianti

Abstract This study reports on an ongoing research project aimed at producing sustainable construction material for the precast concrete industry. This chapter studies the physical and chemical properties of materials, compressive strength, flexural strength, water absorption and porosity of multi-blended cements under different curing methods. Fly ash (FA), palm oil fuel ash (POFA) and rice husk ash (RHA) were used to replace 50% ordinary Portland cement by mass. Specimens were cured in water (WC), air under room temperature (AC), the combination of hot water at 60 °C for 24 h and curing in water (HWC) and air (HAC). The results showed that HAC could be an effective curing method with higher compressive and flexural strengths and lower water absorption and porosity for blended cement mortars. Mortars containing ground granulated blast furnace slag (GGBFS) in binder had higher enhancement of compressive strength under early hot-water curing, while at 24 h hot-water curing, mortar containing ordinary Portland cement (OPC)–RHA–FA binder showed better performance in properties compared to the other binders.

14.1 Introduction

Two of the most widely used materials in construction are concrete and mortar. Concrete is a widely used building material. The success of concrete comes from, on the one hand, the broad availability and low cost of its components and, on the other hand, the ease with which it can be prepared. It is a composite material consisting of cement as binder, sand and stones as aggregates and steel bars as reinforcement [1, 2]. When water is added, the cement hardens and binds together the other components. The binder of concrete is made from a mixture of cement,

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water and sand, called mortar [1]. Mortar has a very important function in a building construction, in uses such as foundations, masonry and brick walls. The functional requirements of mortar are numerous. A mortar joint acts as a sealant or a bearing pad that sticks the units together yet keeps them apart and in this sense performs as a 'gap filling adhesive' [2]. The ability of a mortar to fulfil these various roles depends not just on the mortar manufacture but also on an appropriate application for mortar. The factors to be taken into account include the environmental conditions, the composition of the masonry units involved and the applications of those engaged in the construction process. The other important characteristics of concrete and mortar, besides its strength, are its ability to be easily moulded into any form, it is an engineered material that can meet almost any desired specification, and it is also adaptable, incombustible, affordable and easily obtained. The great advantage of concrete is its excellent mechanical and physical characteristics, if properly designed and manufactured.

At the same time, the greenhouse gas emissions from the production of cement are a major contributor to global emissions, and one way of mitigating these is by using alternative binder materials. In this case study, it is considered interesting to investigate then about the utilization of supplementary cementitious materials (SCMs) due to its potential to be used in environmentally friendly mortar structures. Moreover, a study of the effect of curing temperature and hydration process of mortar also is conducted. Therefore, the experimental work on the mechanical properties of mortar will be done by utilizing artificial waste materials from industry and agriculture in the different curing conditions. In addition, this study focuses on the high-volume-level cementitious materials as partial cement replacement in mortar. This study is also conducted in the different curing conditions with and without heat process (thermal method).

The aim of this study is to evaluate the performance of ternary blended cement containing POFA by incorporating RHA and FA. The use of POFA and RHA is due to the huge availability in Malaysia. The research focuses on ternary blended cement mixes incorporating municipal wastes which are available on a huge amount in Indonesia. Furthermore, the effect of hot-water curing on cementitious mortar containing low Portland cement (25%) is also investigated.

14.2 Materials and Research Methodology

While mortar represents a half proportion of the total area in the concrete construction (approximately 30–50%), it influences the performance of a concrete significantly. Mortar serves many important functions: it bonds units together into an integral structural assembly, seals joints against penetration by air and moisture, accommodates small movements within a wall and a concrete, accommodates slight differences between unit sizes and bonds to joint reinforcement, ties and anchors so that all elements perform as an assembly. The proper selection of raw

materials, mix design and curing methods will produce a high quality of mortar, not only in terms of the strength of mortar but also the effectiveness of its use.

14.2.1 Materials

14.2.1.1 Cement

The cement used in all mixes was ordinary Portland cement (OPC). The specific gravity of cement was about 3.14. Based on particle size analysis (PSA) tests, the specific surface area (SSA) by BET method for OPC was determined to be 2667.24 m^2/kg. The chemical compositions of OPC have been determined by 'X-ray fluorescence spectrometry (XRF)' testing method. The compositions of OPC are given in Table 14.1.

14.2.1.2 Rice Husk Ash (RHA)

Rice husk was obtained from Muhairi Resources Sdn. Bhd. Enterprises, Selangor, Malaysia. The raw rice husk was burnt in a manual incinerator. The combustion process was performed using a simple furnace designed and built at the university. The temperature of incineration is up to 700 °C, and the burning duration was for 24 h. It should be emphasized that the silica is in amorphous form and silica crystals grew with time of incineration. The combustion environment affects the SSA of RHA. Hence, the time, temperature and environment must be considered in the processing of rice husks to produce ash with maximum reactivity. After burning, RHA was grind for 16,000 cycling. The specific gravity of RHA was approximately 2.11. The SSA of RHA is determined at 7667.8 m^2/kg. The colour of rice husk ash was grey.

Table 14.1 Chemical composition of OPC, POFA, FA and RHA (% by mass)

Chemical composition	OPC	RHA	POFA	FA2
SiO_2	20.14	93.25	60.17	36.43
CaO	60.82	0.41	5.23	12.71
Al_2O_3	3.89	0.62	3.25	17.10
MgO	3.10	0.42	4.60	6.79
Fe_2O_3	3.35	0.91	5.22	18.66
P_2O_5	0.064	0.86	3.35	0.271
MnO	0.14	0.09	0.12	0.179
K_2O	0.24	2.29	7.94	1.025
TiO_2	0.16	0.12	0.18	0.891
SO_3	2.25	0.10	0.11	0.579
SrO	0.02	0.02	0.01	0.063
LOI[a]	2.33	3.42	3.46	4.70

[a]*LOI* loss on ignition

14.2.1.3 Fly Ash II

Fly ash II, the most widely used supplementary cementitious material, is a byproduct of the combustion of pulverized coal in electric power-generating plants. It is available in abundance throughout the world. It mainly contains amorphous alumina silica, iron and calcium. The specific gravity of the fly ash used in the study is approximately 2.8. The colour of fly ash was grey. The chemical characteristics of fly ash II are given in Table 14.1.

14.2.1.4 Palm Oil Fuel Ash (POFA)

Palm oil fuel ash is the product of burning palm oil husk and palm kernel shell in the palm oil mill. POFA obtained from Oil Palm India Limited, Kottayam, in Kerala was used in the investigation. The specific gravity of palm oil fuel ash was 1.65. The chemical composition of POFA is given in Table 14.1.

14.2.1.5 Fine Aggregate

The fine aggregate used in the mixes was mining sand with specific gravity and fineness modulus (BS812: clause 21) of 2.65 and 2.72, respectively. The maximum grain size of sand was 4.75 mm.

14.2.1.6 Superplasticizer

In order to have appropriate consistency with low water-to-binder (W/B) ratio, superplasticizer (SP) was required. The specific gravity of SP used was approximately 1.195. It was dark brown in colour, with a pH in the range of 6.0–9.0. The consumed content of SP in the mortar depends on the replacement level of cementitious material. For a flow of 140 $\pm$ 10 mm, the SP used was 0.5–1% of the total binder.

14.2.1.7 Water

The water used in all mixes was water in pipeline of the lab. It was assumed that the specific gravity of the used water was about 1 (Fig. 14.1).

Thomas et al. (1999) studied the effect of ternary blends containing FA and SF on the strength and durability of concrete. It was concluded that the ternary blends of cement with FA and SF offer significant advantages over binary blend cement and even greater enhancements over plain Portland cement. Gesoğlu et al. (2009) investigated the effects of using FA, GGBFS and SF as a supplementary

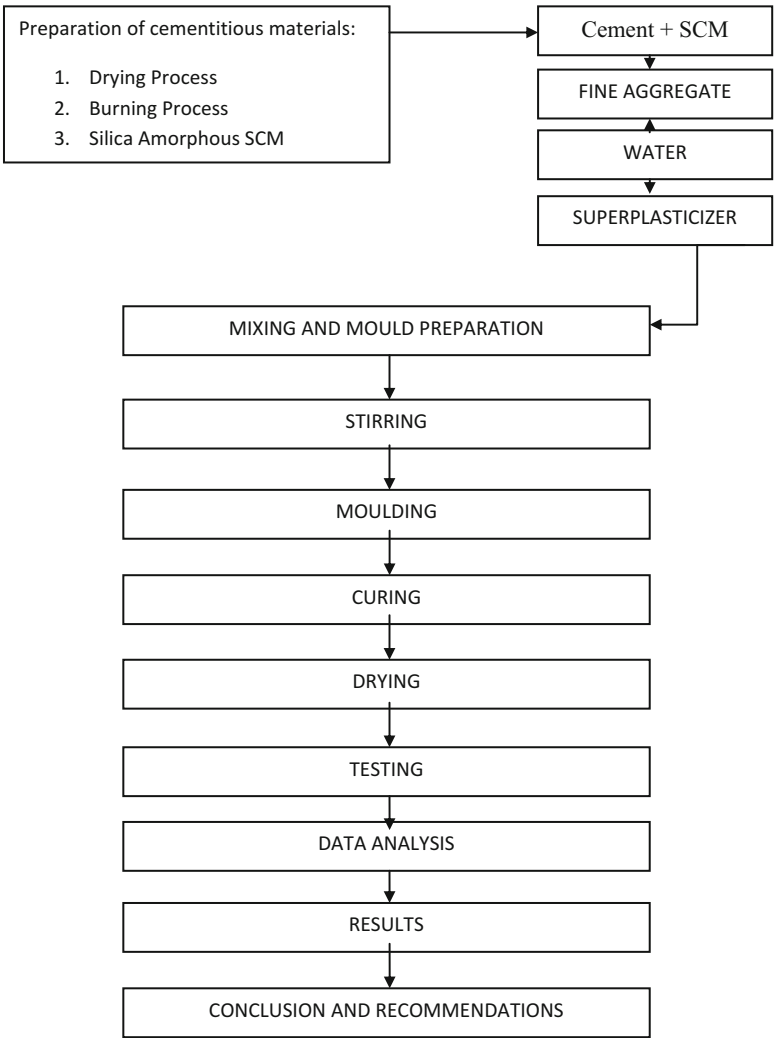


Fig. 14.1 Flow chart methodology of the research

cementitious materials in binary, ternary and quaternary blends on the fresh and hardened properties of self-compacting concretes (SCCs). It is reported that the ternary blended cement with FA and SF show higher compressive strength than binary blended cement with FA at the same level replacement. It was also reported by Güneyisi et al. (2010) who studied the strength and drying shrinkage of self-compacting concretes incorporating multisystem blended cement. The parts of experimental designs show that the compressive strength of ternary blended cement (PC + FA + SF system) was higher than that of binary blended cement (PC + FA system) at the same replacement level. Nochaiya et al. (2010) studied the utilization

of fly ash with silica fume and properties of Portland cement–fly ash–silica fume concrete. It is also reported that the utilization of silica fume with fly ash was found to increase the compressive strength of concrete at early ages. Thus, in this study the use of GGBFS, FA, RHA and POFA as a cement replacement in ternary blended cement was investigated.

The results obtained for initial thermal process are shown in Table 14.2. In concrete construction, thermal stresses and strains within the concrete will be highly influenced both by the heat transfer conditions between the curing concrete and its environment and by the concrete mixture proportions; in this scenario, one key concrete material property is the energy generated within the concrete element due to the exothermic cement hydration and pozzolanic reactions. Because the W/B directly controls the volume of water available for hydration and pozzolanic activity per unit volume of binder and also establishes the initial inter particle spacing between binder particles, it can influence semi-adiabatic temperature rise.

As described in Table 14.2, the highest strength for initial thermal process is attributed to PC mix by the incremental strength of 25% on average. The results obtained in the study for compressive strengths, based on heating time, are divided by two parts; they are:

1. Part I for mortars containing 50% OPC in ternary blended cement (PPR and PPF)
2. Part II for mortar containing 25% OPC in ternary blended cement (PGF II)

The data inventory in this table examined two subjects. The compressive strengths are obtained for different short-time heat durations and also provided the result for 1-day test immediately after demoulding. As expected, substitution of OPC by GGBFS and FA significantly reduced the 1-day compressive strength. It is due to the presence of Portland cement only 25% of the total volume of binder. The 75% remaining was substitute with 50% GGBFS and 25% FA. Furthermore, for 50% OPC replacement, it is found that the lowest reduction was observed in PPF mix by a reduction of about 47.49%, while the great reduction was observed in mixes containing POFA and RHA. The average reduction of these mixes was about 65%. It shows that contribution of POFA (from 25 to 50%) in high-volume substitution level can significantly reduce the compressive strength of mortar. The use of 50% POFA to replace OPC as a binder pointed out to be ‘dry’ paste. The product reaction has a bad workability, with the flow of 70 and 90 mm. This is

Table 14.2 The 1-day compressive strength test results in normal and early hot-water curing condition

Type of mixes	1 day without heating process	2.5 h in hot water	5 h in hot water
PC	32.53	41.10	41.60
PGF II	9.98	18.84	20.12
PPF	17.08	20.56	23.89
PPR	11.23	15.02	17.22

the main reason to combine 25% POFA with other cementitious materials such as RHA and FA. However, test results of early heating curing show that the reduction on the compressive strength can be compensated by using early hot-water curing. Hot-water curing for 2.5 h significantly improved the compressive strength of mortar containing a combination of 50% GGBFS and 25% FA. The 1-day compressive strength of the PGF II mix after 2.5 h hot-water curing was increased for almost 50%. Among two mortars containing ternary blended cement with 50% OPC (PPR and PPF), the enhancement for 2.5 h compressive strength was for mortar containing 25% POFA and 25% RHA by 25.23% improvement. Increasing the duration of hot-water curing from 2.5 to 5 h did not have any effect on the compressive strength gain. The results indicated that early hot-water curing is an effective method in order to gain 1-day strength for cement-based materials. In general, it can be specified that early hot-water curing is more effective to enhance the compressive strength if the sum of CaO content of the binder is more than SiO_2 content.

14.2.1.8 The Compressive Strength Result at Early Age for WC and AC Without Heating Process

The effect of different ultrafine ashes on the compressive strength behaviour of mortar carried out at early ages of curing can be seen in Figs. 14.2 and 14.3. The

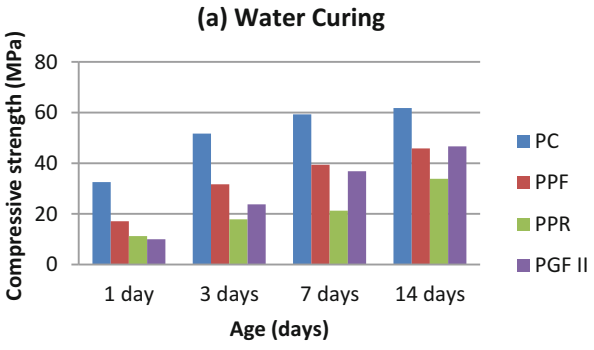


Fig. 14.2 The compressive strength of mortar without heating process at early ages for WC condition

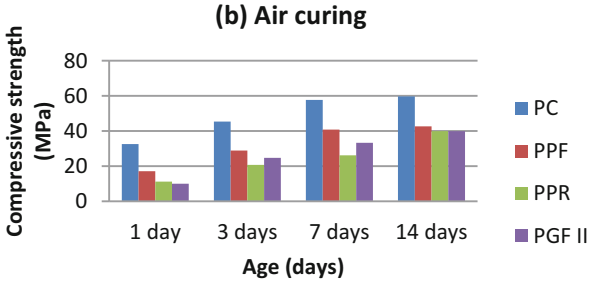


Fig. 14.3 The compressive strength of mortar without heating process at early ages for AC condition

control mortars (PC) present compressive strength of 51.67 MPa, 59.30 MPa and 61.80 MPa for 3 days, 7 days and 14 days, respectively. Comparing the compressive strengths of PPF to PC mortar, the significant differences are observed for both mixes of strength. Based on the results, it can be seen generally that at 3-, 7- and 14-day strengths, for specimens cured in the water (WC), the compressive strength is greater than the specimens cured under room temperature (AC). Reversely, PPR mortars cured in AC condition show better performance than cured in WC condition. In PPR mix in WC condition, the strength obtained increased by 16% and 47% for 7 days and 14 days, respectively. When compared to AC condition at 14 days, the strength of PPR mortar in WC condition decreased by 15%. As a conclusion, the combination of OPC–POFA–RHA (PPR) is suitable to cure under room temperature (AC) at early ages. Meanwhile, the combination of OPC–POFA–FA (PPF) is a better cure in water, due to the pozzolanic reaction going faster at the early ages for POFA–FA combination. Otherwise, RHA is a porous material. This porosity can be observed in the free water at the time of casting. This absorbed water may have a significant role for internal curing. RHA particles are obviously best prepared to absorb a certain amount of water into its pores. Then, in the lack of available water, the absorbed water can be released to maintain hydration of cement (induced). Continuously, when POFA is used in a high volume, it was shown in the trial mix that the result failed (dry/bad flow). Researchers have conducted experimental work regarding this matter in concrete production. Awal and Shehu (2013) investigated that high-volume palm oil fuel ash concrete, like concrete made with other pozzolanic materials, showed a slower gain in strength at early age. Safiuddin et al. (2011) reviewed that the use of POFA is limited to a partial replacement, ranging from 0 to 30% by weight of the total cementitious material in the production of concrete. In addition, it has a filler effect similar to FA. Therefore, mortar containing a combination of POFA and FA gains better strength compared to POFA–RHA condition.

The strength of ternary blended cement mortar containing low-volume OPC (PGFII) cured under room temperature (AC) was lower compared to the strength of specimens cured in water. It may be due to the low portion of OPC used, but the volume of GGBFS–FA is higher (up to 75%). As observed previously, FA is fine and has a high surface area, so it needs water to react well. Furthermore, the actual reactivity of GGBFS depends on its composition, glassy content as well as similarity in behaviour to fly ash (Thomas et al. 1999).

14.2.2 The Effect of Hot-Water Curing Condition on the Compressive Strength at Early Ages

Variations of compressive strength for the specimens cured in HWC and HAC conditions are shown in Figs. 14.4 and 14.5. From these figures, it can be seen that in the cases of PPF and PPR, the strengths of mortars cured in HAC are higher than those of mortars cured in HWC in all early ages. The results revealed that with the

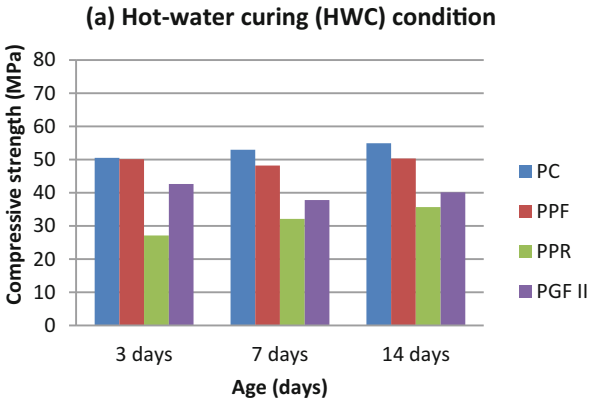


Fig. 14.4 The compressive strength result of mortar under heating process at early ages in HWC conditions

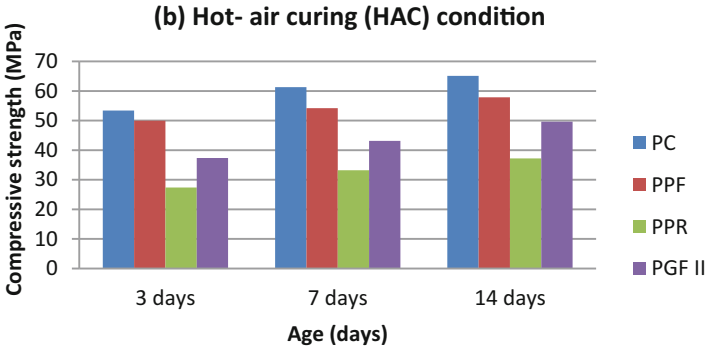


Fig. 14.5 The compressive strength result of mortar under heating process at early ages in HAC condition

use of heating process, the compressive strength of PPF mortar under room temperature (HAC) increased by on average 12% compared to PPF mortar cured in water (HWC). The results obtained from PPR mortars that were cured in HAC increased by on average 4% compared to PPR mortar cured in HWC condition. This trend shows that at early ages, PPR mortars cured in HWC have similar strength development with the PPR mortars cured in HAC condition. Comparing the compressive strength of PPR in HAC and HWC conditions, no significant differences are observed for both conditions.

In addition, when 50% GGBFS and 25% FA are used in mortar (PGF II), the strength decreased by on average 20% compared to PPF mortar under HAC condition at all early ages. Conversely, when PGF II mortars cured in HWC condition obtained lower strength by 14 and 23% compared to PGF II mortars in HAC condition for 7 days and 14 days, respectively. It could generally be said that whenever PGF II mortars are heated, it is preferred to cure under HAC condition than in water (HWC).

14.2.2.1 The Compressive Strength of Mortars for All Conditions at Later Ages

The compressive strength of the mortars in different curing conditions is continuously investigated at 28, 56 and 90 days age. The difference between curing conditions with and without heating process is described clearly using column comparison as shown in Figs. 14.6 and 14.7. It can be seen generally that HAC conditions showed the highest strength results compared with other three conditions at later ages. It was cleared that the strength of PC mortar in WC condition at 56 days can be followed by other mortars in different ages and different curing conditions. As can be seen from Fig. 14.1 without the heating process, PPF mortar achieved 60.6 MPa at 90 days, and PGF II obtained 59.73 MPa at 90 days in WC condition. PC mortar at 56 days gave lower strength than PGF II mortar but shows higher strength than PPF and PPR mortars. It is related to the presence of crystalline structure from GGBFS which can improve strengths at later ages. Generally, from the results of PPF and PPR obtained for AC condition, it was observed that the strength of PPF mortars was higher than those of PPR mortars in all later ages. The

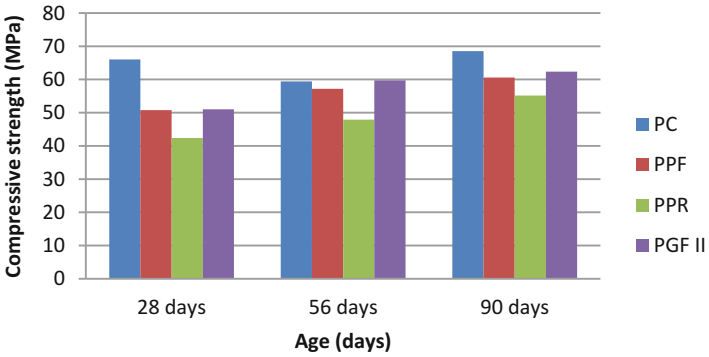
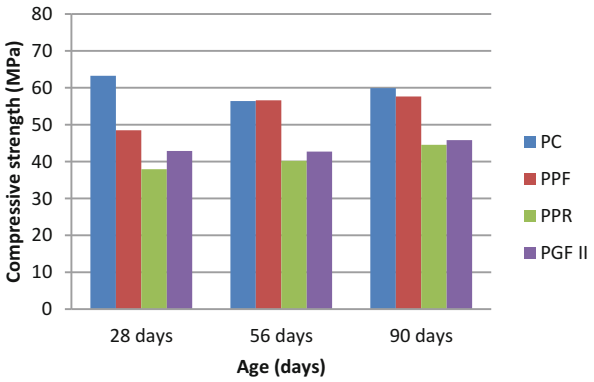


Fig. 14.6 The compressive strength result of mortars at later ages for WC conditions

Fig. 14.7 The compressive strength result of mortars at later ages for AC conditions



results revealed that compared to PPF mortar, PPR mortar under AC condition showed strength loss about on average 24%. Otherwise, PC mortar shows higher strength when compared to PPR mortar with incremental on average about 22% at all later ages. It should be noted that for the specimens cured at room temperature, the maximum relative humidity was 85% and air temperature of 27 ± 3 °C whereas for the specimens cured in water is 100% with temperature by on average 23 °C. High relative humidity and air temperature may be the reasons for strength gain for some mortars under AC condition and also for the most mortars under HAC condition.

In two curing conditions with heating process, it is seen that the strength results of mortars cured in HWC are lower than HAC. Otherwise, for PPF mortar, the strengths were improved at all ages in water curing condition with or without heating process, whereas PPR mortar gain better strength at later ages if curing under room temperature than cured in water with or without the heating process. This shows that the physical and chemical properties of RHA and POFA combined with OPC are more reactive when cured under room temperature. However, this is also affected from high-volume replacement level of cementitious materials. The encouraging results obtained were associated with the synergy between the ashes used. This behaviour can be attributed mainly to the high pozzolanic activity of the RHA and the pronounced physical effects provided by the ultrafine particles in POFA, as was observed by others. The increase or the lack of change in compressive strength of the ternary mortars, when compared to the results obtained for the PC mortar, can also be observed for long curing times. The ternary mortars present intermediate values between POFA, RHA and FA, mainly observed in the heating process at later ages.

Karim et al. (2014) reported that generally, reactivity is favoured by increasing fineness of the pozzolanic materials. The finest particles tend to concentrate near the interface between aggregate and cement matrix. The finest particle size leads to reduced porosity and enhanced internal bonding capacity of mortar at the same time. Chemical and physical properties such as fineness, active alumina and glass content are the main factors determining the pozzolanic activity and strength contribution of FA and RHA. RHA have the highest SiO_2 content, but when mixed with OPC in high volume, it will dry. This phenomenon is similar to the combination of POFA and OPC in high volume.

PGF II mortars used low volume of OPC in mixture. The results obtained in WC condition at later ages show a better performance than other curing conditions. As reported before, the OPC and GGBFS make mortar become more sensitive to air curing condition (AC). This fact can be attributed to high consistency of GGBFS in nearby water. At the stage of hydration process, the fly ash performed faster than GGBFS. It is due to the fineness particle and containing silica amorphous. So that, 50% GGBFS combine with fly ash and produced the better flow and good workability when immersed in water.

Overall, the strength comparison of two group mortars containing POFA (PPR and PPF) at the later ages showed that PPF mortars gave the highest strengths cured under HAC condition. The lowest strengths are related to PPR mortars almost in all

curing conditions, and PG mortar has medium strengths and improves steadily in all curing conditions. According to the results obtained in the study, it can be said that thermal activation with air curing (HAC) is one of the effective methods for the activation of OPC-cementitious materials. Otherwise, PC mix as the control mortar (reference) is still the highest among all ternary blended cements.

Based on curing condition criteria, the strength of the specimens cured in air at room temperature after heat process (HAC) is the highest. The second level of strength is attributed to the specimens cured in water after the heating process (HWC). The third level is for those cured in water without the use of heating (WC), and the last is attributed to the specimens cured in air under room temperature without the use of heat process (AC). This result also shows that the thermal technique like HAC is a feasible and efficient method for the activation of ordinary Portland cement with high-volume cementitious materials in mortars and concretes without the use of water to cure the specimens after the heating process (Figs. 14.8 and 14.9).

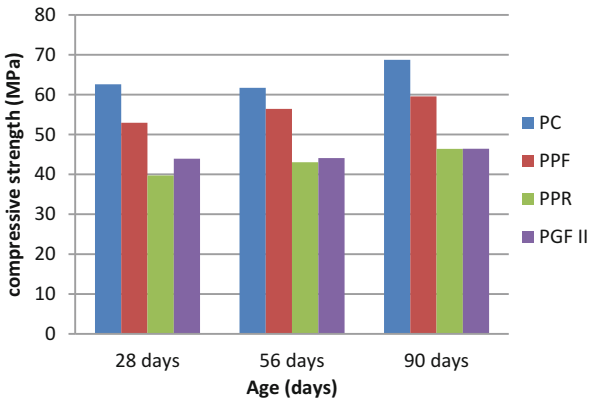


Fig. 14.8 The compressive strength result of mortars at later ages for HWC conditions

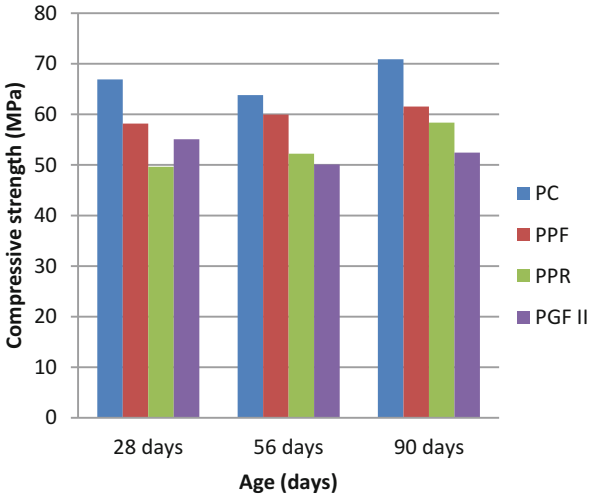


Fig. 14.9 The compressive strength result of mortars at later ages for HAC conditions

14.3 Conclusions

Mortar containing cementitious materials cured under HAC obtained the highest compressive strength results compared to the other three curing conditions at later ages. It was proved that thermal techniques (heat) like HAC are a feasible and efficient method for the activation of ordinary Portland cement with high-volume cementitious materials in mortars and concretes. Therefore, application of such methods will reduce the exploitation of water usage and save energy as well.

From the results at later ages, it is found that PRF mortars gave the highest compressive strength cured under HAC condition, while the lowest strength is related to PF mortars in all curing conditions. Therefore, the results show that the type and combination of binder play a major role in the strength improvement of the mortars in different curing conditions.

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Chapter 15
Optimizing the Use of Rainwater Harvesting at Flats as Effort to Realize Energy-Efficient Buildings: Case Study at Rental Flats in Yogyakarta

Jarwa Prasetya S. Handoko

Abstract The crisis of clean water supply for the major cities in Indonesia is an issue that arises in line with the development of more advanced cities. It is also felt in Yogyakarta. Various attempts have been made by the government in addressing the issue of clean water to meet the needs of the urban population in Indonesia. The availability of clean water for the survival function of a building should consider be considered when constructing human facilities. In this way, buildings potentially requiring large amounts of clean water should consider using it wisely to help provide solutions to the problems of urban water crisis. Rainwater harvesting is a concept that is intended to save water and manage its use to meet the water needs of a building. Utilizing rainwater is an alternative source of clean water to be used for certain activities in the building. Yogyakarta is one of the major cities in Indonesia with high population growth. This leads to an increased demand for community housing. Addressing the needs of urban settlements is continuously carried out by the government of Yogyakarta. Flats are one form of urban settlements that are currently being developed by the government. In the city of Yogyakarta, there are two high-rise buildings built by the government, namely, Dabag flats and Juminahan flats. Therefore, it is necessary to have a study that evaluates the effectiveness of the utilization of rainwater harvesting at flats in reducing the need for clean water of the flats that were examined. This was a comparative study with explorative method using any existing library with case studies of the real condition of flat buildings. This study was conducted in association with the building design of flats and the need for clean water. This was a case study of two flats in Yogyakarta. This paper is expected to provide a general description of the magnitude of the potential use of rainwater harvesting at flats in reducing the need for clean water. From this study, it can be concluded that the utilization of the potential use of rainwater harvesting at flats can reduce the need for clean water to meet the needs of its inhabitants. This will reduce energy requirements in the

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provision of clean water in flat buildings. Thus, optimizing the use of the concept of rainwater harvesting at flats may be one of the efforts to create energy-efficient buildings. This study recommends that the design of flat buildings be able to optimize the integration of the concept of rainwater harvesting. The concept of rainwater harvesting can be applied to flats as an effort to achieve an energy-efficient building.

15.1 Background

A rapid growth of population, followed by industrialization, urbanization, increased agriculture, and water use patterns, leads to water crisis (UNEP 2001). Meeting the needs of clean water for urban residents is very important. Crisis of clean water supply for the major cities in Indonesia is an issue that arises in line with the development of more advanced cities. It is also felt in Yogyakarta. Various attempts have been made by the government in addressing the issue of clean water to meet the needs of urban population in Indonesia. Water shortages are triggered by a rising demand with an increase in population, uneven distribution of water, increasing water pollution, and inefficient use of water (Chiras 2009). Regarding the high demand for clean water, alternative water sources such as rainwater utilization should be considered as a potential choice that is cheap, so as to reduce water consumption.

Rainwater harvesting by utilizing the roof of a building in general is an alternative in obtaining clean water source that requires little processing before being used for human purposes (Zhang et al. 2009). For the tropics, the energy use of fuel and electricity is generally lower compared to countries in the subtropical region that can reach 60% of the total energy consumption. This is caused by the space heating needs in most of the buildings in winter. In the tropics, on the other hand, air conditioning (AC) is only used in a small part of a building. Like other tropical countries, Indonesia consumes fuel in the form of electrical energy in about 30–60% of the total fuel consumption. However, energy savings in the building sector in tropical areas such as Indonesia remain to be done and make a major contribution to the reduction of national energy consumption.

The availability of clean water for the survival function of the building should be considered when constructing facilities. In this way, buildings potentially requiring large amounts of clean water should consider using it wisely to help provide solutions to the problems of urban water crisis. The concept of rainwater harvesting is intended to save water and manage its use to meet the water needs of the building. Utilizing rainwater is an alternative source of clean water to be used for certain activities in the building.

Yogyakarta is one of the major cities in Indonesia with high population growth. This leads to an increased demand for community housing. Addressing the needs of urban settlements is continuously carried out by the government of Yogyakarta.

Flats are one form of urban settlements that are currently being developed by the government. In the city of Yogyakarta, there are two flats built by the government, namely, Dabag flats which were built in 2009 and Juminahan flats which were built in 2008. Both flats are located in Yogyakarta. Yogyakarta government's policy to build *rusunawa* is indeed quite successful for occupancy flats.

Therefore, it is necessary to have a study that estimates the degree of the effectiveness of the utilization of rainwater harvesting at flats in reducing the water needs of such buildings that were examined. This was an evaluation study of the technical aspects of the full occupancy level made in relation to the building design of flats and their need for clean water. This was a case study of two flats in Yogyakarta. This paper is expected to provide a general description of the magnitude of the potential use of the concept of rainwater harvesting at flats in reducing the freshwater requirements of flats.

15.2 Literature Review

15.2.1 Clean Water Needs

The UNESCO (2002) established the basic human right to water in the amount of 60 liters/person/day. The regulation of the Minister of Home Affairs Number 23 of 2006 on Technical Guidelines and Procedures for Setting Tariff of Drinking Water at Regional Water Company states that the standard basic need of drinking water is 10 m^3/head of household/month or 60 liters/person/day.

15.2.2 Water Saving

As more development is done in the world, especially Indonesia, more water resources are spent. Water saving programs according to LEEDTM are mainly concentrated on the following.

1. Water-Efficient Landscaping
   By using plants, flowers, shrubs, and others as pristine area, it can limit the need for irrigation and reduce the amount of chemicals used for plants. In addition, it also uses alternative forms, i.e., with rainwater utilization.
2. Innovative Wastewater Technologies
   Potable water used to carry discharges to water treatment facilities. Efficient equipment and dry supplies require less water to reduce water use.
3. Water Use Reduction
   Maximizing the water efficiency in buildings (e.g., the use of water-efficient toilet) will reduce the burden on the water supply and urban drainage systems.

Table 15.1 Water intensity in minutes

Events occurring at any time	Rain duration in minutes (′) with intensity of liter/min							
	5′	10′	20′	40′	60′	80′	100′	120′
1 year	1.92	1.80	1.53	1.17	0.75	0.75	0.63	0.72
2 years	2.34	2.16	1.86	1.44	1.14	0.90	0.78	0.66
5 years	2.76	2.52	2.10	1.62	1.35	1.11	0.93	0.84

Source: Frick (2006)

15.2.3 Rainwater Harvesting

Wastewater is water that is already used. The categories of wastewater are rainwater, gray water, human wastewater, and industry wastewater. Rainwater can be accommodated in water facilities or returned to the ground using infiltration wells. The rainwater that is channeled to the city's public channel will increase the danger of flooding in the lower areas during heavy rains. A rainwater intensity distribution is shown in Table 15.1.

Rainwater harvesting is a method or technology to collect rainwater from the roof of a building, ground, street, or hill rocks to be used as a source of clean water supply (UNEP 2001; Abdulla Fayez and Al Shareef 2009). Based on the UNEP (2001), some of the advantages and limitations of the use of rainwater as an alternative source of clean water are given in Table 15.2.

Meanwhile, according to John Gould (2006), there are some advantages and disadvantages of rainwater harvesting (Table 15.3).

15.2.3.1 Rainwater Harvesting Quantity

To determine the total water requirements, the quantity of water required for outdoor purposes such as irrigation and reservoir (liter/day) and indoor such as showers, sinks, toilets, and leaks (liters/day) must be determined. To determine the amount of rainwater needed, there are several things that should be considered, such as the volume of water required per day, the size of the catchment, high and low rainfall, the use of rainwater as an alternative water supply, and places available.

If the volume of water needed has been determined, then the volume of rainwater that can be harvested will determine the PAH system used. The following formula can be used to calculate the volume of rainwater:

$$\text{Total rainwater captured}\left(\text{m}^3\right) = \text{high annual rainfall}(\text{mm}) \times \text{rain catchment area}\left(\text{m}^2\right).$$

The efficiency of rainwater captured is determined by the coefficient, which is the percentage of rainwater captured from PAH system that takes into account water loss, of rainwater catchment. This coefficient depends on the system design

Table 15.2 Advantages and limitations of rainwater harvesting

Advantages	Limitations
(1) Minimizing environmental impact: using any existing instruments (roofs, parking lots) can save on new instruments and minimize environmental impact	(1) Wide catchment and storage capacity are often limited, and during the long dry season, water storage areas experience drought
(2) Cleaner: rainwater collected is relatively clean, and the quality of raw water qualifies for clean water with or without further processing	(2) Rainwater harvesting system maintenance is more difficult, and if the system is not treated properly, it can have a negative impact on the quality of rainwater collected
(3) Emergencies: rainwater as a backup water supply is very important to use in an emergency or when there is interference with water supply system, especially during natural disasters	(3) When rainwater harvesting system development is widely used as one alternative, it could reduce water company's revenue
(4) As a backup water: rainwater harvesting can reduce the dependence on water supply system	(4) Rainwater harvesting systems are usually not a part of the construction of a building, and there are no clear guidelines for developers
(5) As one of the conservation efforts	(5) Government does not include the concept of rainwater harvesting in water resource management policies, and the public has not really had the instruments for rainwater harvesting in the environment where they live
(6) Rainwater harvesting is a technology that is easy and flexible. It can be built according to the needs. The construction, operation, and maintenance do not require workers with particular skills	(6) Rainwater storage tank is potential for the growth of insects such as mosquitoes
	(7) Rainfall is an important factor in the operation of rainwater harvesting system. Regions with longer dry seasons or high rainfall require a relatively larger bin

Source: UNEP (2001)

and utilization of PAH rainwater to meet water needs. For indoors, the coefficient of efficiency is 75–90%, while for outdoors, it needs 50% (UNEP 2001). Taking into account some of the factors above, the calculation of rainwater that can realistically be collected is

$$\text{Rainwater collected(runoff)} = \text{A} \times (\text{precipitation} - \text{B}) \times \text{extensive rainwater catchment},$$

where runoff is the rainwater collected (liter), A the efficiency of the collection of water, and B the absorption factor of rainfall (mm/year) and rainwater catchment area (m^2).

Table 15.3 Advantages and weaknesses of rainwater harvesting

No.	Advantages	Weaknesses
1.	Simple construction	High-cost construction. The costs in building a rainwater harvesting system are largely achieved during the development process. However, such costs can be reduced with a simple construction design and the use of local materials
	The construction of rainwater harvesting system is quite simple that local people can be trained to make their own. This can reduce labor costs	
2.	Secured care	Intensive care
	Regular care and maintenance can be monitored by the owner/manager directly	The demand of the importance of regular maintenance is often overlooked
3.	The water quality is relatively good	Swamp water quality
	Chances are better than other water sources such as wells	Polluted by bird droppings, insects, dust, and other dirt
4.	Minimal negative impact	Water supply depends on the season
	Rainwater is a renewable natural resource and environmentally friendly	Prolonged drought is thought to spend rainwater supply
5.	Near water sources	Limited supply
	Rainwater that has been collected can be directly used as water reservoirs whose distance is not far away	The supply is limited by the amount of rain that falls, vast areas of rain catcher, and water storage capacity
6.	Fulfilling the demand for clean water is increasing. Harvesting rainwater to recharge groundwater means it can increase soil water availability in a particular place and time and thus ensure continuous access and is reliable for groundwater reserves	
7.	To reduce surface runoff and drainage channels which cater for avoiding flooding or puddles in the streets	
8.	To reduce groundwater pollution and improve the quality of groundwater through dilution when groundwater is filled with rainwater so as to provide high-quality, soft, and low-in-mineral water	
9.	To provide self-sufficiency in water supply and to complement the needs for domestic water immersion at dry season and dry conditions and reduce soil erosion in urban areas	
10.	Rainwater harvesting from the roof of a building is cheaper and easier to build, to operate, and to maintain	

Source: John Gould (2006)

15.2.3.2 Rainwater Harvesting Quality

Water quality is generally very high during rainfall (UNEP 2001). Rainwater contains almost no contaminants, and therefore, water harvesting results are very clean and free from microorganism contents. However, when rainwater is in contact with the surface of the rainwater catchment, rainwater drainage, and rainwater tank, then the water will bring good physical contaminants, chemicals, and microorganisms.

Some literature shows a different conclusion about the quality of rainwater from the roof of a house. Rainwater quality is very dependent on the quality characteristics of the building such as the topography of the area, weather conditions, type of rainfall catchment, air pollution levels, type of storage tanks, and rainwater management (Kahinda et al., 2007). Wide catchment and storage capacity are often small or limited, and during the long dry season, water storage areas experience drought.

15.2.3.3 Rainwater Harvesting System Component

Rainwater harvesting systems consist of several component processes or sub-systems, namely, catching rain (collection area), channelling and draining rainwater to the storage tanks (conveyance), filter, reservoir (storage tank), drain and pump (Song et al. 2009; UNEP 2001). The place for catching rainwater is the collection area, and the materials used in the construction of the rainwater catching surface affect the efficiency and quality of rainwater collection. The materials used in the construction of the rainwater catching surface must be nontoxic and must not contain any ingredients that can degrade the quality of the rainwater (UNEP 2001).

Rainwater drainage system (conveyance system) usually consists of collecting ducts or pipes that drain the rainwater that falls on the roof to the storage tank (or cistern tanks). The collecting ducts or pipes have a size and slope installed in such a way that the greatest quantity of rainwater can be accommodated (Abdulla Fayez and Al Shareef 2009). Filters are needed to filter out the trash (leaves, plastic, twigs, etc.) that comes with the rainwater from the channel/reservoir so that the quality is maintained. Natural tanks (cistern or tank) and artificial tanks are places where rainwater could be stored. A "Dapata" rainwater storage tank is a typical aboveground tank or ground tank. First flush devices are used if the quality of rainwater is a priority, they channel rainwater discharge deposited in the early minutes so that it is discarded. The purpose of this facility is to minimize the pollutants that come with rainwater. A pump is typically required when the rainwater storage tank is underground.

15.2.3.4 Rainwater Harvesting System Type

According to the UNEP (2001), some of the rainwater harvesting systems that can be applied are divided into two categories, seen from the scope of implementation, namely:

1. Rainwater harvesting techniques on the rooftop of the building. The scope of implementation is on the scale of an individual house or building in an urban or residential area. Residents use the first technique, namely, rainwater harvesting from the roof of the building. The collected water is sufficient at household scale, with the construction of the main components of the rainwater system (or appropriate modification) being the main requirement: the roof is the catchment, collecting ducts (collector channel), filter, and rainwater tank.
2. Rainwater harvesting techniques and surface runoff by building reservoirs, such as trench dams, ponds, lakes, and so on. This system is called the ground surface system (land surface catchment areas); using the ground is a very simple method for collecting rainwater. If PAH is compared with the rooftop system, the ground system collects more rainwater from a wider catchment area. Rainwater collected by this system is more suitable for agriculture because of poor water quality. The scope of implementation is in a wider scale, usually for agricultural land in a watershed or sub-watershed region.

15.2.4 Flats

Flats are storied buildings which are divided into sections that are structured in an environment which is divided into parts structured functionally in the horizontal and vertical direction and the units each of which can be owned and used separately especially for dwellings equipped with parts together, objects together, and ground together, with the management system that embraces the concept of togetherness (UURS No. 16 of 1985).

The construction of flats is a way to solve the issue of settlements and housing needs in congested locations, especially in urban areas whose population is increasing. Simple rental flats, hereinafter, referred to as rusunawa, are residential units in high-rise building that can be used by individuals under the terms of tenancy and have a means of connecting to a public road.

Based on the Government Regulation No. 4 of 1988 on Implementation of Housing, flats can be divided into several types, namely, general flats, special flats, state flats, housing department, and commercial housing. In addition, there are several varieties of flats in Indonesia, namely, flats (rusunawa), intermediate housing (apartment), and luxury housing (condominium). Wide catchment and storage capacity are often small or limited, and during the long dry season, water storage areas experience drought.

15.2.5 Energy-Efficient Buildings

Energy-efficient buildings are defined as the energy-saving buildings designed to minimize energy usage without limiting the functionality, comfort, or productivity of the building occupants (Hawkes and Forster 2002). Meanwhile, according to Karyono (2007), an energy-efficient building is a condition in which energy is consumed minimally, sacrificing human physical comfort. Designing a building that is energy saving is one aspect in realizing sustainable architecture; according to Ken Yeang (2006), ecological design is a bioclimatic design, a design based on the climate of the locality and low energy that emphasizes the design of passive based on the integration of local ecological conditions, microclimate, site conditions, program building, design concept, and system which is responsive to climate and low energy usage.

15.3 Methodology

This was a comparative study with explorative method using an existing library of case studies of real conditions of apartment buildings. This study was conducted in association with the building design of flats and their need for clean water. This was a case study of two flats in Yogyakarta. This paper is expected to provide a general description of the magnitude of the potential use of the concept of rainwater harvesting in flat building in reducing the freshwater requirements of a flats.

15.4 Results

15.4.1 Case Study of Dabag Flats and Juminahan Flats, Yogyakarta

Dabag flats are located in the Dabag village which was built in 2009. Dabag flats are one rusunawa built in Yogyakarta. It consists of 5 floors and is divided into 198 units, each unit having an area of 27 m^2. These flats are separated into two twin blocks. The flat's roof design is divided into three parts so that it has a roof whose area reaches 2268 m^2. An image of the flat's facade is shown in Fig. 15.1 and the plans in Figs. 15.2, 15.3, and 15.4.

Juminahan flats are located in Tegal Panggung village which was built in 2008. Both locations are located in the district of Danurejan, Yogyakarta. Juminahan flats are one rusunawa built in the city of Yogyakarta. Rusunawa Juminahan consists of 5 floors and is divided into 74 units, each unit having an area of 21 m^2. This flat's roof design is divided into two parts so that it has a roof whose area reaches 620 m^2. An image of the flat's plan is shown in Fig. 15.5 and the facade in Fig. 15.6.

Fig. 15.1 Dabag flats' front facade, Yogyakarta (Source: Author's Documentation, 2015)

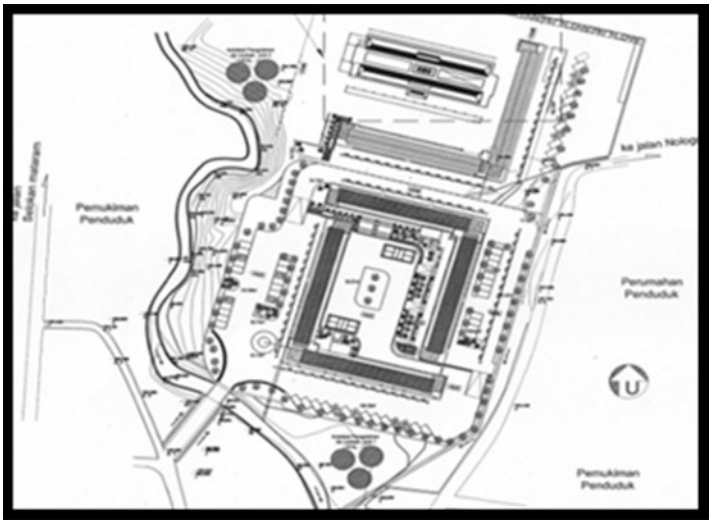

Fig. 15.2 Dabag flats' site plan, Yogyakarta (Source: Author's Documentation, 2015)

The building was built in 2010 and is located at the edge of Codé River in the middle of Yogyakarta. It is located on the outskirts of Codé River that divides Yogyakarta, and it is in a dense residential neighborhood along Codé River.

The building is used as a shelter for poor families who do not have homes, prioritized to be inhabited by people around this rusunawa. The determination of rusunawa is based on the availability of land and the socioeconomic conditions of the area. Rusunawa's early design development is based on the environmental

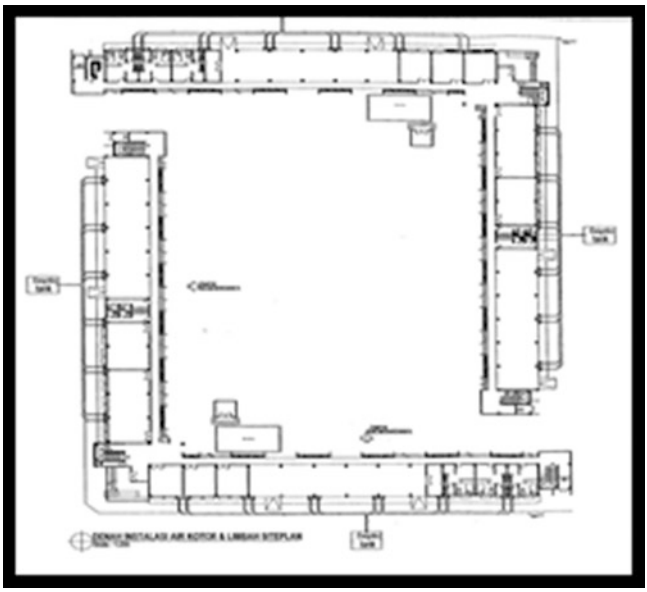

Fig. 15.3 Dabag flats' plan, Yogyakarta (Source: Author's Documentation, 2015)

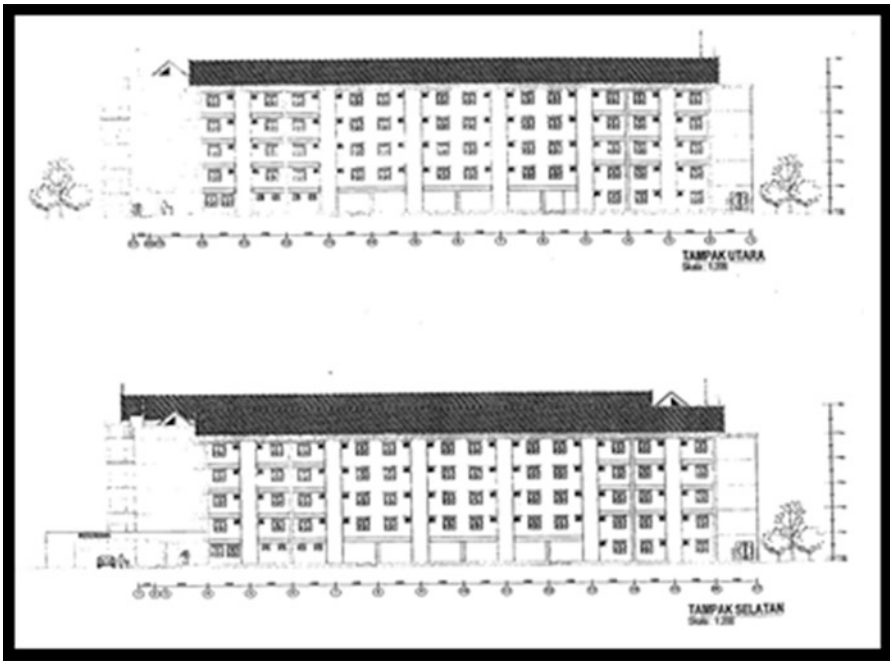

Fig. 15.4 Dabag flats' elevation, Yogyakarta (Source: Author's Documentation, 2015)

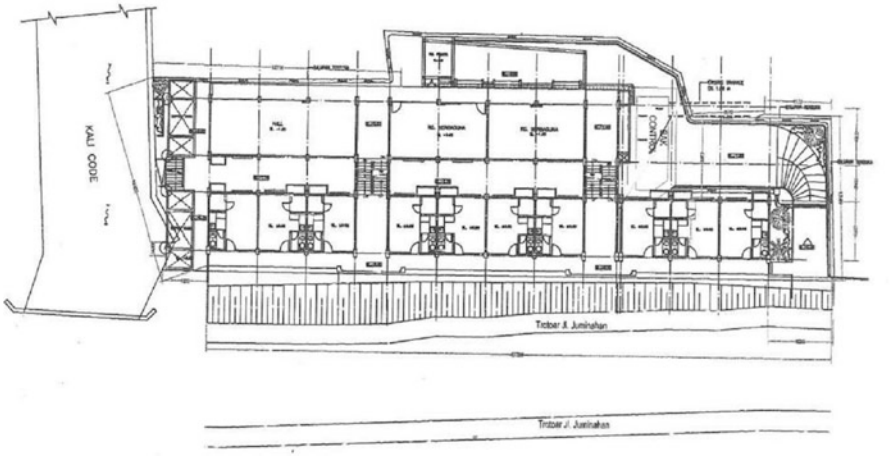

Fig. 15.5 Juminahan flats' site plan, Yogyakarta (Source: Author's Documentation, 2015)

Fig. 15.6 Juminahan flats' front facade, Yogyakarta (Source: Author's Documentation, 2015)

conditions and population density of settlements' code of concern as well as the limited land in urban areas. The provision of flats can be rented at affordable prices to low-income people, improving the quality of life in urban areas, so that in the future people can have healthy and decent homes.

15.4.1.1 Estimated Amount of Clean Water Needs at Dabag Flats and Juminahan Flats

Dabag flats have 198 units with estimated inhabitants of 3 per unit. This means that the flat is inhabited by 594 people. If the total volume of rainwater deposited at Dabag flats' roof and total water needs for each occupant is 180 liters/day, the water requirement for 1 year is 180 liters × 594 × 365 days = 39,025,800 liters.

Juminahan flats have 74 units with estimated inhabitants of 3 per unit. This means that the flat is inhabited by 222 people. If the total volume of rainwater deposited at Juminahan flats' roof and total water needs for each occupant is 180 liters/day, the water requirement for 1 year is 180 liters × 222 × 365 days = 14,585,400 liters.

15.4.1.2 Estimated Amount of Potential Harvested Rainwater

Dabag flats use a rooftop rainwater harvesting system. This apartment has a rain catchment area of 2268 m^2, with an annual rainfall of 1500 mm; the amount of water that can be harvested is determined as follows:

- With an area of 2268 m^2 and the amount of 1500 mm annual rainfall and roof runoff coefficient of 0.90, then the volume of rainwater in the area is 226,800 dm^2 × 15 m × 0.900 = 3,061,800 liter/year.
- Assuming only 90% of the total rainwater can be harvested, while the rest could not be harvested due to evaporation or leakage, then the volume that can be harvested is 3,061,800 liters/year × 0.9 = 2,755,620 liters/year.

  Juminahan flats use a rooftop rainwater harvesting system. These flats have a rain catchment area covering 620 m^2, with an annual rainfall of 1500 mm; the potential amount of water that can be harvested (the water harvesting potential) on the roof of the building is determined as follows:
- With an area of 620 m^2 and the amount of 1500 mm annual rainfall and roof runoff coefficient of 0.90, then the volume of rainfall in the area is 62,000 dm^2 × 15 m × 0.900 = 837,000 liter/year.
- Assuming only 90% of the total rainwater can be harvested, while the rest could not be harvested due to evaporation or leakage, then the volume that can be harvested is 837,000 liters/year × 0.9 = 753.300 liters/year.

15.4.1.3 Percentage Comparison Study Meeting the Needs of Water in the Flats of Rainwater Harvesting

If Dabag flats have total water needs for every occupant of 180 liters/day, then the water needs for 1 year is 39,025,800 liters. Thus, the percentage of rainwater harvesting results compared to the needs of the whole water is (2,755,620/39,025,800) × 100% = 7%. The volume of water is as much as 2,755,620 liters per year or about 7% of the total requirement of water that is needed.

If the total volume of rainwater collected in the roof of Juminahan flats and total water needs for every occupant is 60 liters/day, then the water needs for 1 year is 14,585,400 liters. From these two results, the percentage of rainwater harvesting compared to the total water requirement is (753,300/14,585,400) × 100% = 5.1%. The volume of water is as much as 753,300 liters per year or approximately 5.1% of the total requirement of water that is needed.

15.4.1.4 Optimizing the Utilization of Rainwater Harvesting in the Flats as Effort to Realize Energy-Efficient Buildings

The utilization of clean water from the rainwater harvesting results in the two flats is shown in Table 15.4.

From the comparison in the table above, it can be seen that when the rainwater harvesting system is applied to Juminahan flats, 5.1% will be able to meet the needs of clean water for all the flats' occupants; it can meet the needs for toilet flush and watering plants. As for Dabag flats, it is able to meet 7% of the water needs of its inhabitants.

The condition, the type of unit, and the estimated number of occupants for the two flats are relatively the same, so the difference in the percentage of the benefits of rainwater is more due to differences in the roof area of rainwater catchment, where the roof of Dabag flats has an average area larger than the area of the roof of Juminahan flats. This brings the percentage of Dabag flats' rainwater harvesting to be greater than that of Juminahan flats. It can be concluded that the optimal use of rainwater harvesting in flat building can be done by designing flats that have adequate roof area as a component of rainwater harvesting.

Table 15.4 Comparison of the utilization of rainwater harvesting at flats

No.	Description	Dabag flats	Juminahan flats
1	Number of unit	198 units	74 units
2	Estimation number of residents	594 persons	222 persons
3	Rainwater roof catchment area	2268 m^2	620 m^2
4	Annual rainfall	1500 mm	1500 mm
5	Flat residents' clean water needs analysis	39,025,800 liters/year	14,585,400 liters/year
6	Results of analysis of rainwater harvesting	2,755,620 liters/year	753,300 liters/year
7	Percentage of freshwater results from rainwater harvesting with the flats' overall needs of clean water	7%	5,1%

Source: Author's analysis (2015)

15.5 Conclusion and Recommendations

From this study, it can be concluded that the utilization of the potential use of rainwater harvesting in flat building could reduce the need for clean water that is needed to meet the needs of its inhabitants. This will reduce the energy requirement for the provision of clean water in flat buildings. Thus, optimizing the utilization of the concept of rainwater harvesting at flats may be one of the efforts to realize energy-efficient buildings. This can be done by designing flats that have adequate roof area as a component of rainwater harvesting.

A recommendation from this study is that the design of flat buildings should be able to optimize the integration of the concept of rainwater harvesting. The concept of rainwater harvesting can be applied to the building of flats in an effort to realize an energy-efficient building.

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Chapter 16
Thermo-adaptive-Psychological Thermal Comfort Index of PMVtapsem Development of a PMVtap Index Based on the SEM Approach

Sugini and Jaka Nugraha

Abstract The purpose of this research is to develop the PMVtapsem index model through the development of the PMVtap index of Sugini (2007) based on the method of SEM. Sugini's research in 2007 was performed by placing variables in a parallel position with multiple regression analysis; this PMVtapsem model relies on a different approach based on SEM analysis. SEM analysis forms the basis of the multilevel PMVtap model, which reflects the hierarchical structure and is therefore closer to the conceptual framework. The object of this study is an air-conditioned room with learning and office functions and inhabitants ranging from teenagers to adults with a level of activity not exceeding a metabolic level of 1.4 met. The building sample and room-zoning election are determined deliberately, and the respondents are selected randomly. The empirical data are collected by measurement and observation. Data related to attitude, physiological condition, and different psychological parameters are collected by the questioner. The PMV data are calculated with ASHRAE software. The results of this research are as follows: (1) there are five model variations of PMVtapsem that can be developed and (2) the PMVtapsem model can describe the hierarchical structure of the relational concepts between thermal comfort and variables in terms of the thermo-adaptive-psychological paradigm. However, this model is less applicable and precise than Sugini's 2007 PMVtap model.

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16.1 Introduction

16.1.1 Background

The current state of global warming is correlated with the amount of world energy consumption. The issue of energy security in the era of climate change is becoming acute (Anceschi 2012). Indonesia is the thirteenth largest energy-consuming country in the world (Resosudarmo et al. 2012). Of the total world energy consumption, 45.36% is used in buildings. Of this fraction, the largest area of energy consumption is that of air-conditioning (AC) (Wiggiton 2006). Therefore, this study is important and urgent.

The standards of room thermal comfort have been established based on the thermal index. The international thermal standard ISO 7730 is based on the predicted mean vote (PMV) thermal index, and the American ASHRAE standard is based on the SET and DISCOMFORT indexes. The Indonesia Standard SNI is based on the thermal ET. The question is how exactly indexes can be used as a basis for determining the convenient thermal range standard in a room. Among them, the PMV is an index, used as an international standard, that contains a total of six physiological-physical aspects (Sugini 2002a). However, the problem is that PMV has significant bias when it is implemented in the field (Humphreys et al. 1995; Humphreys and Nicol 2002; Brager and de Dear 1998). It has caused the prediction of the required thermal comfortable range to be excessive, resulting in wasted energy in nine official buildings in Jakarta (Karyono 1995).

Sugini (2007) proposed an index model of thermal comfort that is expected to eliminate the bias, namely, PMVtap. This model is based on the thermo-adaptive-psychological paradigm. It is the latest paradigm subsequent to the physical-physiological paradigm, which is used as a basis for the PMV model. Sugini's PMVtap model employs a regression model in linear variables that weights thermo-adaptive-psychological factors of thermal comfort equally. In one of his recommendations, Sugini proposed an alternative approach that couples a structural variable using the SEM method. This approach is expected to align with the conceptual framework of the PMVtap thermal thermo-adaptive-psychological model.

The PMVtapsem index model of development is important because it provides an additional alternative index that ensures a comfortable standard in accordance with psychological differences and corrects the model of Fanger that suffers from overestimates in tropical countries. The PMVtapsem model is expected to provide more precise thermal comfort standards in air-conditioned spaces to reduce energy waste. Ultimately, attention to energy consumption can improve energy security.

16.1.2 State of the Art of the Domain of the Thermal Comfort Paradigm and Resulting Research

Based on the taxonomic study of thermal comfort and research mapping (developed from Sugini 2002b), the study of thermal comfort with the thermo-adaptive-psychological approach is still limited. However, this approach is believed to be capable of eliminating bias in research into the thermo-adaptive-physiological approach. Thus, research addressing thermal comfort based on the thermo-adaptive-psychological paradigm is necessary and important. The concept of thermal comfort has developed based on a shift of the thermal comfort paradigm. It has moved from a thermo-physiological paradigm to a thermo-adaptive-physiological paradigm and then to a thermo-adaptive-psychological paradigm.

Based on Fanger's work, the basic concept of the occurrence of thermal comfort is the maintenance of heat balance. In the process of body metabolism, sideline products such as body heat occur. This body heat is constantly transferred to the environment. At equilibrium, the rate of production of body heat and the speed at which body heat waste enters the environment are balanced. In such a condition, one experiences a heat balance. The amount of heat waste is coupled to parameters such as radiation, conduction, garments, and evaporation.

The thermo-adaptive-psychological paradigm states that thermal comfort is determined not only by the proportion of body heat but also by a process in which psychological thermal comfort determines the achievement of convenient thermal comfort (Auliciems 1989)

Sugini (2004) proposed a conceptual framework for thermal comfort termed thermal thermo-adaptive-psychological comfort. This concept states that psychological differences between individuals determine thermal comfort. The framework was then revised in his dissertation in 2007.

16.1.3 Research on the Thermal Index Model

At the end of 1923, Houghten, Yaglou, and his colleagues pioneered studies that led to a search for a thermal index. Three physical parameters, namely, air temperature, humidity, and air velocity, are combined in the effective temperature (ET) equation. Based on reports by Koenigsberger and Mayhew (1973), Markus (1980), Fanger (1982), and Sugini (2007), Sugini in 2012 then identified a number of thermal indexes that have been developed, namely, equivalent warmth (EW) (Bedford, English),operative temperature (OT) (Winslow Herington and Gagge, USA), the equatorial comfort index (ECI) (Webb, 1960, Singapore), and resultant temperature (RT) (Missenard French); predicted four-hour sweat rate (P4HSR) (Naval Authority 1947 British), heat stress index (HIS) (USA), graphics bioclimatic (V. Olgyay, Australia), and index of thermal stress (ITS) (Givoni); and predicted percentage of dissatisfied (PPD) (Fanger 1982), PMV (Fanger 1982), and PMVtap (Sugini 2007).

In 2007, Sugini developed a thermal index model (termed the PMVtap thermal thermo-adaptive-psychological index) based on a conceptual framework of thermal thermo-adaptive-psychological comfort. This work was published as *The Index of PMVtap Reformulation of Thermal Comfort Index Base Model on Thermoform able sandwich concept-Adaptive-Psychological Paradigm* (Sugini 2012).

Sugini's PMVtap model is based on multiple regressions by weighting psychological difference variables equally.

The form of model is as follows:

$$\text{PMVtap} = \text{PMV} + \hat{\text{Y}}\text{vorpmv} \tag{16.1}$$

The PMVtap index is formed by a parameter comprising the PMV (in terms of air temperature, radiant temperature, air humidity, and air velocity) and the parameters that determine the Ŷvorpmv. The Ŷvorpmv is determined by the parameters of the variables related to psychological differences between the individual occupants.

The general model (a model that can be treated in the population within the scope of its limitations) of the general Ŷvorpmv is as follows:

Ŷvorpmv general = 0.712 **d1** + 0.803**d2** + 0.238 **xls6** + 0.044 **dxls13**–0.892 **dxk8–**0.233**dxk2**

Thus, the general model of the PMVtap is as follows:

PMVtap general = **PMV**+ 0.712 **d1** + 0.803**d2** + 0.238**xls6** + 0.044 **dxls13**–0.892 **dxk8**–0.233**dxk2**

This formula shows that the Ŷvorpmv is defined in terms of the thermal comfort of the occupant to the room (d1 and d2), the type of room ventilation (dxk8), the duration in the air-conditioned room (xls13), the economic status as characterized by personal income (xls6), and the quality of the room distress determined by the occupant's assessment of furniture density or objects (dxk2).

Sugini's PMVtap model addresses the bias inherent in the PMV model in real rooms through the Ŷvorpmv score; it thus achieves its purpose to identify a model of thermal thermo-adaptive index comfort through the development of PMV by managing bias. Bias management can be performed by searching for the bias association by variation of the parameter variables' individual psychological differences. The multiple linear regression analysis method is used to order the parameters in position in a row. It is important to complete the thermal index model of the thermo-adaptive PMVtap model by incorporating a psychological approach through further analysis. Her recommendations have mentioned the need to develop the model by incorporating the SEM approach. For this reason, the research proposed in this proposal is important and interesting in terms of scientific development in the field of thermal comfort. This development is expected to benefit the development of practical knowledge of the thermal convenient range.

16.1.4 Research Problem

The research problem is the development of the PMVtapsem variation index model and its comparison with the PMVtap model (Sugini 2007).

16.1.5 Specific Objectives

The specific aim of this research is to develop model variations of the PMVtapsem thermal thermo-adaptive-psychological index comfort with the SEM approach.

The PMVtap model is based on empirical studies in the scope of a building population with office room functions and classroom/study locations with level 1.4 metabolisms. This model is restricted to office rooms and classroom/study locations to limit population variations that would complicate the comparison between older models and the current results.

16.2 Design and Research Method

16.2.1 Population and Sample

The research population involves learning and office rooms containing occupants ranging from youths to adults, with a metabolic level no higher than 1.4. The selection of building samples, rooms, and room zoning was determined deliberately based on the objective of the respondents' characteristics. At the level of individual occupants in the building, the respondents were chosen randomly. The number of samples was 910. According to the respondents' characteristics, six SEM models were derived.

The samples in the empirical stage included as many as seven buildings spread across North Yogyakarta (Sleman), Middle Yogyakarta (Municipality), South Yogyakarta (Bantul), and West Yogyakarta (Kulon Progo). In the second part, new data were collected from additional samples from as many as 417 respondents.

16.2.2 Data Collection and Analysis

In the development of the empirical model in the field, the data were collected in multiple ways. Opinion, the perception of the thermal and other room qualities that were appropriate, and data related to psychological variations were recorded

through a survey. The objective data of thermal and other qualities that were possibly related were collected by instrument measurement or by observation.

To observe the relationship between variables, it is often the case that each variable cannot be measured directly through observation. Variables such as these are called latent variables; they are observed through an indicator. Multiple regression analysis is a statistical method analysis to construct a model or patterns of relationships between independent variables and the interplay between variables. Analysis factors are used to formulate a relationship between the latent and indicator variables. SEM is a combination of regression and factor analysis. SEM is a type of statistical modeling approach used to explain the relationship between variables. Relations between the variables in SEM are produced through a series of similarity regression analyses. The interplay of the dependent variables of the regression equation became independent variables of another regression equation (Hair et al. 1998). SEM is a useful statistics tool for researchers in all fields of social knowledge and can be used to test a theory (Bentler 1980).

Different SEM software implementation types exist, including linear structural relationships (LISREL), AMOS, and EQS. LISREL is the most common program used for SEM and is often referenced in various scientific journals in various disciplines (Austin and Calderon 1996). Gefen et al. (2000) determined that in three Information System journals examined from 1994 to 1997, LISREL was used more often than EQS and AMOS.

The analysis of SEM includes three stages: model conceptualization, flowchart formulation, and model specification (Gozali 2005). Model conceptualization is associated with developing a hypothesis (based on the theory) as the basis in linking latent variables with other latent variables and other indicator variables. The path diagram construction simplifies visualization of the hypothesis advanced during model conceptualization. The model specification is the stage of determining the number and characteristics of parameters being estimated.

16.3 Results and Discussion

16.3.1 Sample Description

The sample empirical data indicated that the average of air temperature was 28.4 °C, the wind speed (air velocity) was 0.06 m/s, the relative humidity was 51%, and the radiation was approximately 29.84 °C. The condition of physiological variables of thermal comfort of the occupants of the level of clothing was 0.74 with a 1 met level of metabolism.

Based on the measurements and observation, the occupants' opinions on thermal and other variables related to thermal comfort to the room based on the PMV index can be recorded. Data analysis was performed using ASHRAE software. It was

determined that the average of thermal comfort according to the PMV index was 1.4, while based on the voting respondents (VORs), the thermal comfort was −0.19.

Data analysis included the *paired samples test* to indicate significant differences. For that reason, model management included different VOR values with the PMV (VOR-PMV). The range difference based on a difference in the average of two indexes was 1.6287, in which the PMV-predicted room quality was higher than the occupants' perception. Thus, the PMV overestimates this parameter. This finding is consistent with those of Sugini (2007) and certain other reports.

16.3.2 Analysis of PMVtapsem Model Development

According to the aim of the research, the analysis is performed again with SEM in two stages: mathematical simulation and empirical stages. The analysis of the mathematical simulation and empirical stage was performed using multiple simulation conditions to produce the path diagram scheme shown in Fig. 16.1.

When the model was tested based on the application aspect in predicting, it predicted the possibility of relational patterns between the factors of "vorpmv," "past," "social," and "present" (i.e., the (e) model). This model produced an RMSEA score of 0.087. The factor of "social" indirectly influenced the score of "vorpmv." It influenced the score of "vorpmv" through the factors of "past" and "present."

The PMVtapsem index model can be formulated as follows:

$$\text{PMVtapsem} = \text{PMV} - 0.02\,(\text{thermal lifestyle}) - 0.1(\text{temporary room condition})$$

where:

$$\text{Thermal lifestyle} = -0.7(x7) - 0.6(x8) - 0.13(X10) + 0.23(x11) - 0.17(\text{social})$$

$$\text{Temporary room condition} = 0.66(x29) + 0.71(x30) + 0.32(x31) + 0.11(x32) + 0.37(x33) + 0.3(x34)\ 0.19(x36) - 0.13(\text{social})$$

$$\text{Social} = 0.46(x1) + 0.98(x2) + 0.55(x3) - 0.03(x4) - 0.1(x5)$$

By incorporating the past thermal experience of the occupant, it can be concluded that the thermal comfort is determined by physiological-physical aspects and psychological differences that are defined by activities related to the thermal and temporary room condition. These physical and physiological variables are measured with the PMV index parameter, and the psychological difference is characterized by the two psychological variables of thermal lifestyle and temporary room conditions. Hierarchically, they are determined by social conditions.

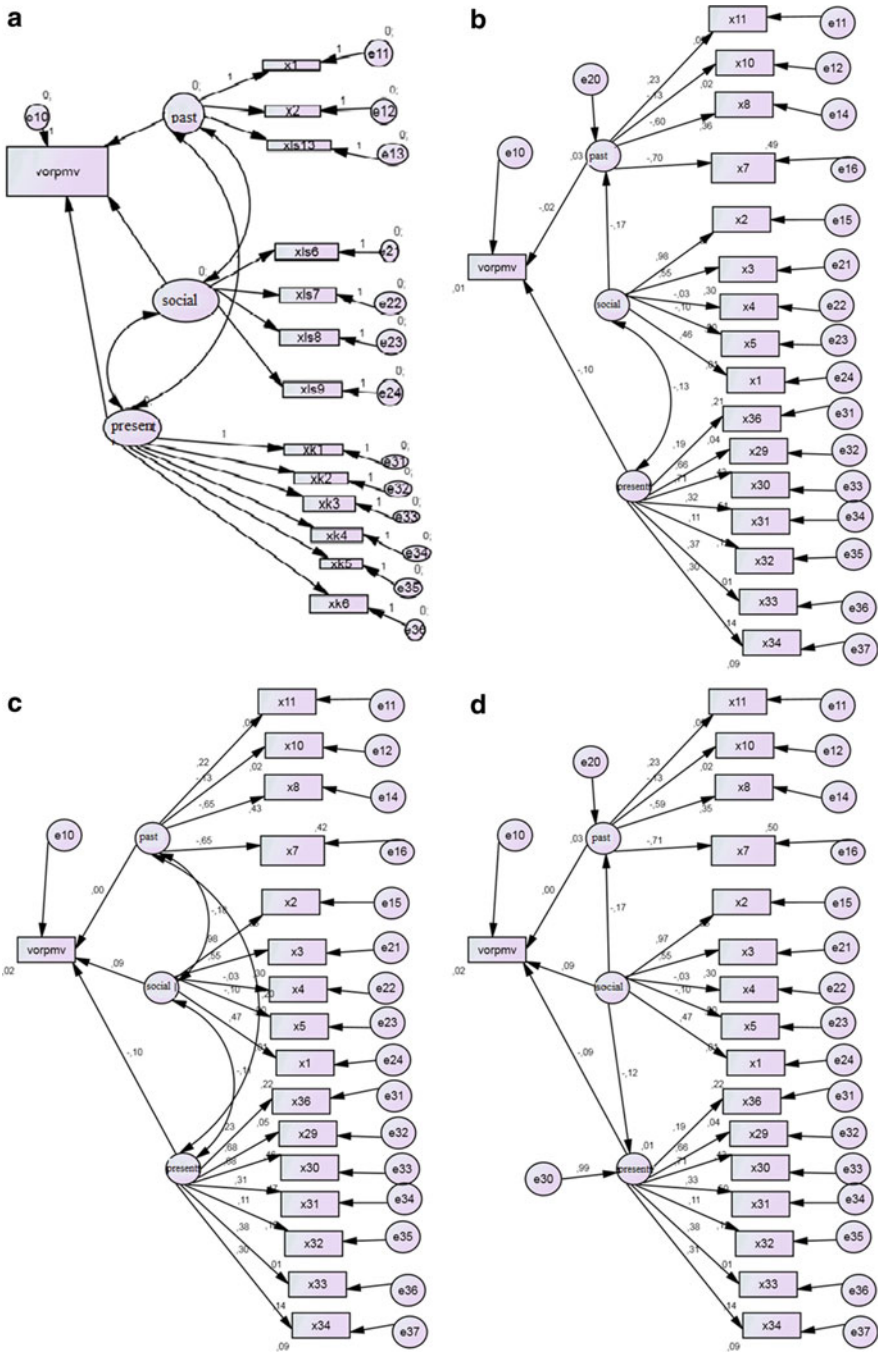

Fig. 16.1 PMVtapsem model-based path diagram analysis of SEM. (**a**) *Model a*: better with mathematical approach. (**b**) *Model b*: alternative 1 with empirical approach. (**c**) *Model c*: alternative 2 with empirical approach. (**d**) *Model d*: better empirical approach. (**e**) *Model e*: the best model

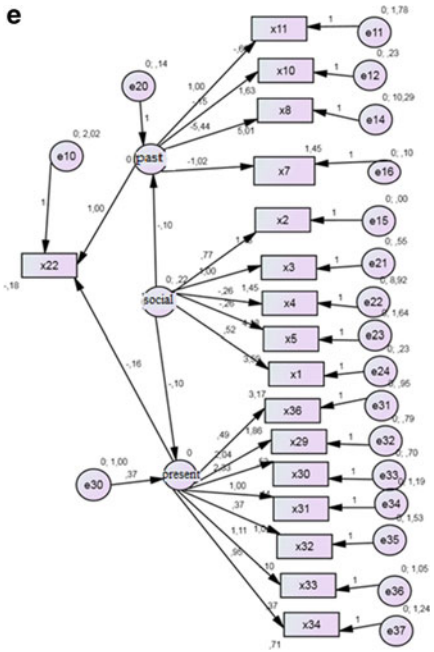

Fig. 16.1 (continued)

16.3.3 Comparison of PMVtap Model (Sugini 2007) and PMVtapsem

Taking the PMVtapsem thermal index model as the previously existing control, the thermal comfort paradigm based on the consistent thermo-adaptive-psychological paradigm can be continuously tested conceptually and practically. The findings support the accuracy of the thermo-thermal-adaptive-psychological comfort paradigm proposed by Sugini in 2007.

From the prediction ability of thermal comfort range, the best model of PMVtap as elaborated above has a lower predictable ability than that of Sugini's 2007 model. The correlation score between the predictive score and score X22 is equal to 0.120333, which is still far lower than Sugini's PMVtap model from 2007, which has a correlated score of 0.598519.

It can be concluded that SEM analysis can illustrate the relational pattern to the clear factor; for arranging indexes, however, another method should be used for regression analysis.

Conceptually, based on the model described in the previous sections, the variables that determine thermal comfort can be delineated. Those variables are as follows:

1. Physiological physical variables, namely, (a) room micro climate, (i) air temperature, (ii) average radiant temperature, (iii) air humidity, and (iv) wind speed, and (b) physiological, (i) activities and (ii) clothes.
2. Psychological variables of differences as follows:

   (a) Past thermal experience corresponding to thermal lifestyle. The past thermal experience is determined by the following: (i) daily ventilation types at office/work room/class, (ii) daily time duration in the AC room, (iii) freedom to control daily room ventilation, (iv) thermal comfort experience, (v) room thermal comfort image that will be occupied, and (vi) social status
   (b) The degree of occupation as characterized by perception: (i) degree of crowding, (ii) object density, (iii) lighting, (iv) degree of openness, (v) room noise quality, and (vi) room facilities

   Additional components are (vii) the types of room ventilation and (viii) social conditions.

3. Social condition. Thermal experience or thermal lifestyle and comfortable temporary room perception were determined by social status, which is dependent on the following: (i) level of education, (ii) type of work, (iii) personal income, (iv) family income, and (v) number of people in the family

A comparison between the PMVtap model of Sugini (2007) and the PMVtapsem model is shown in Fig. 16.2.

Regarding the PMVtapsem model, the result of this research describes variable relationships that determine hierarchical thermal comfort in accordance with the theoretical concept. This concept complements the study of the PMVtap model presented by Sugini in 2007 that models variable relationships to varying degrees.

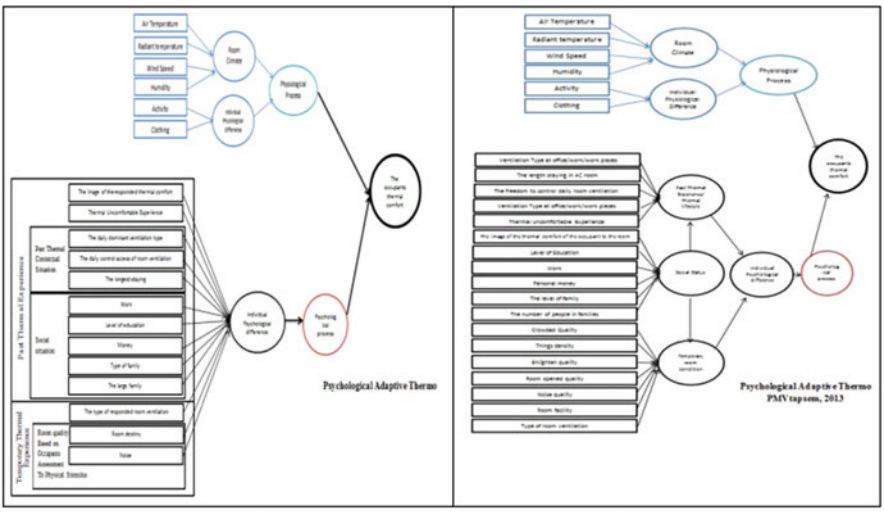

Fig. 16.2 Comparison of PMVtap model by Sugini (2007) and PMVtapsem

Based on the implementation aspect, the PMVtap model can explain the hierarchical structure of the variable relationship based on the concept, but for the sake of the application of standard determination and the prediction of thermal comfort distance, the thermal index of Sugini's PMVtap 2007 is easier to implement.

16.4 Conclusions

Based on the descriptive and comparative analysis, it could be concluded that PMVtapsem model can describe the relationship of variables that determine hierarchical thermal comfort in accordance with the theoretical concept. This study successfully developed five variations of PMVtapsem models, of which the best model is number five. The PMVtapsem index is a function of the PMV, thermal lifestyle, and temporary room condition. PMVtapsem = f{PMV, thermal lifestyle, and temporary room condition}. Thermal lifestyle: Thermal = f{type of daily workplace ventilation, length staying in AC room, the freedom to control daily room ventilation, thermal discomfort, the image of the thermal comfort of the occupant to the room, and social conditions}. Temporary room condition = f {occupants' perception of crowdedness, occupants' perception of object density, occupants' perception of room lighting, occupants' perception of degree of openness, occupants' perception of room noise quality, occupants' perception of room facility, and social conditions}. Social conditions = f{level of education, work, personal income, total family income, and number of people in the family}.

The room thermal comfort is determined by both the physiological-physical variables and the past thermal experience or thermal lifestyle and temporary room conditions. The thermal lifestyle is determined by the daily type of ventilation in the office/work room/class, the daily duration in the air-conditioned room, the freedom to control daily room ventilation, the thermal discomfort, the room thermal comfort shadow that will be occupied, and the social status. The temporary room conditions are determined by the degree of crowding, object density, room brightness, degree of openness in the room, room noise quality, facility, types of room ventilation, and social status. Social status is determined by levels of education, occupation, personal income, total family income, and the number of people in the family.

Based on a comparison with the model of Sugini 2007, it is concluded that the PMVtapsem model can better describe hierarchical structure of variable relation, but for the application of standard determination and the prediction of thermal comfort range, the thermal index of Sugini's PMVtap from 2007 is better and easier to use because it is simpler and more precise. Significant differences exist between the thermal comfort quantified by the PMV thermal index and the user response in the field. This condition is consistent with Sugini (2007) and certain other reports.

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Chapter 17
A Review on the Values of the Islamic Garden in Response to a Garden Design in Malaysia

Haza Hanurhaza Md Jani, Nor Zalina Harun, Mazlina Mansor, and Ismawi Zen

Abstract This chapter aims to investigate the physical characteristics of the Islamic garden and discover the values which can be adapted to a garden design in Malaysia. The chapter reviews several significant aspects for developing an understanding of the Islamic garden and its characteristics. There are two methods embedded in the chapter, namely, document analysis and semi-structured interviews. The outcome of the chapter highlights the importance of strengthening an understanding of the Islamic garden as a key to protecting and perpetuating the legacy of the Muslim civilisation.

17.1 Introduction

Human civilisation has seen many prominent types of gardens. Archetypal examples include the English, Japanese, French and Islamic gardens. Among those influential types, the Islamic garden is of course highly associated with Islamic civilisation and perceived as its legacy. For that reason, this research intends to determine the degree of the importance of the value in a context of the Islamic garden. The research also focuses on identifying the physical characteristics that represent and reflect the image of the Islamic garden. With this intention, this chapter is intended to define the term value from the perspective of several fields of study. Another key point is to develop a list of physical characteristics exemplifying the Islamic garden. The two keywords highlighted are 'values' and 'Islamic gardens'.

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According to the *Longman Dictionary of Contemporary English* (Procter 2001) as well as Trompenaars and Hampden–Turner (1997), values are defined 'as the degree of usefulness or desirability of something, especially in comparison with other things'. Correspondingly, the term value is defined in *Collins English Dictionary* as 'the desirability of a something, often in respect of any property such as usefulness or exchangeability, worth, merit or importance'. The term is defined in most dictionaries as the quality of something that is desired by someone because of the degree of its importance and usefulness. However, the term value may be slightly different in the certain field of study with regard to the scope of the research. Correspondently, this chapter evaluates the definition of value from the perspectives of historical study, Islamic study, urban sociology, behavioural science, human geography and architecture and finally from the viewpoint of landscape architecture. The purpose of approaching the term from several different angles is to discover the appropriate definition of value in the context of the Islamic garden.

The Islamic garden is widely recognised as being typified by the gardens established during the peak of the Muslim civilisation (Ruggles 2008). The first Islamic garden was inspired by the interpretation of a garden by the Al-Quran. In light of that, the gardens developed in Muslim civilisation are regarded as a metaphor of the garden of paradise as interpreted by the Quran. The Islamic garden created in Persian and Andalusian regions is observed as a resemblance of the garden in paradise (Nazia Ansari 2011). In spite of the resemblance, the garden is also viewed as a garden space for reflection and resting and more importantly as a reminder of the oneness of God (Ruggles 2008; Nazia Ansari 2011). Therefore, this research has been carried out to identify the definition of values and the physical characteristic of the Islamic garden. The research contributes to determining the values of the physical characteristic of the Islamic garden that can be adapted to a garden design in Malaysia. In particular, Malaysia is in the process of reapplying Islamic principles into their governance system. Thus, the notion of adapting the value of the Islamic garden into a garden design is perceived as a consistent effort and in line with the current movement made by the government.

17.1.1 Problem Statement

Several recognisable Islamic gardens were formed in Muslim civilisation, such as the Persian, Andalusian and Mughal garden. The first establishment of the Islamic garden was during the seventh century through the development of the Persian garden. The Persian garden is considered the pioneer of the Islamic garden, and it has significantly influenced other prominent Islamic gardens such as the Andalusian and Mughal garden. Although the establishment of the Islamic garden began during the seventh century, it started to be recognised by the European culture during the seventeenth century. From that point onwards, the influence of the Islamic garden spread throughout the world until the beginning of the twentieth century.

Unfortunately, such inspirations are slowly disappearing, and one of the reasons is the interference of the modern movement. There are four reasons that lead to the decreasing number of the Islamic gardens, which are (a) the decline of Muslim civilisation, (b) the interference of the modern movement, (c) deficiency of physical evidence and (d) attention on the focus of the Islamic garden. These issues are caused by (a) the loss of the Muslim culture and heritage; (b) incapability to recall, continue and protect the legacy of the Islamic civilisation; and (c) inability to adapt the values of the Islamic garden into modern garden design.

Therefore, this research is conducted to investigate the physical characteristics of the Islamic garden based on three prominent gardens which are the Persian garden, Andalusia in Spain and Mughal garden and to discover the values adapted to a garden design in Malaysia.

17.2 Literature Review

This section discusses two main topics, which are the definition of value in the Islamic garden and the review of the Islamic garden.

17.2.1 The Definition of Value

According to Dictionary.com Unabridged (2015), the term value is defined as 'intrinsic excellence or desirability. Value is the quality of anything which renders it desirable or useful. Worth implies, especially spiritual qualities of mind and character or moral excellence'. However, the term value varies depending on the field of study. For that reason, seven disciplines of the study were reviewed in this chapter, namely, historical study, Islamic study, urban sociology, behavioural science, human geography, architecture and landscape architecture. A summary of the definitions is presented in Table 17.1.

Based on these definitions, the operational term used to describe value in this chapter is 'the quality of something that is desired by someone or decided by the society based on the degree of its importance and usefulness. The desired preference is consistent, it involves physical and emotional charged, and the recognition of it is put into action'. According to this operational term, there are four phases used to evaluate the term value. Firstly, value is related to the word importance and society. Secondly, value is defined based on the degree of its usefulness and importance. Thirdly, value strives for consistency. Fourthly, value can be seen after people put action behind it.

Table 17.1 The definition of value

Discipline	Definition
Dictionary	The quality of something that is desired by someone because of the degree of its importance and usefulness
Historical study (HS)	Value arises from a ranking, and the classification of the rank is decided by a society based on its importance
Islamic study (IS)	The concept of value in Islam is a standard on which we judge an action to be right or wrong based on Quran and Sunnah
Urban sociology (US)	Value has its worth and importance; subject; community and national oriented; the result of interaction between personal and impersonal elements; and the desired preference and strong belief put into action
Behavioural science (BS)	Values are persistent through time and have clear directionality as elements in culturally or individually distinctive patterns are interrelated. It is a concept or belief and desirable state, surpasses specific situations and is an evaluation of behaviour ranked based on importance
Human geography (HG)	Values can be defined as learned, relatively persistent and not necessarily consciously, emotionally charged and represented as moral conceptualizations that assist us in making judgements and in preparing us to act
Architecture (A)	The value in architecture or landscape architecture depends on the degree
Landscape architecture (LA)	Of how people look and can relate to the design. It is more than just mere functionality but can also reflect the character and spirit of the place. It is influenced by the principles of composition, people's needs, symbolism or identity and individual artistry of architectural creators

17.2.2 The Definition of Value

According to the Operational Guidelines (2008) by UNESCO, the term garden falls under the first classification of a cultural landscape, which is a clearly defined landscape designed and created intentionally by man. This embraces garden and parkland landscapes constructed for aesthetic reasons which are often associated with religious or other monumental buildings. An Islamic garden is a garden influenced by Islam. Formerly, the Islamic garden was designed as an earthly symbol of paradise. The term Islamic garden was first acknowledged during the establishment of the Persian garden in the seventh century (Haaga 2005). It is claimed as the basis for the Islamic garden. The inspiration of the Persian garden has been adopted in several other prominent Islamic gardens, for instance, Moghul gardens in Kashmir, India, and Alhambra and Generalife in southern Spain. The influence of the Spain garden has spread throughout the world until the twentieth century, and the evidence of the influence can be traced, for instance, the revival garden in California and Mexico. The Islamic garden promotes the concept of simplicity. Therefore, the sense of the Islamic garden is well adapted to the modern world.

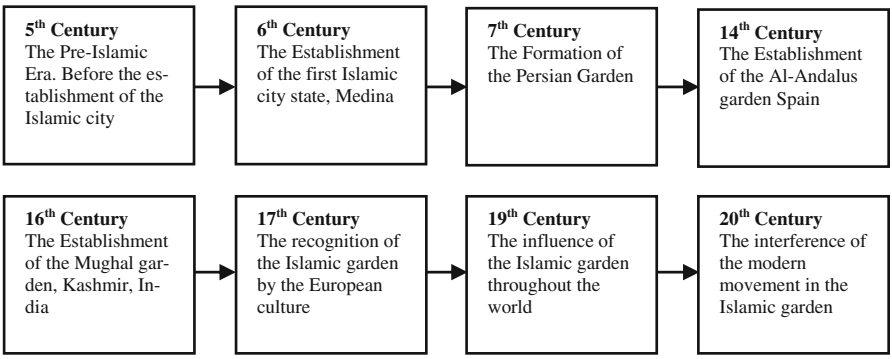

Fig. 17.1 The chronology of the Islamic garden

The inspiration of the Islamic garden first catches the attention of the European culture in the seventeenth century before it slowly disappears due to the modern movement. The chronology of the Islamic garden is as follows (Fig. 17.1).

Research has shown that the establishment of the Islamic garden starts in the early seventh century until the present time. In the meantime, the implementation of the Islamic garden has slowly been adapted into the garden design. There are several prominent Islamic gardens that have been recognised after the establishment of the Persian garden. Examples include the Andalusian garden in Spain and Mughal garden in India.

17.3 Methodology

This study is based on a qualitative research methodology. There are two methods embedded in the research, namely, document analysis and semi-structured interview. The document analysis is adopted in the research to identify the evolutions and influences of the physical characteristic of the Islamic garden. Moreover, the method is intended to discover the definition of value in the Islamic garden and how it has affected the adaptation of the Islamic garden in a garden design in Malaysia. Meanwhile, a semi-structured interview is conducted to support the data gathered from the document analysis. The findings of this research emphasise three important aspects, namely, (a) the evolutions and influences of the physical characteristic of the Islamic garden, (b) the definition of value in Islamic garden and the significance of adapting the value in a garden design in Malaysia and (c) the relevance of adopting the Islamic garden from an Asian perspective, especially in Malaysia. The flow of the research is presented in Fig. 17.2.

The outcome of the research highlights the importance of strengthening an understanding of the Islamic garden. The appreciation towards the Islamic garden can be developed after increasing the level of the knowledge on (a) what is the Islamic garden, (b) why it is important to preserve and (c) how it can be sustained.

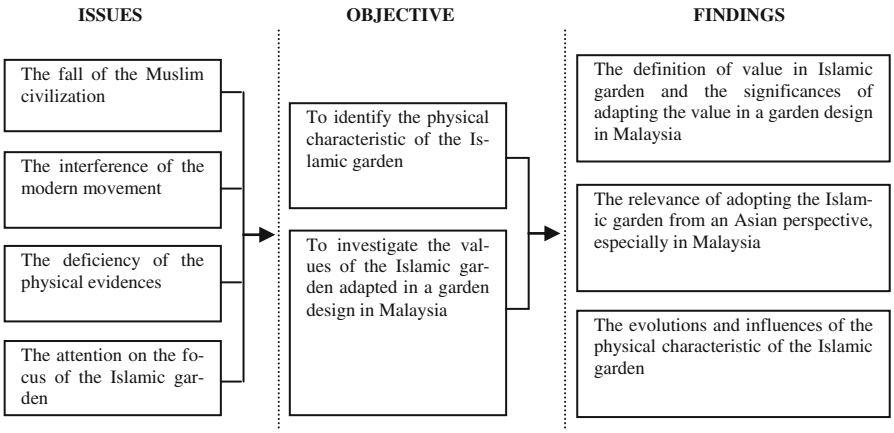

Fig. 17.2 The flow of the research

Other than that, this research addresses on the significance of adapting the value of the Islamic garden in a garden design from an Asian point of view, specifically in Malaysia. Malaysia is recognised as an Islamic country but is comprised of a multireligious and multi-racial society. Hence, this research emphasises the implications of the Islamic garden for an Islamic nation, especially in an environment involving the heterogeneous society.

17.4 Findings

The findings of this research emphasise three significant aspects, which are the definition of value in Islamic garden, the evolutions and influences of the physical characteristic of the Islamic garden and finally the relevance of adopting the Islamic garden from an Asian perspective, especially in Malaysia.

17.4.1 The Process of Defining Value in Islamic Garden

Based on the literature review, there are four stages to how people evaluate value. Something in this study can refer to culture, belief or physical elements. The first stage is to determine the importance of the subject. The second stage is to evaluate the degree of its usefulness, while the third stage is to assess what is desired by the society. The final stage is to materialise the subject into action, such as in the form of model or a design guideline. The process is presented in Fig. 17.3.

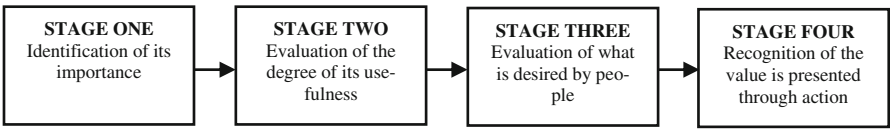

Fig. 17.3 The process of defining value

17.4.2 The Evolutions and Influences of the Physical Characteristic of the Islamic Garden

The historical movement of the Islamic garden in the Muslim civilisation spanned from the seventh to the sixteenth century. It started with the development of the first Islamic state in Medina to the peak of the Ottoman Empire. The Islamic garden was first acknowledged as the establishment of the Persian garden in the seventh century (Haaga 2005). That garden is claimed as the basis for the Islamic garden, and the inspiration of the Persian garden has been adopted in several other prominent Islamic gardens, such as the Andalusian garden in Spain. The evolution is presented in Table 17.2.

A study conducted by Pour et al. (2012) categorised all the garden elements into three main orders which are the planting, watering and lodgement order. Hence, the Islamic garden design can be assessed based on the three orders. The Persian garden is inspired by the interpretation of a garden by the Quran. Therefore, most of the planting design is fruits or edible trees as the garden emphasises more on the agricultural aspect. The design was adopted in the garden design in Andalusia, Spain. The Andalusian garden focuses on function as well as beautification. The design is illustrated in Figs. 17.4 and 17.5.

17.4.3 The Relevance of Adapting the Islamic Garden in Malaysia

Malaysia is known as a heterogeneous society, as it has three main ethnicities, namely, the Malays, Chinese and Indians, as well as other minorities (Department of Statistic Malaysia 2010). Hence, the cultural diversity is no longer a new subject to the country as peace and unity are among the principles upheld by all citizens. Although there are cultural differences, Islam is recognised as the state religion, and the dominant society is Islamic. Under the influence of the fourth prime minister, Tun Dato' Seri Dr Mahathir bin Mohamad, Malaysia rejected the idea of Western values and promoted Asian values instead, which highlight three aspects, namely, feudalism, Islam and traditional customs. The purposes of the Asian values are to ensure anti-Western imperialism, stable government and protection of the community through the influence of Malay Islamic culture (Mohd Azizuddin Mohd Sani et al. 2009). To continue these efforts, the fifth prime minister suggested the concept

Table 17.2 The evolution of the Islamic garden

No	Garden in Al-Quran	Persian garden	Andalusian garden
1	In paradise, there flow streams and canals with golden banks and beds of pearls and rubies, the soil of which has a smell sweeter than musk	There is a central canal in it	The main canal as the axis of the water element
		Provision is made for the flow of the water to be visible, and grooves are cut in the bottom of the channels to cause the water to flow roughly as if it were flowing over rocks	Improvement in terms of the design of the main canal. The water jets are allocated along the canal
		Canals are so designed that the flow of the water produces a sound	The improvements in the design elements. It functions not only as watering system but creates a better view of the garden design
2	There is a perpetual shade that is tamed to move according to the will of man	A large number of trees are planted for the sake of shade, and, as a result, the garden contains arrow walks	Plants are planted along the canal. This creates a pattern for the planting design
3	There is no extreme heat from the sun or bitter cold		The planting design gives shade and cools down the temperature in the arid area
4	There are trees that are so green that they appear to be black	A close relation with nature is obtained in a simple manner. There is no interval or boundary line between the mansion and the rest of the garden so that it cannot be seen where one begins and the other ends	The garden is allocated two-thirds of the whole area and usually attached to a building
			The combination of different types of planting design in the garden gives a calm and tranquil environment
5	Mention is made of the names of trees such as the thornless lotus, tangled myrtle, palm and pomegranate	The planting of rose bushes is frequent	Planting ranges from edible plants to ornamental plants
			The garden is colourful and has good odour
6	There are high buildings unique in the world	The area of the garden is surrounded by a wall	One-third of the whole garden is allocated for lodgements such as palaces or buildings
		There is a mansion or palace in the middle	
7	The dimensions of paradise may be likened to the width of the sky and the earth	A garden is laid out on steep ground	The natural landform assists in giving a better water flow
		The area of the garden is divided into four	The fourfold design indirectly has created patterns for water and planting design
		The design of the garden is based on the use of straight lines	

(continued)

Table 17.2 (continued)

No	Garden in Al-Quran	Persian garden	Andalusian garden
8	There is an extraordinary abundance of unforbidden and perennial fruit which may be freely eaten	There are a large number of fruit trees; the bigger the garden, the more fruit trees are planted	There are a relatively equal number of fruit and ornamental plants. Persian garden focuses more on agriculture, while the Andalusia garden is the combination of agriculture and beautification
		The garden focuses more on agriculture	

Fig. 17.4 The main water canal is located at the central axis of the Andalusian garden

Fig. 17.5 The arrangement of the planting order in the Andalusian garden

of Islam Hadhari. Islam Hadhari is an approach to change the secular paradigm to Tawheed paradigm, with the intention of uniting the Ummah as promoted by the Quran and Hadith (Mohamed Sharif Bashir 2005).

Currently, Malaysia is governed by the sixth prime minister, Dato' Sri Haji Mohammad Najib bin Tun Haji Abdul Razak. Under his supervision, he proposed the concept of One Malaysia which has the similar concept introduced by the Prophet Muhammad PBUH through the development of Medina Charter (Yusri Mohamad Ramli and Ghani Jusoh 2012). Medina is an example of a heterogeneous society. According to Ismail Albayrak (2010), historical records have suggested that at that time, there were approximately 4500 Jews and 4000 Pagan Arabs, in addition to the 1500 Muslims, living in Medina. Therefore, Medina was known as a

place of diversity and a pluralistic society. Thus, the implementation of the concept of One Malaysia is rather relevant to Medina Charter in terms of the city-state as an Islamic country and heterogeneous society. Through countless efforts, these gestures speculate that Malaysia is in the process of bringing and applying back the Islamic way of governance system concerning the first Islamic law, the Medina Charter. The success of the charter laid on the concept of unity and equality, protecting the rights of Muslim and non-Muslim.

Based on the literature of the Medina Charter, several matters became apparent. Regarding the definition, the Medina Charter discusses the same issues regarding the mediation of peace between the citizens in Medina. Medina was a place with a diverse and heterogeneous society even before the arrival of the prophet. The charter was created to bring unity among the citizens, as it promotes equality and provides protection regardless of race, tribe or gender. The Medina Charter is an example of Islamic law accepted by Muslim and non-Muslim and explains how the charter managed to unite a multireligious and multi-ethnic society in Medina. In response to the heterogeneous society in Malaysia, it is identified that Malaysia as a Muslim country comprises of a heterogeneous society. Through the efforts of the current and previous prime ministers, it was discovered that Malaysia is in the transition process of creating an Islamic environment. The finest example and reference are the Medina Charter. Medina Charter upheld the rights of the citizens encompassing public or private matters. There are several human rights outlined in the context of a heterogeneous society in Malaysia. Medina has similar characteristics, which are the city-state and heterogeneous society. Therefore, the idea of adapting the value of the Islamic garden is aligned with efforts made by the government.

17.5 Conclusion

A study on the Islamic garden should be conducted as a future reference to maintain and continue the legacy of the Islamic civilisation. This study has defined, identified and recorded the traces of the Islamic garden. It highlights the definition of the Islamic garden, including its significance, characteristics and potential. In general, the study is performed as an effort to maintain and continue the legacy of the Islamic history. Other than that, it is observed as important to study the past as it holds the fundamental core to shaping the future. Therefore, to learn from the past is viewed as one of the many ways to improve the current condition of the present garden implementation in terms of the Islamic garden. In response to the global context, this chapter is perceived as a means to help address the loss of Muslim culture and heritage. The research provides a written document on the physical elements of the Islamic garden, and the content can be referred as future references. Meanwhile, from the perspective of the local context, the research expands understanding and appreciation towards the importance of the Islamic garden.

Additionally, it highlights the significance of adapting the values of the Islamic garden into the local environment and garden design in Malaysia.

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Part IV
Socio-environmental Science and Engineering

Chapter 18
The Potential of Cacao Pod Rind Waste (*Theobroma cacao*) to Adsorb Heavy Metal (Pb and Cd) in Water

Anita Dewi Moelyaningrum

Abstract Jember, Indonesia, is one of the districts producing large amounts of cocoa (*Theobroma cacao*) in Indonesia. The main waste of cocoa production is the cacao pod rinds, comprising approximately 75% of the raw product. Cacao pod rind waste, containing ~12.67% pectin, has the potential to adsorb heavy metals. The objective of this study is to analyse the potential benefits of cacao pod rind waste from Jember cacao plantations to adsorb heavy metals such as Pb and Cd in water. This study represents true experimental research using the completely randomized design (CRD) method. There were control group (C) and three treatment groups (T1, T2 and T3 with 100 g/L, 300 g/L and 600 g/L, respectively) with six repetitions. Both parameters (Pb and Cd) were analysed in 24 samples using atomic adsorption spectrophotometry (AAS). The results show that as more cacao pod rind waste is exposed, the volume of water becomes increasingly turbid. Welch's F test showed that there were significant differences in the levels of Pb in the control group (F, 7.125; Sig, 0.002) and three treatment groups (Sig, 0.00; 0.003; 0.002). In regard to Cd, the one-way ANOVA test using LSD post hoc showed that there were significant differences between the control and treatment groups (F, 3.142; Sig, 0.048; Sig 0.048, 0.009, 0.04). Thus, cacao pod rind waste from Jember has the potential to adsorb heavy metals such as Pb and Cd in water. It could contain heavy metal pollution and maintain sustainability of the environment.

18.1 Introduction

Indonesia is the third largest cocoa producer in the world. Cocoa or chocolate production in Indonesia shows significant growth, reaching 3.5% per year. Jember is one of the main districts producing cacao (*Theobroma cacao*), both for domestic

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consumption and for export. Jember potential with 7,660 hectares of cacao plantation producing 7.67 thousand tons of cocoa per year (Jember, Indonesia official website 2012), and also produces a corresponding high amount of pod rind waste. Cacao pod rind (shell) waste comprises up to 75% of the weight of the entire fruit. Unfortunately, most of the cacao pod rind waste is only used as plant fertilizer by piling it at the sides of the cacao plant.

Cacao pod rind waste has the potential to be reused. Cacao pod rind waste contains high levels of pectin, averaging 12.67%. Pectin is almost evenly distributed in the plant fibres, with the higher concentrations in the middle lamella (Conrad 2008). Pectin is a naturally occurring polymer of D-galacturonic acid methyl ester.

Heavy metals are dangerous contaminants that cause either acute or chronic conditions, if they enter the human body. Continuous contact between humans and heavy metals, such as Pb and Cd, will cause a variety of health effects. Heavy metals can cause anaemia, encephalopathy, mental retardation, etc. Pb and Cd are non-essential metals in human physiology, in that they are not needed by the body, but rather represent a very high level of toxicity. Pb and Cd are not biodegradable and their toxicity does diminish over time. Pb and Cd are heavy metals that are widely spread in the environment, in large part, due to the wide use of Pb and Cd in both industrial and household products.

Human activities, intentionally or often unintentionally, emit Pb and Cd into the environment, which can enter the human body and cause toxicity. Many aspects of industrialization, including fertilization, electroplating, mining, printing and fuel, are sources of heavy metal pollution. In addition to industry and fuel, Pb and Cd exposure can also occur from everyday household products that are found all around us. Some household items are also identified as containing Pb, such as paint (Apostoli et al. 2006), batteries, ceramics and cosmetics. Personal hygiene behaviour is related to the prevention of Pb exposure from household appliances. Final waste disposal, which occurs either by the open dumping method or the controlled landfill method in Indonesia, often leads to heavy metal pollution in the environment, such as in soil and water (Widyasari et al. 2012; Moelyaningrum and Pujiati 2015).

As stated earlier, heavy metals are non-biodegradable, persistent toxins in the environment, which can enter the human body. Biosorption is one of the mechanisms responsible for the metal binding capacity of various biological materials, such as pectin in the cacao tree. Biosorption is more advantageous than other methods in containing heavy metal pollution and boosting environmental sustainability, as it is low cost and environmentally friendly. Pectin can serve as an adsorbent via the biosorption process, which demonstrates the ability of biomass to bind heavy metals in solution through steps of metabolic or physiochemical processes (Asraf 2010). The acetylated hydroxyl function on C2/C3 of galacturonosyl in pectin was predicted to bind heavy metals (Dronnet et al. 1996).

Cacao pod rind waste and the widespread Pb and Cd contamination in the environment have prompted researchers to assess the potential of cacao pod rind waste from Jember cacao (local cacao pod rinds), which are rich in pectin, to adsorb and bind heavy metal contamination such as Pb and Cd in water.

18.2 Material and Method

18.2.1 Materials

Cacao pod rind waste, which was sourced in Jember, Indonesia, for use as experimental adsorbent, had the thin husk peeled off. It was then chopped to 1×2 cm^2 in size and weighed for each treatment (Fig. 18.1).

The water for this research was collected from a groundwater source near the site of final landfill disposal in Jember, which has been polluted with Pb and Cd from the municipal waste.

18.2.2 Adsorbent Doses

Treatment involved using pectin-rich cacao pod rind waste mixed with 1 L of water containing Pb and Cd contaminants. The immersion time was 48 h. The quantity and quality of the water were both monitored.

The control group used water contaminated by Pb and Cd, but without cacao pod rind waste. Treatment group 1 (T1) contained adsorbent cacao pod rinds in the amount of 100 g/L; treatment group 2 (T2) contained adsorbent cacao pod rinds in the amount of 300 g/L; and treatment group 3 (T3) contained adsorbent cacao pod rinds at the amount of 600 g/L.

18.2.3 Methods

This study employed experimental research with post-test only control group design. In this design, there are two groups each randomly selected; the first group is a control group (C), which is an untreated group, and there are treated groups (T). The method used in this research is completely randomized design, in which the experiments were conducted with three kinds of treatment (TI, T2, T3)

Fig. 18.1 The cacao pod rind waste with thin husk peeled and cut to ~1 × 2 cm in size (Source author's image)

and a control (C). Repetition and replication of observations and measurements were done in each group six times so that the total sample was 24 samples. Pb and Cd concentrations in the water was analysed by AAS. The concentration data was analysed with SPSS 16, using a distribution normality test, followed by the Welch's F test and the one-way ANOVA test.

Replication and repetition:

$$(r-1)(t-1) \geq 15$$
$$R = r \times t$$

where:

t = treatment (4)
r = sample
R = total replication

18.3 Results and Discussion

18.3.1 Measurement of Water Quality and Quantities in Each Group (Control, Treatment 1, Treatment 2, Treatment 3)

Cacao pod (fruit) has a rough and leathery rind about 2 cm (0.79 in.) to 3 cm (1.2 in.) thick, although this varies with the origin and variety of pod. It is filled with 30–50 seeds that are fairly soft and have a pale lavender to dark brownish purple colour (Cocoa Bean 2015). The cacao pod rind waste that is used does not undergo any treatment, except the thin epidermis or husk is peeled off and the rind is cut to the size of $\pm 1 \times 2$ cm.

In treatment 1 (T1) group, polluted water containing Pb and Cd was exposed to cacao pod rind waste at the level of 100 g/L. There was physical degradation of water quality, which was a little bit turbid, and its colour turned brown compared to the control group. The mean decrease in water volume after 48 h was 68.3 mL (6.83%), while there was no change in odour compared to the control group. In treatment 2 (T2) group, polluted water containing Pb and Cd was exposed to cacao pod rinds at the level of 300 g/L. There was a physical degradation of water quality that was more turbid than that of the T1 group. However, no change in odour quality was discernible. Meanwhile, after 48 h, the mean decrease in water volume was 190 mL (19%). In treatment 3 (T3) group, polluted water containing Pb and Cd was exposed to cacao pod rinds at the level of 600 g/L. The T3 group exhibited the greatest decrease in water volume compared to the other groups, with a mean decrease of 430 mL or 43%. The cacao pod rind waste attained the characteristic of a liquid adsorbent.

Contacting cacao pod rind waste turns the water into a brownish colour that is caused by pectin. Pectin is a substance in the class of heteroside polymers, which is found in many fruit skins. Pectin is a white to light brown, sticky substance that is frequently used in the field of food and nonfood industries as a jelly-forming, thickening and stabilizing agent for certain products (Towle and Christensen 1980).

The volume of raw water contaminated with Pb and Cd also decreased in proportion to the amount of cacao pod rind waste presented during the 48-h observation period. The water became thickened and as a result, the water volume was reduced. The reduction of the water volume shows that the cacao pod rind waste has the potential to absorb water. The average volumes of water after the 48-h observation period are shown in Fig. 18.2, while the physical water quality is shown in Fig. 18.3.

18.3.2 Measurement Result of Contamination Level of Pb and Cd in Each Group (Control, Treatment 1, Treatment 2, Treatment 3)

Clean water and drinking water have water quality standards, which are requirements in terms of human health and safety. The standards are intended to provide protection to the health of Indonesian citizens. Pb and Cd are heavy metals that are commonly present in the environment and are often found in the air, water and soil and thus represent a source of possible exposure to humans. Pb and Cd are heavy metals that are highly toxic to the bodies of living things. The entry mechanisms of heavy metal contamination, such as Pb and Cd, include inhalation via the respiratory tract, ingestion via the digestive tract or absorption through the skin. Because they are nondegradable and thus persistent in the environment, Pb and Cd have a high toxicity even at low levels.

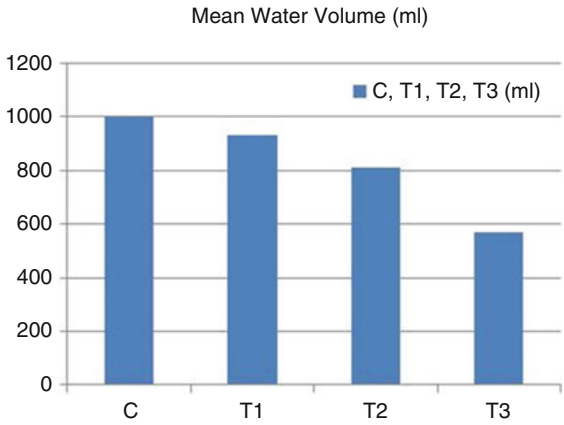

Fig. 18.2 Mean water volume with cacao pod rinds on the C, T1, T2 and T3 groups in the 48-h period

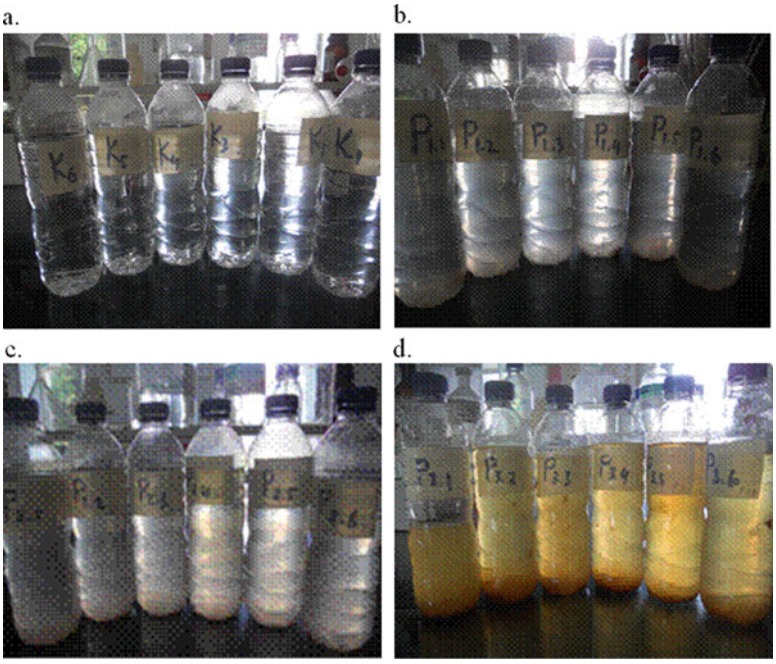

Fig. 18.3 Water quality of the C, T1, T2 and T3 groups (**a**, **b**, **c** and **d**, respectively) in the 48-h period (Source author's image)

Based on the Ministry of Health of Indonesia, Regulation No. 416 of 1990 on water quality standards, it was determined that the drinking water quality standard for Pb is 0.05 mg/L and for Cd is 0.005 mg/L (Ministry of Health of Indonesia, Regulation Number 492 of 2010). A decree by Ministry of Health of Indonesia, Regulation Number 907 of 2002, on drinking water monitoring requirements, states that the minimum standard for Pb in drinking water is 0.01 mg/L and for Cd is 0.003 mg/L (Ministry of Health of Indonesia, Regulation Number 492 of 2010). The regulations were then updated from the Ministry of Health of Indonesia, Regulation No. 492 of 2010, on drinking water quality with a maximum limit of heavy metal contamination for Pb which is 0.01mg/L and for Cd 0.003 mg/L (Ministry of Health of Indonesia, Regulation Number 907 of 2002). The regulations specify this stringent minimum standard for Pb in water because it has been proven that Pb causes toxic effects in the environment, human beings and all living things. The World Health Organization (WHO) maximum permissible limit is 0.01 mg/L Pb and 0.03 mg/L Cd (WHO 2011).

The control group (C) in this study used raw water without treatment with cacao pod rind waste. The levels of Pb in the water were measured in six repetitions using AAS. The control group will be used as a comparison against the three treatment groups. Treatment groups T1, T2 and T3 will undergo exposure to cacao pod rind waste amounting to 100 g/L, 300 g/L and 600 g/L, respectively.

The mean results of six repetition measurements of Pb and Cd contamination levels in the control water were 0.283 mg/L Pb and 0.30 mg/L Cd. The mean results of measurements of the heavy metal concentrations in treatment water 1 (T1) were 0.139 mg/L Pb and 0.154 mg/L Cd. The mean levels in treatment 2 (T2) were 0.165 mg/L Pb and 0.098 mg/L Cd, while the mean levels in treatment 2 (T2) were 0.159 mg/L Pb and 0.14 mg/L Cd. The complete data are shown in Figs. 18.4, 18.5, 18.6 and 18.7.

These results showed that cacao pod rind waste adsorbed Pb and Cd from water in treatment groups T1, T2 and T3. The highest Pb concentrations were recorded in the control group and then decreased with the treatment group of cacao pod rind waste during 48 h. Treatment group 1 (T1) exhibited optimum adsorption of Pb. The highest Cd concentrations were also recorded in the control group and then decreased with increasing amounts of cacao pod rind waste in the treatment groups during 48 h. However, treatment group 2 (T2) exhibited optimum adsorption of Cd.

Biosorption is a complex mechanism, and the effectiveness of biosorption with cacao pod rind waste depends on many factors. Various biological materials affect the biosorption process differently, and the composition of cellulose, hemicelluloses, lignin and pectin is an important factor. Consequently, the cacao pod rind waste that was used in this research was all sourced from the same area. In addition,

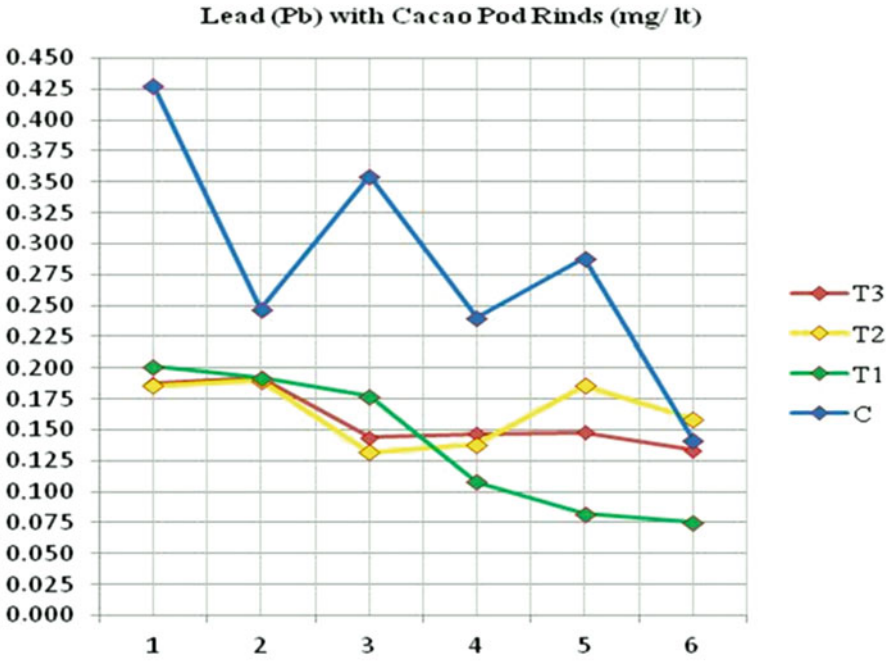

Fig. 18.4 Pb in the C, T1, T2 and T3 groups in the 48-h period

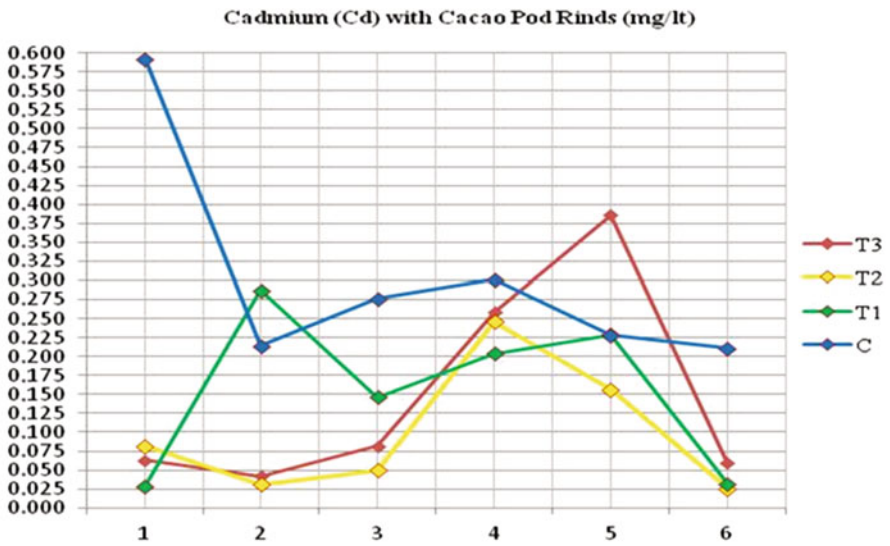

Fig. 18.5 Cd in the C, T1, T2 and T3 groups in the 48-h period

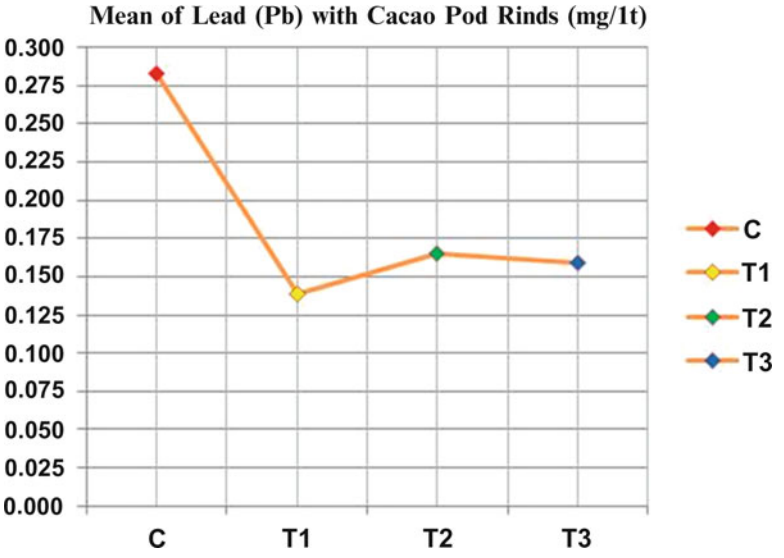

Fig. 18.6 Mean Pb in the C, T1, T2 and T3 groups in the 48-h period

ion concentration, temperature, pH, adsorbent dosage and contact time can affect the heavy metal binding properties.

Treatment group 1 (100 g cacao pod rinds/L) exhibited the greatest binding of Pb in 48 h compared to treatment groups 2 and 3. Treatment groups 2 and 3 could not

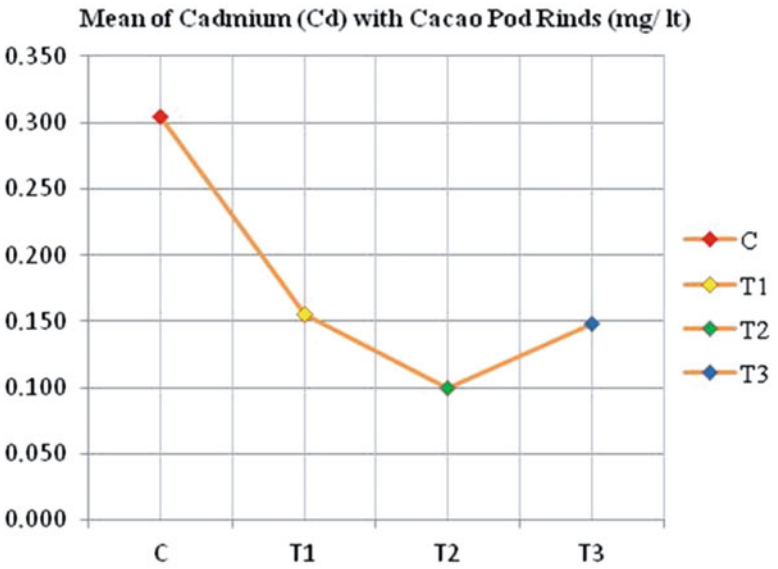

Fig. 18.7 Mean Cd in the C, T1, T2 and T3 groups in the 48-h period

bind optimally with Pb; it probably occurred because the peptin of cacao pod rinds saturated and could not adequately adsorb the Pb, which remains in the water. Treatment group 2 (300g cacao pod rind/L) showed the highest binding of Cd in 48 h. Treatment group 1 (100 g cacao pod rinds/L) showed that cacao pod rinds were insufficient to bind with Cd, whereas treatment group 3 showed that the cacao pod rinds were probably saturated and could not adequately adsorb the Cd, which remained in the water.

18.3.2.1 Test Analysis of Differences

The Kolmogorov-Smirnov normality test showed that the data from all groups for both parameters Pb and Cd have normal distributions (Sig $p = 0.2$ with $\alpha > 0.05$ and Sig $p = 0.826$ with $\alpha > 0.05$, respectively). The test of homogeneity of variance showed that Pb does not have the same variance (Sig 0.19). The Welch's F test indicates that there are significant differences in the levels of Pb in the control group (C) and the treatment groups ($F = 7.125$; Sig 0.002). There are also differences between the control and the individual treatment groups T1, T2 and T3 (Sig 0.00; 0.003; 0.002) (Table 18.1). The test of homogeneity of variance showed that Cd does have the same variance (Sig 0.677). One-way ANOVA test showed the value of $F = 3.142$ and Sig 0.048, so there was a significant difference between the control and treatment groups T1, T2, T3. Furthermore, the LSD post hoc test was conducted to determine whether there are differences between the groups. The LSD post hoc test results showed there were significant differences between the control

Table 18.1 The standard deviation of each group for Pb among C, T1, T2 and T3 groups

	N	Standard deviation
Control	6	0.0992566
T1	6	0.0572762
T2	6	0.0259262
T3	6	0.0246772

Table 18.2 The standard deviation of each group for Cd among C, T1, T2 and T3 groups

	N	Standard deviation
Control	6	0.1457816
T1	6	0.1061937
T2	6	0.0866020
T3	6	0.1410541

group (C) and individual treatment groups T1, T2 and T3 (Sig 0.048; 0.009; 0.04) (Table 18.2).

The local cacao pod rind waste from Jember, Indonesia, has the potential to adsorb and bind heavy metals Pb and Cd because of its constituent pectin. Cacao pod rind was an organic material. The pectin in cacao pod rind waste from other countries may be different, because of age, type, soil conditions, harvest time, climate, etc. Some organic materials can be used economically as adsorbents. Balaria (2006) showed that citrus pectin from citrus peels can bind Pb. Similarly, walnut peels can adsorb Zn (Liu et al. 2014; Sudha et al. 2015), and *Citrus limettioides* (lime) peel and seed can adsorb Ni(II) (Liu et al. 2014; Hussen 2014), while orange peel is effective in the recovery of Ni (Santos et al. 2015). Potato peels can adsorb Cr(IV) (Mutongo et al. 2014), mangosteen peels are effective in Cr(IV) removal (Huang et al. 2013), pineapple peel can adsorb Cu^{2+} and Pb^{2+} (Hu et al. 2011) and jackfruit peel can adsorb Cd(II) (Inbaraj and Sulochana 2004).

Further research are needed to measure the pectin from cacao pod rind from Jember, Indonesia, and other countries to identify their characteristics to adsorb the Pb and Cd. The ability of pectin from cocoa pod rind to bind Pb and Cd depends on many confounding factors such as age of the cacao tree, type, soil conditions, harvest time, climate, etc. Therefore, the further reseach needs to control all the confounding factors and using artificial polluted water which contain the amount of Pb and Cd.

18.4 Conclusion

Cacao pod rind waste from cacao trees in Jember, Indonesia, has the potential to adsorb heavy metals such Pb and Cd in water. Cacao pod rind waste is adsorbent, odourless and brownish in colour and has a good appearance and texture after 48 h in water. Using the cacao pod rind waste to bind the Pb and Cd in the polluted water

has more advantages than chemical treatment or ion exchange. Besides that, it can help mitigate the cacao pod rind waste from cacao plantations and improve the economics of cacao production.

This is a simple application of binding Pb and Cd in the polluted water using the cacao pod rind. It just needs a thin husk peeled-off the cacao pod rind and then chopped it into 1x2 cm^2 in size before contacting them with the polluted water for 48 h. It is easy to use and can help environmental sustainability.

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Chapter 19
Mechanical Properties of Composites Based on Poly(Lactic Acid) and Soda-Treated Sugarcane Bagasse Pulp

Lisman Suryanegara, Yudhi Dwi Kurniawan, Firda Aulya Syamani, and Yeyen Nurhamiyah

Abstract One of the drawbacks of poly(lactic acid) (PLA) is related to its low toughness which limits the range of applications it can be applied to. Thus, the use of soda-treated pulp of sugarcane bagasse (SCB) as a reinforcing agent was applied in our research. The composites were prepared by mixing the pulp in various percentages, i.e., up to 20 wt%. The mechanical properties of the resulting composites were evaluated to assess the efficacy of the reinforcing agent. It was found that the tensile strength was decreased by the increase of the filler content compared to the neat PLA. However, Young's modulus was increased up to 13% at 20 wt% of the loading filler.

19.1 Introduction

Nowadays, the rise of consciousness towards environmental issues and requirements of waste management policies has gained much attention from many researchers to focus on the development of biodegradable and biocompatible materials as a promising alternative to traditional, fossil-based polymers (Braun et al. 2012; Espino-Pérez et al. 2013; Frone et al. 2011; Šumigin et al. 2013; Wigner 1965). One of the approaches taken recently which has dealt with this concern is through utilization of biopolymers which are naturally occurring in all living organisms (Petersson et al. 2007). The use of biopolymers as a raw material for plastic production will provide great benefits for the environmental conservation efforts as compared to the use of fossil-based material due to less damaging effects (Suryanegara et al. 2009). Biopolymers can be derived from various sources such as agricultural feedstocks, marine fauna, and microbial activities. Many researchers

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have recently shown the use of biopolymers as a potential matrix for the preparation of bio-based environmentally benign composites such as soy-oil-based epoxy, starch-based polymers, polycaprolactone (PCL), polyhydroxy butyrate (PHB), polyester amide, and polylactic acid (PLA) (Graupner et al. 2009; Haafiz et al. 2013).

PLA is an economically successful bio-based polymer and has been found to be fully degraded in less than 30 days in suitable conditions (Huda et al. 2005; Huda et al. 2006). Its large-scale production was initiated in 2001 via fermentation of sugars into lactic acid, followed by reactive distillation to lactide oligomer and subsequent ring-opening polymerization (ROP) using Sn(Oct)2 as catalyst to provide high molecular weight PLA (Lunt 1998; Raquez et al. 2013; Vink et al. 2003). Among biodegradable polymers, PLA has a huge potential to replace petroleum-based plastics due to its high mechanical properties which are comparable to polystyrene and easy processability compared to other biopolymers which open its wide application in packaging, automotive, and medical area (Suryanegara et al. 2009).

PLA has been attracting much attention due to its high strength (50–70 MPa), high modulus (3 GPa), and relatively good biocompatibility. However, because of the intrinsic brittleness and lower impact resistance of PLA, numerous efforts have been conducted to enhance its properties in order to achieve compatibility with thermoplastic processing and manufacturing, allowing to compete with commodity polymers (Pei et al. 2010). In order to circumvent these inherent drawbacks, reinforcing fillers are now incorporated to improve these properties while maintaining their inherently good properties such as transparency and biodegradability (Maria et al. 2010). To afford fully bio-based composites, reinforcement of PLA with lignocellulosic materials fibers has been studied intensively (Huda et al. 2005; Mohanty et al. 2002; Oksman et al. 2003; Samir et al. 2005). Composites of PLA reinforced with natural and man-made cellulose fibers (Graupner et al. 2009) including regenerated cellulose fibers (Shibata et al. 2004), wood fibers (Huda et al. 2006), recycled newspaper fibers (Huda et al. 2005), plant fiber from kenaf, rice straw, hemp, and oil palm empty fruit bunch (Maurizio et al. 2008; Qin et al. 2011; Senawi et al. 2013; Song et al. 2012) have been synthesized and showed enhancement in biodegradability, thermal stability, and mechanical properties. Cellulose is one of the most abundant biopolymers occurring in various plant-based material which serves as the major reinforcing phase in plant structures due to its crystalline state (Maddahy et al. 2012), so that it is responsible to the reinforcement effect observed to the composites as suggested by many researchers.

Sugarcane bagasse (SCB) is the by-product abundantly obtained from sugar industry which mainly consists of cellulose, hemicellulose, and lignin (Senawi et al. 2013; Shibata et al. 2004). About 40–50% (Moubarik et al. 2013) of SCB is the glucose polymer of cellulose, providing the potential source for reinforcement agent of composites. In our study, pulp obtained from digestion using sodium hydroxide (1% w/v) of ground SCB was applied as the reinforcing agent. The mechanical properties were evaluated in the term of both its tensile strength and modulus.

19.2 Experimental Method

19.2.1 Materials

An amorphous poly(lactic acid) biopolymer (NatureWork® Ingeo™ Biopolymer 4060D) with density of 1.24 g.cm^{-3} and melting point of 210 °C was chosen as the matrix. The sugarcane bagasse was collected from sugarcane plantation in West Java, Indonesia. The sodium hydroxide was purchased from Merck. The ethanol and acetone were distilled prior to use.

19.2.2 Preparation of SCB Pulp

The bagasse was air-dried and then cut into small pieces. The cut bagasse was ground, and the pieces were passed through a 40 mesh and the retained pieces on 60 mesh were collected. The pulp was obtained by subjecting the collected ground bagasse to digester with the ratio of solid to liquor (1% w/v of NaOH) which was 1:15 (w/v). The pulping process was performed at 170 °C for 1 h. After cooling to below 70 °C, the pulp was collected and washed with water several times until neutralized.

19.2.3 Preparation of Composites

The pulp was stirred in distilled ethanol for 30 min to remove the water (1 g dry-based of pulp: 70 mL of ethanol). This process was repeated four times for completeness. The pulp was then solvent-exchanged to acetone four times in the same manner with washing process. The suspension of the pulp in acetone was stirred and added with PLA gradually. The stirring was continued at 800–1000 rpm for another 1–1.5 h until a well-dispersed mixture is observed. The mixture was then spread out into teflon-layered tray and allowed to evaporate in the fume hood at room temperature for overnight followed by oven-drying at 60 °C for 24 h. The composition of the composites was listed in Table 19.1.

The oven-dried composites were cut into small pieces (1–2 cm) and kneaded by a twin rotary mixer (rheomix, HAAKE polydrive) at 140 °C, 40 rpm for 12 min. The resulting compound was then crushed and hot-pressed into sheets at 150 °C in two steps, preheating for 8–9 min, and 4 MPa for 30 seconds. The samples were cooled to room temperature for another 20 min.

Table 19.1 Composition of the composites

Composites	PLA (g)	Pulp (g)
PLA	60	0
PLA/pulp 5 wt%	57	3
PLA/pulp 10 wt%	54	6
PLA/pulp 20 wt%	48	12

19.2.4 Tensile Test

The tensile properties of the resulting composites were measured using Shimadzu universal testing machine (UTM) with load cell of 1 kN. The specimens used have rectangle shape with about 6 cm × 0.5 cm × 0.1 cm in size and about 2 cm upon gripping measured using calipers. The crosshead speed was set to 1 mm/min. All the results were presented in the average value of five measurements.

19.3 Result and Discussion

19.3.1 Caustic Soda Pulping

Caustic soda is one of the original chemical delignifying agents for lignocellulosic material which was patented in 1845 and is also the major compound in kraft pulping liquor (Song et al. 2012; Subyakto et al. 2011). The soda process is performed by heating of fibrous material in a reactor to 140–170 °C under pressure in the presence of 13–16% sodium hydroxide, which is called cooking liquor (Doherty and Rainey 2006). In this way, lignin was separated from the cellulose and suspended in the liquid part. The liquid phase, which is known as black liquor, was separated from the solid phase containing liberated cellulose, which is called pulp. This pulp was then ready for further process. In milder cooking conditions, the residual lignin is still relatively high (>5%), but it provides better yield (Sahin 2007). In this research, milder conditions were applied using much less concentrated cooking liquor (1% w/v) and investigated its reinforcing effect to the PLA composites.

19.3.2 Tensile Properties

The tensile properties of the resulting composites and the neat PLA (control) as well as the strain at breaking were summarized in Table 19.2.

The effect of soda-treated SCB pulp addition on the tensile properties of PLA/pulp is depicted in Figs. 19.1, 19.2, and 19.3. As shown Figs. 19.2 and 19.3, incorporation of soda-treated SCB pulp into PLA matrix did not provide any

Table 19.2 Tensile properties of the composites

Composites	Tensile modulus[a] (GPa)	Tensile strength[a,b] (MPa)	Strain at break[a] (%)
PLA	1.18 ± 0.07	47.9 ± 2.1	15.6 ± 4.3
PLA/pulp 5 wt%	1.32 ± 0.02	38.3 ± 2.3	5.5 ± 0.9
PLA/pulp 10 wt%	1.32 ± 0.06	37.3 ± 0.8	4.8 ± 0.5
PLA/pulp 20 wt%	1.34 ± 0.05	34.2 ± 2.4	5.0 ± 0.4

[a]average ± SD
[b]maximum stress
[c]average value of $n = 4$

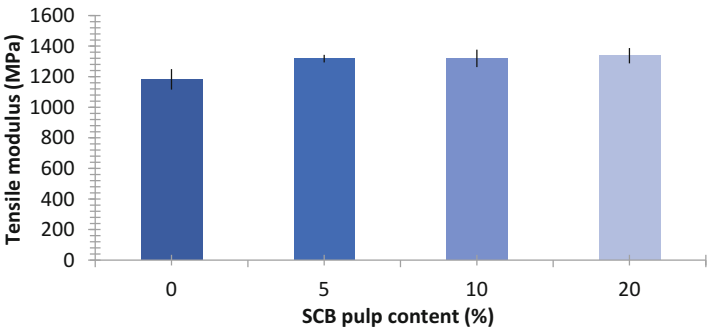

Fig. 19.1 Tensile modulus of PLA/pulp composites

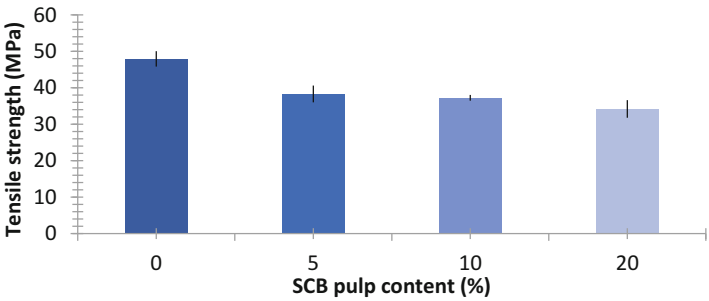

Fig. 19.2 Tensile strength of PLA/pulp composites

enhancements in both its tensile strength and elongation at break of the composites as compared to the pure PLA. However, Young's modulus was increased from 1.18 GPa to 1.34 GPa with the increase of pulp loading. The increase of tensile modulus with the increase of pulp content in PLA can be addressed by increasing amount of hydrogen intermolecular interaction, stiffening effect, and crystallinity of the filler which is a typical characteristic of filler/polymer composites (Cheng et al. 2009).

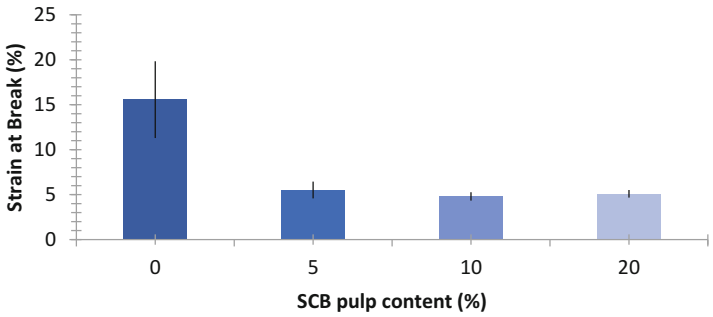

Fig. 19.3 Strain at breaking of PLA/pulp composites

The tensile strength of the PLA/pulp composites is shown to be descending with the increasing pulp loading, as shown in Fig. 19.2. The lower tensile strength of the composites may be attributed to agglomeration of the pulp due to Van der Waal's forces (Yew et al. 2005). As a consequence, the filler-filler interaction becomes more tangible than the filler matrix. Numerous voids at the filler-matrix interface may be formed due to the poor interfacial adhesion between them. This covers the inefficient stress transfer to the filler, which is the load bearing property, leading to low value of strength. This result is in accordance with the earlier related work (Qu et al. 2010; Yew et al. 2005).

Figure 19.3 shows the trend of the strain at break of the composites with the increase of the filler loading. It can be clearly observed that the strain at break tends to be decreased as the pulp content is increased. These phenomena may be attributed to the stiffening effect of the fiber by prohibiting the segmental chain movement of PLA during the tensile testing. Berglund (Pei et al. 2010) explained that the strain at break is related to the volume fraction of the loaded reinforcement, the degree of dispersion of the reinforcement in the matrix polymer, and the efficient interaction between the reinforcement and the matrix. The tendency of the pulp to aggregate causes significant local stress concentration and reduced the degree of elongation at breaking (Cheng et al. 2009).

We noticed a significantly lower value obtained in our work for tensile modulus of neat PLA (1.2 GPa) compared to the literature (3 GPa) (Anderson et al. 2008; Haafiz et al. 2013; Jonoobi et al. 2010; Pei et al. 2010; Suryanegara et al. 2009; Wigner 1965). On the other hand, some other related references by different authors obtained a tensile modulus value similar to our result (Pei et al. 2010; Subyakto et al. 2011; Syamani et al. 2013; Xu et al. 2012). This divergence may be caused by the different shape of the specimens used for tensile test, i.e., rectangular shape instead of dog bone shape so that the figures observed in our measurements might not represent the exact value of PLA tensile modulus. However, as shown in Figs. 19.1, 19.2, and 19.3, the effect of the addition of the filler to the PLA composites still gave a reliable clear pattern.

19.4 Conclusion

The composites of PLA/soda-treated pulp of sugarcane bagasse were successfully fabricated. The mechanical properties of the resulting composites were evaluated in terms of both its tensile strength and modulus. The tensile properties of the composites showed an increase in Young's modulus up to 13% at a pulp content of 20 wt% due to the stiffening action of the fiber. However, both tensile strength and elongation at break decreased with increasing the pulp loading to 27% and 69%, respectively, probably due to a poor dispersion of the pulp in PLA matrix and subsequent chain curtailment movement.

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Chapter 20
Modeling Indoor $PM_{2.5}$ Air Pollution, Estimating Exposure, and Problems Associated with Rural Indonesian Households Using Wood Fuel

Haryono S. Huboyo, Puji Lestari, and Susumu Tohno

Abstract A large segment of rural Indonesian households still use wood as their main fuel for cooking. In this study, we modeled the indoor air pollution implications and estimated exposures using $PM_{2.5}$ concentrations in kitchens and living rooms with time activity information by season at villages in West Java Province (Lembang, highland) and in Central Java Province (Juwana, coastal area). The $PM_{2.5}$ concentrations were measured 24 h using UCB particle monitors. Modeling indoor air pollution was conducted using a single box model. The average daily exposures in Lembang and Juwana were 0.24 (mg/m^3) and 0.1 (mg/m^3), respectively. The relative risks (RRs) (95% CI) of cardiopulmonary diseases due to wood fuel use were, respectively, 1.52 and 1.44 for Lembang and Juwana. The adjusted RRs for cardiovascular diseases were, respectively, 1.47 and 1.39 for Lembang and Juwana. The ratio of simulated concentrations to actual concentrations was better for the Lembang site, 0.9 and 1.7, compared to the Juwana site, 1.13 and 1.8, for the wet and dry seasons, respectively. Overall, this model is quite useful to preliminarily assess the indoor air pollution that might occur if housing parameters are well characterized. It seems that this model has greater accuracy for predicting moderate indoor kitchen concentrations, i.e., those around 1 mg/m^3. Adoption of dual fuel energy (LPG-wood fuel) in rural areas is mainly driven by economical motive. To solve the problem comprehensively, it needs long-term, medium-term, and

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short-term program. The immediate action (short term-program) is to mitigate indoor air pollution within rural households as much as possible by ventilation arrangement and good cooking practice implementation.

20.1 Introduction

The use of firewood as the primary fuel is still dominant in developing countries (Heltberg 2003; Smith et al. 2004). In Indonesia, based on data from the Ministry of Energy and Mineral Resources, at least 243 million barrels of oil equivalent (BOE) of biomass were consumed nationally in 2010, a share of more than 74% of total household energy consumption (CDIEMR 2011). According to historical data, this consumption is expected to continue to rise despite the oil into LPG conversion program that has grown from year to year.

The International Energy Agency estimated that in 2004, 95% of rural Indonesian people still used biomass fuel (IEA 2006). More quantifiably, Kamaruddin (1998) estimated that annual per capita wood consumption was about 0.88 m^3 of fuel wood/head/year, the equivalent of about 17.7 MJ/person/day. The persistent use of wood fuel, despite households having already received LPG stove packages, is a safety concern (i.e., fear of explosion or fire with the use of LPG, particularly by the elderly), as are fuel accessibility, fuel prices, and the taste of the LPG-cooked food.

The prolonged use of firewood for cooking eventually has a health impact on the cookers, as the resulting smoke particles are generally in the inhalable size range, with peaks of 0.1–0.2 μm (Kleeman et al. 1999). The health impact associated with the use of firewood has been widely studied in the developing world. A summary can be found in Fullerton et al. (2008).

The concentration levels of pollutants may vary significantly over time and space because of the large variety of sources, the operation method of some sources, and the various ventilation facilities present. Significant variations may also occur from room to room in a house; the living arrangement could be a factor when assessing indoor air pollution levels. Clark et al. (2010) pointed out the importance of housing characteristics, which eventually affect ventilation, plus of stove quality, when undertaking large-scale exposure studies of indoor air pollution. In this case, measuring $PM_{2.5}$ concentrations in the kitchen and living room could give the best estimates of the health impact on the inhabitants.

This research's aim was first to identify the risk to the cooks due to $PM_{2.5}$ exposure as the result of wood fuel use. Second, it sought to model the indoor $PM_{2.5}$ air concentrations derived from cooking activities in the distinctive kitchen environment. The third is to analyze the root problem and proposed recommendations related to Indonesian household using wood fuel.

20.2 Research Methodology

20.2.1 Indoor $PM_{2.5}$ Measurements

To reveal the indoor air pollution in both areas, we sampled households in each site during two seasons to determine the indoor $PM_{2.5}$ concentrations. The measurements took place in the kitchens of rural households for 22–23 h using inexpensive photoelectric monitors (UCB monitors). The UCBs were set in the middle of the wall in front of the stove. To minimize interference, the UCBs were hung at least 1.5 m away from the doors and windows and were 150 cm above the floor. These devices were already calibrated in a simulated kitchen as well as in the field with gravimetric-based principle devices. The UCB photoelectric chambers were cleaned after every five measurements, and prior to use, the UCB was zeroed in a Ziploc bag for at least 30 min. The detailed results of the $PM_{2.5}$ concentrations for both sites are explained elsewhere (Huboyo 2013; Huboyo et al. 2013). The locations for the measurements are shown in Fig. 20.1.

20.2.2 Exposure and Risk Estimates for the Cooks at Both Sites

We estimated exposures using $PM_{2.5}$ concentrations in the kitchens and living rooms as well as the outdoor ambient concentrations and combined the time activity information by season at the two sites. The average 24-h exposure to $PM_{2.5}$ for each person was estimated using a modified formula that had been originally proposed by Balakrishnan et al. (2004) and by Mestl and Edwards (2011). The exposure formula was:

$$E_w = \left(\frac{[Tc^*Ckc] + [Tk^*Ck] + [Ti^*Ci] + [To^*Co]}{Tc + Tk + Ti + To} \right)_w$$

$$E_d = \left(\frac{[Tc^*Ckc] + [Tk^*Ck] + [Ti^*Ci] + [To^*Co]}{Tc + Tk + Ti + To} \right)_d$$

$$E_{\text{total}} = \text{average}(E_w, E_d)$$

where

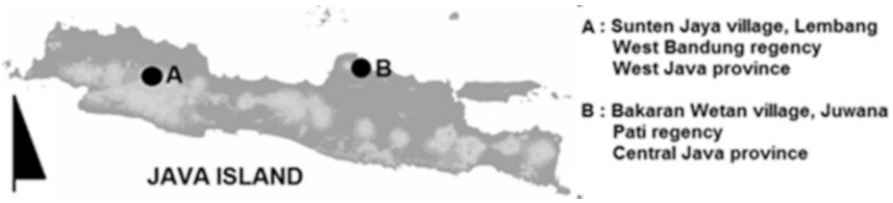

Fig. 20.1 The measurement sites

w: wet season
d: dry season
Tc: time spent in the kitchen while cooking, 1.84 h (wet season) and 2.32 h (dry season) in Lembang and 0.84 h (wet season) and 0.74 h (dry season) in Juwana
Ckc: kitchen concentration during cooking
Tk: time spent in the kitchen when not cooking (we assumed this to be 0.5 h/day for wood fuel preparation and other purposes)
Ck: average kitchen concentration other than during cooking periods
Ti: time spent in the living room (the remaining time after *Tc*, *Tk*, and *To*)
Ci: 24-h average concentration in the living room
To: time spent outdoors, calculated by estimating the worktime for householders, i.e., 7 h and 9 h, respectively, for Lembang and Juwana
Co: outdoor concentration during the wet and dry seasons

The equation was divided by (*Tc* + *Tk* + *Ti* + *To* [24 h]) to estimate the 24-h average concentration exposure. This formula assumes the kitchen $PM_{2.5}$ concentrations are well mixed; the $PM_{2.5}$ concentrations in the bedroom are comparable to those in the living room; the time spent in the kitchen, living room, and outdoor do not change by season; the cooks also work in the fields; and the cooking duration in the morning and evening (particularly in the Lembang site) are comparable. The data used here were adopted from UCB measurements in Huboyo (2013) and Huboyo et al. (2013). The parameters used in the calculation are summarized in Table 20.1.

20.2.3 Indoor Air Pollution Modeling Using a Single Box Model

The indoor air concentrations during the cooking periods were predicted using a single-box model. This model assumes a well-mixed room with a single constant

Table 20.1 Parameters for estimating daily exposure of $PM_{2.5}$

	Wet season	Dry season		
Parameters	Lembang	Juwana	Lembang	Juwana
Ckc (mg/m^3)	2.01 (1.78)	1.09 (1.37)	1.16 (1.01)	0.78 (0.76)
Ck (mg/m^3)	0.24 (0.19)	0.12 (0.08)	0.13 (0.1)	0.09 (0.05)
Ci (mg/m^3)	0.12 (0.04)	0.09 (0.02)	0.18 (0.18)	0.07 (0.02)
Co (mg/m^3)	0.06 (0.00)	0.05 (0.00)	0.06 (0.03)	0.08 (0.01)
Tc (h)	1.29	0.84	2.36	0.73
Tk (h)	0.50	0.50	0.50	0.50
To (h)	7.00	9.00	7.00	9.00
Ti (h)	15.21	13.66	14.14	13.77
Daily exposure, E(mg/m^3)	0.21	0.11	0.24	0.10

Note: values in the parentheses are standard deviation

emission source. It also assumes instantaneous mixing and no backflow into the room. This model considers stove performance and kitchen characteristics. The ventilation, represented by the air exchange rate, is the main parameter for pollutant removal; other removal mechanisms were assumed to be negligible. The model is adopted from Johnson et al. (2011). It is described mathematically as:

$$C_t = \frac{Gf}{AER(V)}\left(1 - e^{-AER(t)}\right) + C_0\left(e^{-AER(t)}\right)$$

where

Ct: concentration of $PM_{2.5}$ at time t (mg/m^3)
G: emission rate (mg $PM_{2.5}$/h)
AER: air exchange rate (/h)
V: kitchen volume (m^3)
t: time (h)
C_0: $PM_{2.5}$ concentration from the preceding time unit (mg/m^3)
f: fraction of emissions that enter the kitchen environment

The time interval of iteration was set in 1 min intervals to match with the monitored $PM_{2.5}$ in the UCB (also in 1 min intervals). The AER was estimated using the same formula as that found in Huboyo (2013). This AER did not consider the availability of the ventilation area. Instead, it was estimated by the slope of the least-square fit of the natural logarithm for the decay of CO concentration (McCracken and Smith 1998). In this study, the AERs were in the range of 0.2–3.23 h^{-1}. The fraction of emissions entering the kitchen environment was assumed to be 1 at both sites, since no chimneys were installed. The background concentration before cooking started was set as the initial C0. The emission rate was assumed to be constant throughout the cooking period. This rate depends on the stove power, stove thermal efficiency, and emission factors (fuel-based emission factors). The emission rate G (mg $PM_{2.5}$/min) was calculated as:

$$G = \frac{E_F}{E_D}P(\eta)$$

where

EF: fuel-based emission factor (mg $PM_{2.5}$/kg fuel)
ED: the energy density of the wood fuel (MJ/kg) (16 MJ/kg was assumed in Huboyo 2013)
P: stove power (MJ/h), 4832 W from the WBT test in Huboyo et al. (2013)
η: stove efficiency (18% based on the cold test in WBT, Huboyo et al. 2013)

We used 500 mg PM emission/kg wood fuel as the PM emission factor. This is the lower end of the emission factor of a simple wood stove, as depicted by MacCarty et al. (2010).

20.3 Results and Discussion

20.3.1 Risk Estimates for the Cooks at Both Sites

The average daily exposures in Lembang and Juwana were 0.24 (mg/m3) and 0.1 (mg/m3), respectively. If we assume the inhalation rate is 18 m^3/day for adults (Smith and Peel 2010), then the daily exposures correspond to daily doses (DD) of 4.36 mg and 1.85 mg $PM_{2.5}$ exposure, respectively, for the cooks in Lembang and Juwana. This average daily dose of $PM_{2.5}$ was used to obtain the relative risk (RR) for cardiopulmonary and cardiovascular diseases. The logarithmic relationship between RR and daily dose for cardiopulmonary (Cp) diseases and cardiovascular (Cv) diseases suggested by Pope et al. (2009) are:

$$\mathrm{RR(Cp)} = 0.1083 \times \ln(\mathrm{DD}) + 1.37, \mathrm{R2} = 0.87$$

The upper and lower 95% confidence limits are:

$$\begin{aligned} \text{Upper} &= 0.1014 \times \ln(\mathrm{DD}) + 1.55, \mathrm{R2} = 0.86; \\ \text{Lower} &= 0.1137 \times \ln(\mathrm{DD}) + 1.22; \mathrm{R2} = 0.80 \end{aligned}$$

$$\mathrm{RR(Cv)} = 0.0978 \times \ln(\mathrm{DD}) + 1.33, \mathrm{R2} = 0.89$$

The upper and lower 95% confidence limits are:

$$\begin{aligned} \text{Upper} &= 0.0986 \times \ln(\mathrm{DD}) + 1.48, \mathrm{R2} = 0.86; \\ \text{Lower} &= 0.0969 \times \ln(\mathrm{DD}) + 1.20, \mathrm{R2} = 0.89 \end{aligned}$$

The estimated relative risk (RR) can then be calculated as shown in Table 20.2:

Since the Lembang communities cook twice a day and have the worst kitchen environment, they have longer exposures (Tc) and higher pollutant exposures (higher Ckc) compared to the Juwana communities. This will ultimately make the pollutant daily dose higher compared to that in the Juwana site. The relative risk of cardiopulmonary diseases and cardiovascular diseases due to using wood fuel showed higher values in the Lembang site than in the Juwana site. Since most of the cooks are housewives, the cooks would be women of 30 years or more of age.

Table 20.2 Estimated relative risk (RR) due to wood fuel use for the cooks in two sites

Sites	24-h average exposure (mg/m^3)	Estimated daily dose (mg)	Adjusted RR [95%CI]	
			Cardiopulmonary diseases	Cardiovascular diseases
Lembang	0.24	4.36	1.52 [1.38–1.69]	1.47 [1.33–1.62]
Juwana	0.1	1.85	1.44 [1.29–1.61]	1.39 [1.26–1.54]

The relative risk estimate of the cooks for cardiopulmonary diseases was quite lower than that estimated for India (Desai et al. 2004), which had been shown to be 3.20 [CI: 2.30–4.80]. However, it was almost comparable to the relative risk calculations made by Mestl and Edwards (2011) for Chinese wood fuel users, i.e., 1.51 [1.36–1.69]. In addition, the result for relative risk of cardiovascular disease in the Lembang site was also comparable to the 1.48 [1.34–1.64] found by Mestl and Edwards (2011).

The evidence of risk of COPD for women older than 30 years due to biomass fuel use is strong. Hence, exposure reduction is indispensable. It is therefore essential to promote good cooking practices and healthy kitchens among wood fuel users, who are still a high proportion of the population across Indonesia.

20.3.2 Modeling Indoor Air Pollution Using Wood Fuel

The results of simulated concentrations compared with actual concentrations are illustrated in Fig. 20.2. The ratios of the simulated concentrations to the actual concentration on average were 1.1 and 1.7 for the wet season and dry season, respectively. However, several samples from both sites had a large degree of uncertainty, i.e., their ratios showed 3–5. The actual emission rate varied widely, depending on the burning condition of the stove. Were we to keep this emission rate at a constant value and were we then to compare the minute-by-minute results between actual and simulated concentrations, the simulation results have a large amount of uncertainty (they either overestimate or underestimate). For example, in the L7 sample in the wet season, the variability of the actual emission rate was very high (the std. deviation was about 7 mg/m^3, while the simulation results showed only 0.7 mg/m^3). This high variability in the emission rate might be due to the cooks' behavior of blowing air into the stove, wood refueling, and wood fuel moisture. This model is sensitive to emission rates and kitchen volumes, accounting for about 50% of the variance in the kitchen concentrations. Therefore, these parameters greatly influence model accuracy. The AER contributes to about 10–25% of the kitchen concentration variability. It seems that this model has greater accuracy for predicting moderate indoor kitchen concentrations, i.e., those around 1 mg/m^3. The ratio of simulated concentrations to actual concentrations is better for the Lembang site, i.e., 0.9 and 1.7, compared to the Juwana site, i.e., 1.13 and 1.8, for the wet and dry seasons, respectively. Overall, this model is quite useful for a preliminary assessment of the indoor air pollution that might occur if the housing parameters are well characterized.

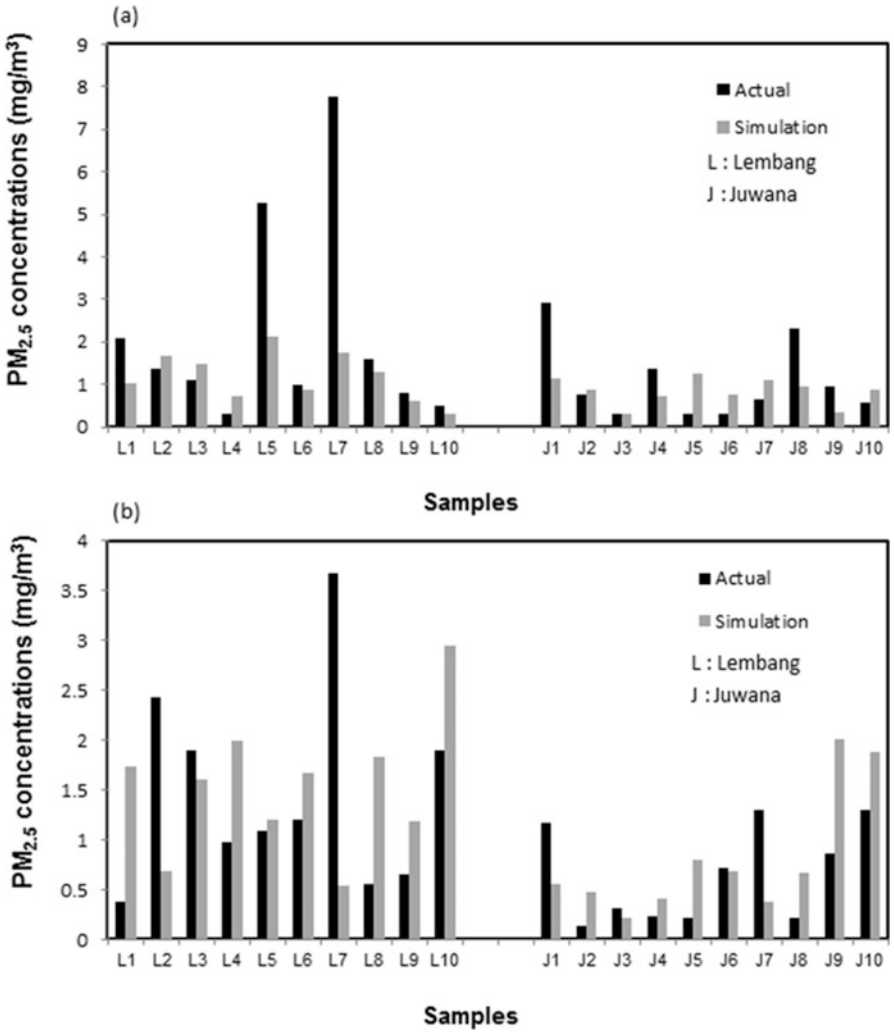

Fig. 20.2 Comparison of actual concentration and simulated concentrations during cooking periods in two seasons: (**a**) wet season and (**b**) dry season

20.3.3 Problem and Proposed Recommendation for Household Using Wood Fuel

Wood fuel will still dominate in the future energy supply for Indonesian rural households. Based on energy statistics, the household sector is estimated using biomass increase from 2000 to 2010 on average by 1.6% (CDIEMR 2011). Based on national social economic survey, the wood fuel user fractions were 69% in rural areas and 15% in urban areas.

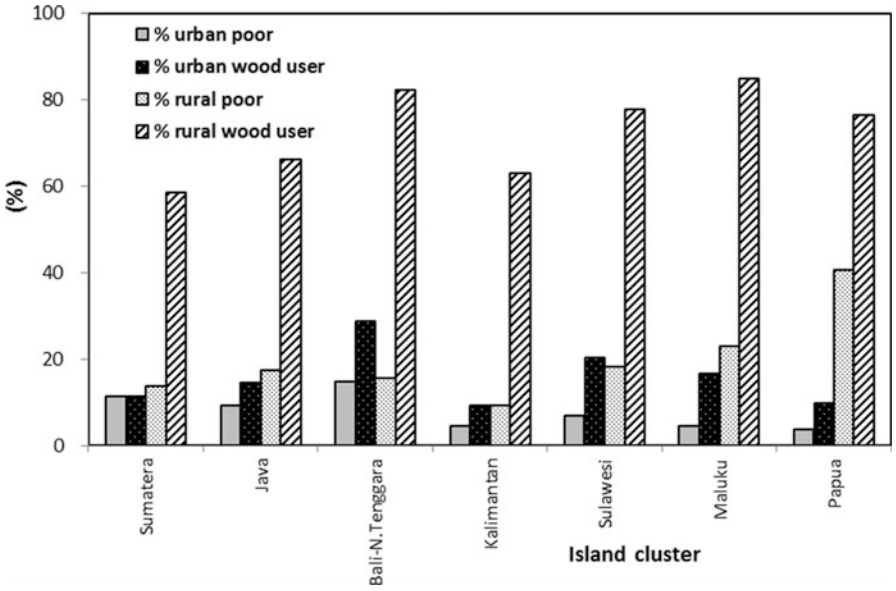

Fig. 20.3 Wood fuel users based on island (clustered provinces)

Likewise in other developing countries, some parts of the wood fuel users are located in urban areas in addition to huge consumers in rural areas (see Fig. 20.3). Interestingly many of these users, both in urban and rural region, are not simply categorized as "poor" or low-income households where for rural households it shows in high fraction. It seems culture and accessibility influenced the fuel choices of these affluent households.

Adopting modern fuel, i.e., subsidized LPG, would not necessarily leave wood fuel as household cooking fuel energy. Adoption of dual fuel energy (LPG-wood fuel) in rural areas is mainly driven by economical motive. This will have benefit to rural household cooking energy security in case of the disturbance of subsidized LPG supply. Moreover, the wood fuel is still required for heavy cooking such as boiling water and rice cooking. In fact, the wood fuel users were also not to be targeted of LPG fuel conversion.

Wood fuel users are generally categorized as low-income families, and then it is supposed that their lifestyle is not in healthy conditions. According to the survey by the Ministry of Health, Indonesia, about 83.2% of housing in rural areas are unhealthy compared to 67.5% in urban areas (NIHRD 2010). It is likely that wood fuel users have unhealthy households as depicted in Fig. 20.4. Unhealthy housing environment will exacerbate health effects related to indoor air pollution attributable to harmful pollutant exposure emitted from unprocessed wood fuel in a traditional wood stove.

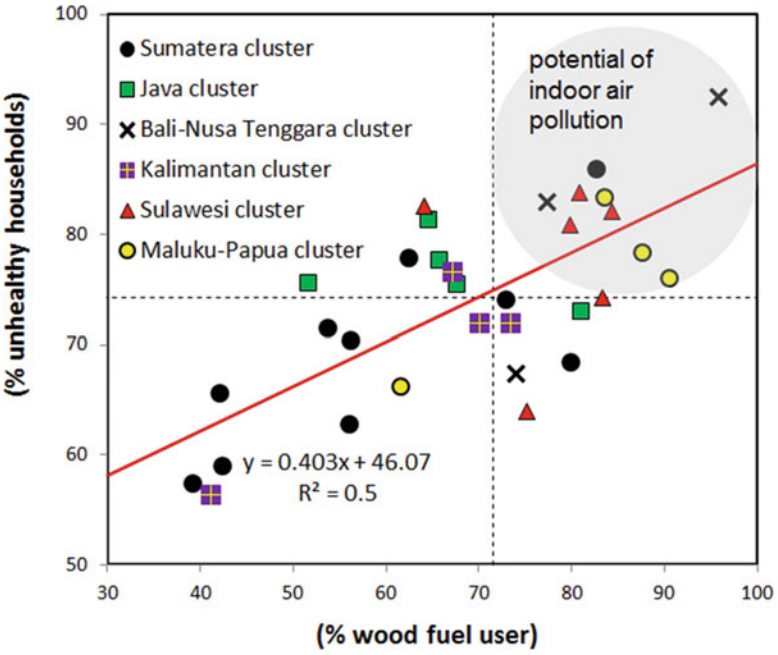

Fig. 20.4 Relationship between wood fuel user and unhealthy household at province level (grouped at island cluster based) (Note: Wood fuel users are for rural only, while unhealthy household variables denote average of rural-urban households. Unhealthy household building criteria: nonpermanent wall, earthen floor, insufficient ventilation and natural lightning, dense households (<8 m^2/person) for urban and rural area)

The level of indoor air pollution is closely related with physical housing characteristics. Due to enclosed environment, the housing characteristics and people's behavior inside the house will determine the exposure of pollutants to household members. Even though the total amount of pollutants inside the house is relatively small compared to that of outdoor, the exposure to pollutants is relatively higher than outdoor due to longer time spent inside.

Local housing characteristics were influenced by local wisdom, culture, climate, and location. Typically the households in mountainous area using wood fuel were potent to have the indoor air pollution episode than in coastal areas owing to smaller room volumes, longer cooking duration, smaller ventilation area and space heating need. In addition, the improper behavior in a large fraction of the mountainous people such as keeping close the ventilation during cooking incurs harmful pollutant exposure at higher risk.

Indoor air pollution concentrations in rural mountainous area on average were higher than those in coastal area (Huboyo 2013). This was due to bigger volume, sufficient ventilation, and less frequent cooking with wood fuel. The susceptible

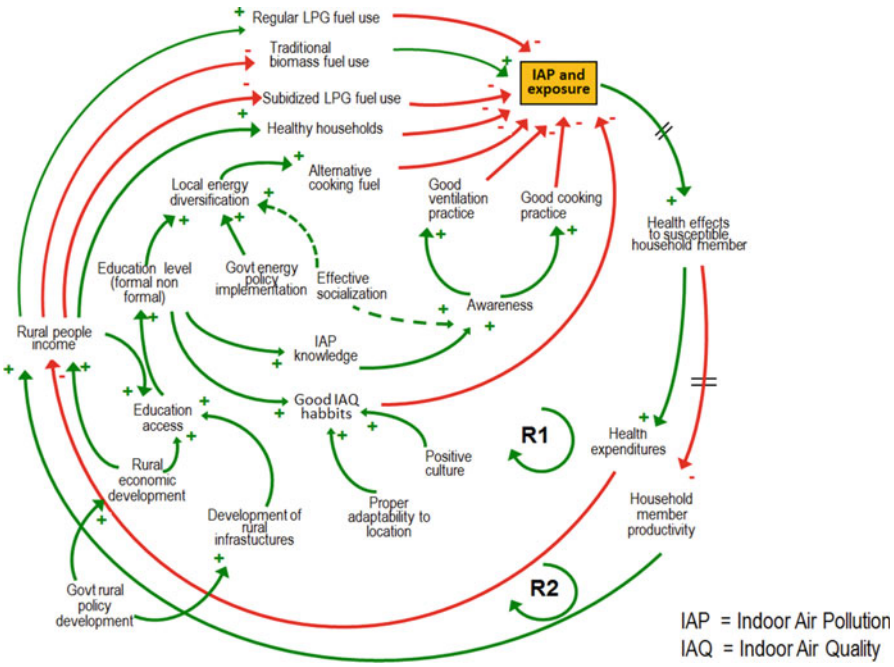

Fig. 20.5 Causal diagram analysis of indoor air pollution in Indonesian rural households

household members present in the kitchen were likely more exposed in the mountainous site than in coastal site due to smaller volume and inadequate ventilation. It is recommended to minimize activities in the kitchen during cooking period because most of the indoor PM2.5 mass size fraction was dominated in submicron size range which is respirable and poses a health threat.

Indoor air pollution episode in rural areas is rooted by persistent use of wood fuel with traditional wood stove in unhealthy household. The schematic root problems and probable solutions are illustrated in Fig. 20.5.

As the economic motive was behind this condition, therefore poverty alleviation as mandated in Millennium Development Goal (MDG) is the core to solve the problem. However, to eradicate rural poverty requires sustainable rural development in a long-term program. Then it needs, otherwise, immediate action (short term-program) to mitigate indoor air pollution within rural households. Furthermore, medium-term program is also needed to mitigate it to ensure reliable resources for infrastructure development, funding resources, and time for socialization. There are many ways to improve indoor air quality in rural area households; however, this proposed recommendation assumes the characteristics of the village are typical with those in this observed area.

20.3.3.1 Short-Term Program

The proposed program is based on current ventilation area availability to minimize the cost of changing ventilation scheme. This might be done by opening up the ventilation to dissipate the combustion pollutants as quickly as possible from the inner households and implementing good practice in cooking which should be familiarized by the cooks. The stove should be put near the ventilation to allow smoke exit, move intermittently to neighboring rooms during cooking, keep the interconnecting door between the kitchen and living room close, avoid putting plastic/waste garbage to include in the burning, prolong for keeping the wood stock/other biomass for cooking, and minimize the time of non-cooks to be in the kitchen during cooking.

20.3.3.2 Medium-Term Program

In this proposed program, several physical and nonphysical resources are needed. First is the installment of an improved (efficient) wood stove with chimney. These stoves should be provided by external funding scheme because most of rural people are poor. Second is diversification of cooking energy with adopting local resources such as biogas, biofuel, or other renewable energy. This program already exists under self-sufficient energy village program (Ministry of Energy and Mineral Resources). However, this should be fostered to reach as many as rural villages and emphasize on providing cooking energy, too (not only for providing electricity). Third is reorganizing the kitchen households by enlarging the kitchen to get a reasonable volume if sufficient ventilation could not be afforded or if possible separation from the dwelling room and promoting sustainable harvesting of wood fuel by only harvesting the branches of trees (not the trunk) to prevent biomass resource depletion. Last is giving socialization on healthy cooking and healthy living and wise use of cooking energy.

20.3.3.3 Long-Term Program

Alleviate the poverty by giving access of rural people on education, developing adequate basic infrastructures, providing health services, and securing clean energy as well as electricity. Healthy living will be achieved if there are enough opportunities for rural people to be empowered. Helping rural people to maintain their livelihood and raise their incomes without depending on subsidized fuel will establish the balance of urban-rural growth. Other issue is the change of persistent habits which should be broken. Change the inappropriate habits leading to deteriorating indoor air quality such as smoking, using mosquito coil burning (using a lotion or electric mosquito repellant instead), burning the garbage, and applying space heating with wood stove combustion.

20.4 Conclusion

The relative risk of cardiopulmonary and cardiovascular diseases was higher in the mountainous site than in the coastal site due to the former having worse kitchen environments and longer exposures than did the coastal area. The calculated risks for the cooks using wood fuel for cooking in the mountainous site are comparable to those found by other researchers. A single box model can be used for roughly estimating indoor air pollution from using wood fuel when cooking. The ratio of simulated concentrations to actual concentrations was better for the Lembang site, i.e., 0.9 and 1.7, compared to for the Juwana site, i.e., 1.13 and 1.8, for the wet and dry seasons, respectively. Overall, this model is quite useful to preliminarily assess the indoor air pollution that might occur if housing parameters are well characterized. Reflecting on this work, countermeasures for mitigating indoor air pollution in these areas should be prioritized as reducing pollutants at their sources, such as installing improved wood stoves, providing or practicing sufficient ventilation to expel the pollutants out of the houses, and improving the quality of the living environment by separating the kitchen from the main building.

Adoption of dual fuel energy (LPG-wood fuel) in rural areas is mainly driven by economical motive; therefore, poverty alleviation as mandated in Millennium Development Goal (MDG) is the core to solve the problem. To solve the problem comprehensively, it needs long-term, medium-term, and short-term program. Eradicating rural poverty requiring sustainable rural development is a long-term program. Medium-term program is also needed to mitigate it to ensure reliable resources for infrastructure development, funding resources, and time for socialization. The immediate action (short-term program) is to mitigate indoor air pollution within rural households as much as possible by ventilation arrangement and good cooking practice implementation.

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Chapter 21
Sustainable Well-Being Subjective Indicators: Human Interdependence with Other Humans and with the Environment

Aisyah Abu Bakar, Mariana Mohamed Osman, Syahriah Bachok, and Mansor Ibrahim

Abstract The intention of this study is to assess the theories and current approaches to well-being and sustainability to help identify the dimensions and influencing factors for sustainable well-being for Malaysia. *Problem*: Studies on the subjective measure of sustainable well-being exhibit high attention to human interdependence with other humans (HIH) and human interdependence with the environment (HIE). However, a conclusive study concerning the dimensions and influencing factors that determine the interdependencies is lacking. *Approach*: An exploratory review was adopted to identify the dimensions and influencing factors of HIH and HIE. *Findings*: The study discovered that both HIH and HIE have four dimensions each. The dimensions for HIH are (i) personal empowerment, (ii) positive relations, (iii) organisational opportunity and (iv) community development. The dimensions for HIE are (v) individual personality, (vi) interaction with nature, (vii) environmental attitude and (viii) external conditions. *Limitation*: The full reliance on literatures is the weakness of the paper. An empirical study is needed to prove the applicability of the dimensions and influencing factors discovered. *Significance*: The key findings of HIH and HIE are practical for research exploration in Eastern Muslim and developing countries, such as Malaysia.

21.1 Introduction

This chapter is an exploratory review to identify a theoretical framework for the subjective measures of sustainable well-being. It is part of ongoing research to determine the variables for sustainable well-being for Malaysia at the local scale. Sustainable well-being in its simplest terms means to pursue well-being without

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compromising the abilities of others to pursue their well-being (Kajikawa 2008; Kjell 2011; O'Brien 2008). The term 'others' refers to all living and resourceful beings. 'Others' is recognised as humans and the environment. The variables of sustainable well-being are manifested in human interdependence with other humans and human interdependence with the environment(Kjell 2011). The term 'interdependence' refers to mutual reliance between two groups, which in case (i) is between humans and other humans and in case (ii) between humans and the environment. The variables are practical for national and international use for measuring the readiness and the extent of effort of everyday practices towards sustainable well-being at the local scale. In terms of identifying suitable measures for Malaysia, the key findings discovered through selected studies largely conducted in Malaysia are also highlighted and discussed.

21.1.1 Problem Statement

The absence of comprehensive and reliable subjective indicators for sustainable well-being in the current national (Malaysia) measures for well-being means that the intangible aspects of well-being are ignored. The well-being of citizens is currently measured through the provision of services and material goods (Malaysia Quality of Life Report 2011 and Malaysia Well-being Report, 2013) (Abu Bakar et al. 2015). Consequently, satisfaction, happiness and the opportunity for citizens to achieve self-actualisation are often disregarded. This study explores the dimensions and influencing factors of HIH and HIE. The findings are useful for developing subjective sustainable well-being indicators for Malaysians.

21.1.2 Research Questions and Research Objectives

The study intends to identify the dimensions and influencing factors of HIH and HIW towards developing potential subjective indicators for sustainable well-being for Malaysia. This study commences with research questions. The first question is 'what are the dimensions and potential indicators of HIH and HIE?' The second question is 'how can the intervening variables that influence the level of HIH and HIE for Malaysia be recognised?' Accordingly, the first objective is to establish the dimensions of sustainable well-being. The second objective is to assess selected studies conducted in Malaysia beginning from the year 2000 onwards concerning factors influencing HIH and HIE.

21.2 Methodology

This study employs systematic literature reviews comprising four stages: (i) initial literature review, (ii) exploratory literature review, (iii) focused literature review and (iv) refined literature review. The first stage investigates the significant understanding concerning HIH and HIE conducted around the world. The second stage assesses the pattern of findings from published articles in Malaysia from 2010 onwards. The first stage classifies the factors and dimensions of HIH and HIE based on the findings from the second stage. The final stage establishes potential subjective indicators and intervening variables for HIH and HIE that are applicable for Malaysia. The reason behind selecting this literature review approach is to determine the boundary and focus of the study. From one stage to another, the researcher is able to determine and clarify the dimensions, elements and intervening factors for sustainable well-being.

This paper discusses examples of the findings from related subjective well-being studies from 2010 onwards to capture the variables involved in HIH and HIE. The purpose of limiting the sources is to establish the parameters for determining the patterns of recent findings on subjective well-being studies, particularly in Malaysia. The selection of the studies depends on their relevance in examining the dimensions of HIH and HIE as well as the dynamics and factors involved in HIH and HIE that are addressed. The identified issues, dynamics and factors relate to the discovery of a theoretical framework and potential indicators of HIH and HIE.

21.3 Literature Review: Subjective Measures of Sustainable Well-Being

The significance of sustainable well-being lies in the interdependencies between a variety of interaction processes and systems (Kajikawa 2008; Kjell 2011; O'Brien 2008). Every so often, human interaction systems are in tension and not mutually compatible. Interdependencies can result from well-being that is sustained at another's expense. The studies of social context illustrate how one person's well-being may stem from the ill-being of others and vice versa.41 Thus, interdependencies between humans and the contexts in which they act are a significant measure of sustainable well-being. The theories of sustainable well-being suggest that sustainable well-being is achievable through a supportive and congruent interaction system (Kjell 2011; O'Brien 2008). In other words, for well-being to be sustained, the entities in the interaction system must also achieve compatible and cohesive wellness. The entities are people and the environment (Kajikawa 2008).

21.3.1 Dimensions and Elements of Human Interdependence with Other Humans and the Environment

The dimensions of HIH are identified in (i) personal empowerment, (ii) positive relations, (iii) organisational opportunity and (iv) community development. It is found that personal empowerment manifests in the opportunity to exercise control, voice and choice. Positive relations manifest in the positive experience of trust, nurturance and affection. Organisational opportunity manifests in inclusion, learning and horizontal structures. Finally, community development manifests in the maximisation of social support and benefits and the availability of support throughout the life cycle. Additionally, the dimensions of HIE are identified in (i) individual personality, (ii) interaction with nature, (iii) environmental behaviour and (iv) external conditions. It is found that individual personality manifests in lifestyles, life values and personal qualities. The interaction with nature manifests in the need to interact with nature, norms, commitment, abilities and skills relating to the natural environment. Environmental behaviour manifests in environmental sensitivity, concerns and behaviour towards the environment. Finally, external conditions manifest in economic development, legalities, physical context, cultural roots and social values. Tables 21.1 and 21.2 further elaborates on the definitions and elements applicable for the dimensions of HIH and HIE.

21.3.2 Dimensions and Elements of Human Interdependence with Other Humans and the Environment

The field of environmental and human psychology can assist in elucidating the understanding of the interrelationships between humans and the environment for a more people-centric built environment. The dynamics of human interaction with

Table 21.1 Dimensions, definitions and elements of HIH

Dimensions	Definitions and elements of HIH
Personal empowerment	A multidimensional social development assisting individuals to take control of their own lives or a particular part of their lives to make an impact by acting on issues that they believe are important (Page and Czuba 1999; Warr 2007)
	Adjusting self to develop self-awareness (understanding strengths and limits) and self-esteem (confidence) to fulfil potential and achieve realistic goals (Knack 2005; Trimm 2014)
	An interactive process of (i) setting personal, meaningful and realistic goals, (ii) identifying resources and attaining knowledge, (iii) fostering self-efficacy (iv) developing skills and competence, (v) taking and reflecting actions and (vi) assessing impacts and refining efforts (Cattano and Chapman 2010; Fisher 2008; Winch 2011)

(continued)

Table 21.1 (continued)

Dimensions	Definitions and elements of HIH
Positive relations	Supportive relationships that people experience within personal capacity that determine how well they learn, develop, function and contribute to the health and interpersonal relations with a larger society (Duck 2007; Roffey 2012).
	Relationships that are threaded through every stage of life: infancy's early attachment, making friends, sense of belonging in teenage groups, romantic relations and parental affairs that influence well-being and life satisfaction (Gable et al. 2003; Reis et al. 2007)
	Level of understanding in personal relations enacted and received through (i) awareness and desire to know about each other; (ii) responsiveness in interpersonal communication; (iii) level of experience and trust; (iv) sense of affirmation, acceptance and inclusion; (v) ability to interpret intrusive behaviours; (vi) level of motivation and assistance; (vii) sense of forgiveness and self-regulation; and (viii) level of gratitude and praising emotions (Biesanz et al. 2007; Finkenauer and Righetti 2011; MacGeorge et al. 2004)
Organizational opportunity	The organisation's ability to promote and maintain the physical, psychological and social health of workers at all levels, and for every job, and to provide opportunities for employees to progress (Torri and Toniolo 2010; Pruyne 2011)
	The culture of well-being in the workplace is reflected in (i) personal resources (health and vitality, work-life balance), (ii) organizational system (fair play, job security, environmental clarity, management system, work environment, social value), (iii) functioning at work (strength and feelings of progress, sense of control, work relationships), and (iv) experience of work (optimistic feelings, positive interaction, variety of roles, celebrate achievements) that give confidence to employees to be more productive and advance in the organization's hierarchy (Diener and Seligman 2014; Harter et al. 2003; Warr 2007)
	Positive leadership, wellness of individual, teamwork, emotions and prevention of anti-social behaviours at work that foster (i) autonomy, (ii) self-functioning, (iii) competence, (iv) relatedness, and (v) inspiration as well as motivation for productivity and progress (Baker et al. 2005; Trimm 2014; Vickerstaff and Phillipson 2011)
Community movement	Structured efforts through a place-based approach (applied to neighbourhoods, towns, villages, cities, suburbs or countries) in producing assets that maximise the capacity of residents to improve their quality of lives. The assets can be individual or collective, or physical, economic, political, social or cultural (Vidal and Keating 2004; Green and Haines 2007).
	Active participation through full commitment to communal initiative and effective leadership to create favourable conditions for economic and social progress for the whole community (Barr et al. 1996; Pierson 2007; Stern 2000)
	The building up of social integration that believes in democratic participation, inclusiveness, non-authoritarian, community self-determination, community ownership, enhanced natural capacities and networks, social justice and equity, universality, service integration, and 'upstream approach (Gilchrist and Taylor 2011; Hickey and Mohan 2011)

Table 21.2 Dimensions, definitions and elements of HIE

Dimensions	Definitions and elements of HIE
Personal lifestyle	The organised developing system within an individual that is manifested in patterns of feelings, thinking and behaviour that represent the collective actions of the individual's psychological subsystem (Frantz et al. 2005)
	An individual's personal orientation reflected through (i) motivational characters (attitudes and values), (ii) mental moods and abilities, (iii) life values, (iv) lifestyle (voluntary modesty) and (v) personal qualities (conformity, indolence, place of control) that influence or determine the individual's attitudes and behaviour (Krajhanzl 2010; Laurens 2012; Page and Czuba 1999)
	An individual's unique and measurable traits reflected through enduring behaviours. The traits are likely to be (i) inherited, (ii) influenced by behavioural genetics and (iii) shaped through evolution forces and, thus, characterise the way an individual interacts with his or her physical and social environment (Ahmad 2006; Spain and Harms 2004)
Interaction with nature	An interpretation of the relationship with nature that demonstrates attitudes towards nature and the mental abilities in the attitudes. The attitudes manifest in (i) the need for contact with nature, (ii) abilities for contact with nature, (iii) environmental sensitivity, (iv) general attitude towards nature, and (v) environmental concern (Schmuck and Schultz 2002; Schultz and Zelezny 1999)
	The internal emotions, awareness and aptitudes experienced while in contact with the natural environment, such as the urge to be in contact with nature, the ability to cope outdoors (emotionally, intellectually, skilfully), the whole range of stimuli and sensations gained from nature and the awareness of the scientific details of the environment (Stern 2000; Bechtel and Churchman 2002; Clayton and Myers 2009)
	The contact between humans and nature reflected in the (i) adaptation to what is, (ii) modification of the environment and (iii) dependability on environmental resources and influence on the perception of whether or not one is a part of or separate from the natural environment (Vinning et al. 2008)
Environ mental behavior	Responsible behaviour towards the environment manifested in the (i) knowledge of issues, (ii) knowledge of action strategies, (iii) locus of control, (iv) attitudes, (v) verbal commitment and (vi) individual sense of responsibility, largely affected by whether an individual has (i) direct experience or indirect experience and (i) normative influences or momentary influences (Kollmuss and Agyeman 2002; Page and Czuba 1999)
	Environmental concerns shaped through personal orientation (egoistic, social, biosphere) that undergo three basic barriers to pro-environmental actions: (i) individuality (laziness and lack of interest), (ii) responsibility (lack of efficiency, lack of trust, sense of needlessness) and (iii) practicality (lack of time, money, information encouragement, resources, storage and facilities) (Page and Czuba 1999; Vlek and Steg 2007)
	Positive behaviour towards the environment associated with (i) behavioural intention, (ii) attitudes towards behaviour, (iii) subjective norms, (iv) factual knowledge, and (v) social and moral values. The association can be encouraged through motivational factors, which include

(continued)

Table 21.2 (continued)

Dimensions	Definitions and elements of HIE
	(i) perceived cost and benefit (reasoned choice on alternative with better economic benefit), (ii) moral and normative concerns (value-basis beliefs, concerns, moral obligation and social norms), (iii) affect (instrumental, symbolic and affective motives) and (iv) habits (goal, same course of action, satisfying response) (Vlek and Steg 2007; De Groot and Steg 2008; Aarts and Dijksterhuis 2000; McKenzie-Mohr 2013)
External condition	External influences, namely, (1) economic environment (prices, product availability and organic products certification), (2) legal environment (pollution, construction standards, waste handling and animal abuse), (3) cultural and social environment (traditions, moral values, religious and value system, influence of organisation, mass media, social groups and authorities) and (4) physical environment (availability and quality of outdoor environment, environmental condition, traffic infrastructure, civic amenities and waste management) (De Groot and Steg 2008; Kollmuss and Agyeman 2002; Krajhanzl 2010; Vlek and Steg 2007)
	Contextual factors, particularly physical infrastructure, technical facilities, quality of public services, characteristics and availability of products, market supply and pricing regime (Page and Czuba 1999; Santos 2008)
	Situational factors, which include economic constraints, transparent policy and legal actions, social pressures, collective preferences and opportunity to choose a different alternative (Poortiga et al. 2002)

other humans and the environment is a very wide web. The model cannot be static but change from time to time as the determinants of the interrelations between humans and humans and humans and the environment evolve (Kjell 2011).

Many subjective well-being studies have been centred on the individualistic Western countries, whereas people in the East tend to be part of a collectivistic society. Collectivistic values have a significant influence on the things that make Eastern people happy (Lou and Jian 1997; Lou et al. 2006). Although Eastern cultures would provide significant knowledge to well-being studies, there is a lack of well-being studies on Eastern Muslim countries such as Malaysia.

Studies in Malaysia, which relate to HIH and HIE, are found in eight fields of study. For HIH, the fields of study explored are (i) personal well-being, (ii) relational well-being, (iii) organisational well-being and (iv) communal well-being. Additionally, for HIE, the fields of study explored are (i) environmental behaviour, (ii) outdoor environment, (iii) policy and enforcement and (iv) stress and pollution. The key findings of the selected studies represent the influencing factors of the level of HIH and HIE for the Malaysian population.

Tables 21.3 and 21.4 summarise the key findings of the research associated with HIH and HIE that are mostly conducted in Malaysia. The findings are later grouped into key terms in the synthesis and findings section to determine the potential influencing factors or intervening variables for the level of HIH and HIE in Malaysia.

Table 21.3 Key findings of selected studies for HIH

Fields	Key findings: human interdependence with other humans
Personal well-being	The highest source of happiness for both Malaysian and Indonesian respondents is family. The result demonstrates how Malaysian and Indonesian societies are naturally inclined to collectivistic values that place family and group welfare before personal contentment (Jaafara et al. 2012). Sample: Malaysian Muslims in Kuala Lumpur and Indonesian Muslims in Jakarta and Bandung
	There are significant intercorrelations between well-being domains: (i) standard of living, (ii) health, (iii) life achievements, (iv) personal relationships, (v) personal safety, (vi) feeling of being part of the community, (vii) future security and (viii) life as a whole (Clark et al. 2014). Sample: Students aged 12–14 attending secondary schools in Ipoh
	Personality traits influence relationships between work-family conflicts and job satisfaction (Hashim et al. 2012). Sample: married school teachers at selected primary and private schools in the Klang Valley
	There exists a positive and significant correlation between personal well-being and religiosity. Well-being also shows a significant positive correlation with (i) beliefs and worship and (ii) prayer (Achour et al. 2014). Sample: Muslim female academicians of the University of Malaya, National University and Putra University
	There is a significant relationship between stress and coping, and religion is recognised as the most apparent source of coping skills (Sipon et al. 2014). Sample: Sepang flood victims of 2012
	A holistic model for well-being of Muslim women = spiritual well-being as central to the well-being model where spiritual well-being transcends other well-being dimensions (Hassan 2015).
Relational well-being	Family well-being is predicted by (i) resiliency, (ii) safety, (iii) savings, (iv) healthy lifestyle, (v) time with family, (vi) work-family balance, (vii) importance of religion, (viii) number of bedrooms at home, (ix) debt and (x) childcare (Noor et al. 2012). Sample: Malaysian households
	Family life satisfaction is a multidimensional construct consisting of (a) family functioning, (b) family resilience and (c) time with family (Abu Rahim et al. 2013). Sample: father or mother of house-holds in Malaysia
	Out of 2640 women interviewed, 85% stated that they had never experienced violence, while 15% indicated they had experienced some type of violence – 5% of the women experienced physical violence, 7.8% experienced emotional violence, and 1.7% experienced sexual violence. Additionally, 8% of the interviewees experienced violence committed by their intimate or live-in partners (Shuib et al. 2013). Sample: women between 18 and 50 years old and permanent residents/citizens of Malaysia
	Tangible and emotional support is significantly associated with well-being. Social embeddedness significantly mediates the effect of social cohesion upon well-being through tangible support and through emotional support. Thus, it is suggested that social cohesion leads to increased social embeddedness, which contributes to inducing tangible support and emotional support, thus affecting well-being (Momtaz et al. 2014). Sample: Elderly in peninsular Malaysia

(continued)

Table 21.3 (continued)

Fields	Key findings: human interdependence with other humans
Organiza-tional well-being	(i) Job satisfaction, (ii) job involvement and (iii) job security explained 57% variance of quality of work (Noor et al. 2012). Sample: Factory workers in Malaysia
	Two directions of work-family conflicts are work interference with family (WIF) and family interference with work (FIW). Level of WIF is higher than level of FIW (Panatika et al. 2011). Sample: school teachers at 130 schools in Malaysia
	There is (i) a strong positive relationship between self-esteem and satisfaction outcome, (ii) a moderate negative relationship between self-esteem and work-family conflict and (iii) a weak negative relationship between work-family conflict and satisfaction outcome (Rashida et al. 2012). Sample: married nurses from public healthcare services in Malaysia
	Gender, marital status, age group, education level, monthly income and working experience are not predictors of financial well-being (Mokhtar et al. 2015). Sample: public employees in Selangor and Putrajaya
Communal well-being	Neighbourhood location and surroundings influenced neighbourhood satisfaction, thus affecting residents QoL (Sedaghatnia et al. 2013). Sample: residents of mixed use neighbourhood in Kuala Lumpur
	Social capital has positive consequences for family and societal well-being, strengthening neighbourhood and increasing the quality of life. The level of social capital is influenced by (i) how long the neighbourhood has been established and (ii) the diversity and composition of its people, locations and the surrounding developments. Collective actions and cooperation are negatively correlated with the sense of cohesion and inclusion. This means that high-density neighbourhood results in loneliness as residents felt withdrawn from one another while dealing with 'sensory overload' (Hamdan et al. 2014). Sample: urban households in Kajang, Puchong, and Kota Damansara
	There is high internal reliability in the components of social capital, which are (i) participation in community activities, (ii) proactivity in the social context, (iii) neighbourhood connections, (iv) multi racial tolerance, (v) sense of trust and protection, and (vi) life values (Marzuki et al. 2014). Sample: residential areas in the northern part of Malaysia

21.4 Synthesis and Findings

This section provides the synthesis based on the key findings of selected studies towards discovering the dimensions and influencing factors of HIH and HIE. The influencing factors for HIH and HIE can be identified from the summarised key findings of selected studies. Fig. 21.1 summarises the influencing factors based on the key findings.

The influencing factors displayed in Fig. 21.1 help to determine the potential intervening variables affecting the level of HIH and HIE for Malaysia. The fields of study in which the influencing factors of HIH are identified include (i) personal

Table 21.4 Key findings of selected studies of HIE

Fields	Key findings: human interdependence with the environment
Environmen-tal behavior	Inception of ecopsychology elements in environmental education increases attitudes towards the environment (Kamidin et al. 2011). Sample: trainees from the Batu Lintang teacher training institute.
	Gender and parents' education level have no effect on conservation behaviour. Urban and rural strata and faculties have strong effects on conservation behaviour Asmuni et al. 2012). Sample: UiTM students, Shah Alam
	Students prefer convenient modes of transportation, e.g. personal cars over the public transport, due to needs and constraints (Singhirunnusorn et al. 2012). Sample: students of Mahasarakham University
	Recycling attitudes cannot guarantee recycling behaviour. Collectivists have higher recycling behaviour than materialists and individualists (Abdul Latif and Omar 2012). Sample: Residents of Tioman Island
	Knowledge, attitude and recycling behaviour have significant and positive correlations (Singhirunnusorn et al. 2012). Sample: Song-Nue and ban-Madd communities, Mahasarakham municipality, Thailand
	Sense of community and place develops a willingness to take responsibility for more than their immediate surroundings (Laurens 2012). Sample: Residents of the riverbank settlement along Surabaya canal, Indonesia
	Situational factors influence the recycling behaviour and intention to recycle. The intention to recycle is a partial mediator in linking situational factors to recycling behaviour. Sample: Residents of the riverbank settlement along Surabaya canal, Indonesia (Abdul Latif and Omar 2012)), and residents of Kuala Lumpur, Penang and Johor Bahru
	Communication barely occurs between designers and building users. Due to continual adaptations of individual settings and cultural factors, the inclusion of environment behaviour in architectural practices seems impossible (Horayangkura 2012)
Outdoor environment	The Orang Asli community believes that it is necessary to maintain stability of social life to provide peace and stability in the forest (Kamarul Zahari et al. 2012). Sample: Batek community in Taman Negara National Park, Pahang
	Users feel safe in surroundings with vegetation that is well maintained, not too dense, has a clear view and is clean and spacious. Gender and age have no significant relationship to the personal safety in public parks (Maruthaveeran 2012). Sample: users of Kepong Metropolitan Park
	Influential factors affecting house value are (i) variety of park elements, (ii) conceptual or design of the park, (iii) distance to the park, (iv), views towards the park and (v) active areas in the park facing the house (Shukur et al. 2010). Sample: residential area in Bukit Jelutong
	The lower the satisfaction of the patients due to bed positioning in relation to window and inaccessibility to an outdoor garden, the longer their recovery process (Ghazali and Abbas 2011). Sample: eight paediatric wards of public hospitals in the Klang Valley
	A strong positive correlation exists between the diversity of green infrastructure and (i) physical well-being, (ii) cognitive well-being and

(continued)

Table 21.4 (continued)

Fields	Key findings: human interdependence with the environment
	(iii) social well-being (Mansor et al. 2012). Sample: urban community/ residents of Taiping
	There is a relationship between people's accessibility to green open spaces and their corresponding social health and behaviour (Singhirunnusorn et al. 2012). Sample: park users in Mahasarakham municipality, Bangkok
	Stimulation of natural elements is statistically effective in terms of (i) flexibility of functions, (ii) play participation and (iii) curiosity of students (Faizi et al. 2013). Sample: children aged 4–7 years old, in a preschool in Iran
	Urban-rural strata, age and gender have a significant effect on outdoor walking speed. Walking distance and walking time are dependent on physical ability, stamina health and availability of pedestrian space, visual appropriateness and obstacles (Azmi et al. 2013). Sample: urban neighbourhood areas in Shah Alam and Putrajaya and rural neighbourhood in Sabak Bernam
	Users equally distributed among gender and age groups = safety and implausibility of unwarranted juveniles. Human behaviours' response to parks' physical setting (Ngesan et al. 2013). Sample: users of public urban park in Shah Alam
Policy and enforcement	Failing to enforce regulations due to limited resources increases pressure on the solid waste management industry and intensifies barriers to residents' participation in recycling and waste separation (Lim 2011). Sample: council members of solid waste management (SWM) department and residents of Kuching
	The environmental ethical commitment of Malaysian managers is statistically explained by (i) regulation aspects, (ii) financial aspects and (iii) stakeholder information and is not explained by (iv) ecological concerns, (v) ethical climate, (vi) stakeholder pressure or (vii) the personal moral obligation for environmental consequences (Delima and Zaman 2012). Sample: 150 selected manufacturing corporations in Malaysia, listed in FMM Directory 2005
Stress and pollution	Environmental stresses are statistically related to housing size, surrounding living area and exposure to natural disaster (Sahari et al. 2012). Sample: students of UNIMAS, UiTM, OUM, UPM and USM
	Improper construction process and procedures during house alterations result in pollution and stress to the natural environment, health and quality of life (Isnin et al. 2012). Sample: low-cost terrace housing, Section 17 & 18, Shah Alam
	Simultaneous relationships exist between per capita income and per capita pollutant emission (Borhan et al. 2013). Sample: eight ASEAN countries
	People living in a tropical climate, such as Malaysia, adapt to higher temperature, more humidity and less breezy conditions (Nasir et al. 2013). Sample: Shah Alam Lake garden.

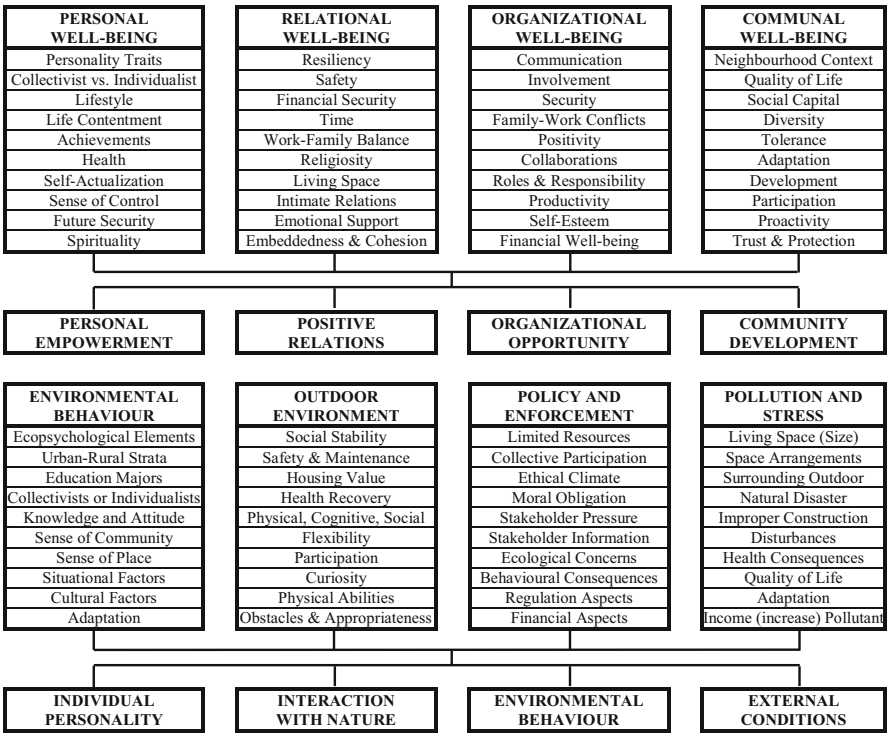

Fig. 21.1 Relation of the dimensions and influencing factors

well-being, (ii) relational well-being, (iii) organisational well-being and (iv) communal well-being. The influencing factors are later themed under four dimensions of HIH. The dimensions are (i) personal empowerment, (ii) positive relations, (iii) organisational opportunity and (iv) community development. For HIE, the fields of study in which the influencing factors are identified include (i) environmental behaviour, (ii) outdoor environment, (iii) policy and enforcement and (iv) pollution and stress. The influencing factors are later themed under four dimensions of HIE. The dimensions are (i) individual personality, (ii) interaction with nature, (iii) environmental behaviour and (iv) external condition.

The understanding of the dimensions of HIH and HIE determines the themes of the discovered influencing factors generated from selected studies of particular study fields. In other words, the selection of the dimensions that a particular influencing factor belongs to depends on the understanding of the dimensions that are best associated with the influencing factors. For example, the 'regulation aspect' in the 'policy and enforcement' field, as well as the 'natural disaster' in the 'pollution and stress' field, belongs to the dimension 'external condition'. That is, the understanding and distinction of 'external conditions' best represent the 'regulation aspect' and 'natural disaster' (refer to Fig. 21.1). Tables 21.5 and 21.6 show

Table 21.5 Dimensions and influencing factors of HIH

HIH dimensions	Manifestation	Potential indicators (definitions and elements)	Intervening variables (influencing factors)
Personal empowerment	Opportunity to exercise control, voice and choice	Self-determination, sense of control, self-efficacy, physical fitness, mental health, optimism, meaning and life values	Personality traits, collectivist vs. individualist, lifestyle, life contentment, achievements, health, self-actualisation, sense of control, future security, spirituality
Positive relations	Positive experience of trust, nurturance and affection	Caring/love/affection, respect for diversity, reciprocity, nurturance and affection, emotional support, collaboration, democratic participation in decision-making	Resiliency, safety, financial security, time, work-family balance, religiosity, living space, intimate relations, emotional support, embeddedness and cohesion
Organizational opportunity	Inclusion, learning and horizontal structures	Respect for diversity, democratic participation, collaborative relationships, engagement, good communication, clear roles and productivity, learning opportunities	Communication, involvement, job security, family-work conflicts, positivity, collaboration, roles and responsibility, productivity, self-esteem, financial well-being

Table 21.6 Dimensions and influencing factors of HIE

HIE Dimensions	Manifestation	Potential indicators (definitions and elements)	Intervening variables (influencing factors)
Individual personality	Lifestyles, life values and personal qualities	Levels of consumerism, materialism, collectivism and individualism; extent of voluntary modesty, conformity and indolence, sense of control	Ecopsychological elements, education majors, collectivists or individualists, situational factors, cultural factors, adaptation, curiosity, sense of community, sense of place, quality of life
Interaction with nature	The need to interact with nature, norms, commitment, abilities and skills relating to natural environment	Health in association with surroundings, time spent in open air, presence of natural objects indoor, extent of exposure to nature, ability to cope outdoors physically emotionally and intellectually and being used to various types of outdoors, able to see and hear what others miss and able to recall experiences with nature	Physical abilities, obstacles and appropriateness, urban-rural strata, flexibility, health consequence, health recovery, living space (size), space arrangements, surrounding outdoor, adaptation

(continued)

Table 21.6 (continued)

HIE Dimensions	Manifestation	Potential indicators (definitions and elements)	Intervening variables (influencing factors)
Environmental behaviour	Environmental sensitivity, concern and behaviour about the environment	Motivated to understand and preserve nature and the environment and acquire whole range of pro-environmental habits and concern about environmental damage, willing to reduce needs for the preservation of the environment, involved in public activities or political programmes	Knowledge and attitude, participation, moral obligation, stakeholder pressure, stakeholder information, ecological concerns, behavioural consequences, collective participation, social stability and physical, cognitive and social abilities

the influencing factors of HIH and HIE, respectively, that are themed under the dimensions of HIH and HIE.

Since the selected studies are largely gathered from case studies in Malaysia, it is likely that the influencing factors are the variables determining the level of HIH and HIE of Malaysians. Nevertheless, it is impossible to measure the influencing factors directly without understanding what elements constitute each factor. Furthermore, some factors can be associated with other factors and thus contribute to a redundant measure. Therefore, at this point, the factors can only be considered as latent variables. A latent variable refers to the inferred or unobserved variable derived from some observed or directly measured variables. Additionally, some of the influencing factors resembled and contrasted with the potential indicators gathered from the definitions and elements of HIH and HIE earlier on. Hence, the similarities and differences suggest that Malaysia probably has a unique scenario in the understanding of HIH and HIE, thus implying a different and perhaps lower readiness to achieve sustainable well-being. However, the assumption is yet to be tested in the empirical stage of the study.

21.5 Conclusion

This exploratory review focuses on developing potential subjective indicators and the intervening variables of HIH and HIE at the local scale for Malaysia. The literature review is important to establish an understanding of the operational terms and variables in the theory of HIH and HIE. The review also distinguishes the dimensions, manifestations, potential indicators and influencing factors or potential intervening variables of HIH and HIE. The indicators are valuable for measuring the readiness of the citizens to embrace sustainable well-being in their lifestyle. The

indicators are also useful to indicate the extent that the current lifestyle incorporates relations between humans and other humans and humans and the environment. The results can provide helpful data for policy review, which, hitherto, was difficult to evaluate due to the lack of quantifiable subjective data (Abu Bakar et al. 2015). The limitation of this paper is the lack of empirical data to prove the statistical applicability of potential indicators and influencing factors of HIH and HIE in Malaysia. The next challenge of the study is to substitute the potential indicators into a questionnaire in a comprehensive yet concise manner that is understandable to the targeted respondents. The data obtained and analysed from the questionnaires will determine if the potential indicators and intervening variables are reliable in determining sustainable well-being.

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Chapter 22
Low Resource Use and High Yield Concept in Climate-Smart Community Empowerment

Arzyana Sunkar and Yanto Santosa

Abstract Assuring food, energy and water security is a great challenge for government and development agencies. In addition to many critical lands that were left barren, different cases have shown that land clearance to satisfy food production and increase income has often used quick and cheap methods. These human-driven activities have become terrifying images of climate change. Various analyses have indicated that socio-economic circumstances are generally more important considerations in designing effective conservation methods for households faced with the primary need to survive and satisfy basic needs. These reinforced that sustainable development must focus on the power of local people to manage the environment on which they depend. Using the Bangkalan Madura region of East Java and peat swamp areas of four provinces in Indonesia as examples, this chapter discusses the drivers behind the successful implementation of a community empowerment model in responding to climate change and at the same time developing livelihood strategies for food, energy and water security as well as improving economic welfare by enhancing resource use efficiency. The presence of high social capital of Bangkalan community and readily available free agricultural inputs in the peatland provinces were also significant factors. This chapter concludes that the low resource use and high yield concept in empowerment programme is the key success to an effective climate change mitigation and adaptation, as well as enhancing community livelihood. This chapter also highlights the need of policy shift, the sustainability and scalability of the programme.

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22.1 Introduction

Sustainable development concept addresses a concern for degrading natural resources, and in rural area, it is actually about food security (Sunkar 2008), which is often achieved at the expense of environmental degradation. Local communities often face difficult trade-offs in decision-making about natural resources (Ministry of Agriculture [MoA] 2011). Lack of alternative income, as well as competition for resources, often encourages them to choose immediate needs over the benefits that may become visible in the longer term (Sunkar 2008). These competing priorities have often resulted in activities such as illegal logging, encroachment and agricultural expansion leading to deforestation, not to mention land and forest degradation. Research conducted in 46 tropical and sub-tropical countries indicates that agriculture is the main driver of deforestation in developing countries (Boucher et al. 2014), contributing to climate change.

Climate change has so far caused depletion in agricultural productivities and declining economic welfare (Nelson et al. 2009), as well as hunger (Wheeler and von Braun 2013). Reference (Moomaw et al. 2012) estimated that within the next two decades, the projected food demand would increase by 50%, water demand by 35–60% and energy demand by 45%. With the increasing human population, it is no doubt that the world food requirement will also increase, which must be supported with an increase of agricultural lands. Therefore to achieve security in food, water and self-sufficiency in energy, adaptation and mitigation to climate change will be necessary, which will require the community to be transformed to a climate-smart community to be able to cope with the changing climate conditions.

Climate-smart objectives apart from climate change mitigation and adaptation would also include improved food security and rural livelihood (Scherr et al. 2012). One way to achieve such objectives is through the application of climate-smart agriculture, defined by reference (FAO 2013) as 'agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals'. This definition identified food security and development as the principal goal of climate-smart agriculture, while productivity and climate change adaptation and mitigation are the three pillars necessary for achieving such goals (FAO 2013; Lipper et al. 2014). Enhancing food security while contributing to mitigating climate change often requires an efficiency of resource utilization. Thus, increasing resource efficiency is essential to increase and ensure food security on the long term and contribute to climate change mitigation, which highlights the importance of using local resources.

Utilization of local resources would mean that sustainable development should focus on the power of the communities that, for the most part, depend directly or indirectly on the exploitation of natural resources and on those mostly affected by natural resource degradation. In addition, food insecurity is an indicator of poverty, and social capital is said to be able to significantly alleviate poverty. Household food security is positively influenced by social capital according to reference

(Dzanja et al. 2013). In the same line, references (Tibesigwa et al. 2014) also suggest that a more efficient and effective alternative to household coping strategy is to strengthen the community's social capital. Similar suggestion was also forwarded by reference (Chen et al. 2014) who found that social capital in a farm household and the adaptive capacity of the community against environmental perturbation are linearly correlated. Social capital is believed to enable households to gain access to needed supplies and allowing them to work together for increased efficiency and security. Therefore, social capital is an important concept that underlies the interconnectedness of various socio-economic factors and food insecurity (Misselhorn 2014). Strengthening a community, social capital would mean empowering the community, because social capital is about building community confidence of their own power to manage their environment. Community empowerment involves all efforts made by a group of people, with or without external support, to be able to continue to develop their capacity or potential for the improvement of their quality of life, independence and sustainability.

Although various efforts to halt deforestation and forest and land degradation have involved the local community participation, many still indicate ineffective results. Several research questions that can be formulated are: What factors impede such success? What form of community empowerment can actually increase the enthusiasm of the local communities and change their behaviour? This chapter seeks to provide a conceptual framework for successful community empowerment programmes in transforming local communities into climate-smart communities that are at the same time able to develop livelihood strategies to ensure their food, energy and water security as well as improve their economic livelihood. This chapter also provides insights into the importance of considering societal drivers (social-cultural-economic factors) in community empowerment programmes.

22.2 Methodology

22.2.1 Method

A literature review of successful community empowerment programmes in mitigating and adapting to climate change in Indonesia was conducted. The cases were systematically selected from successful national projects carried out by land-based ministries (i.e. the Ministry of Forestry and Ministry of Agriculture). Attention was given to publications that were in project reports and reported case studies. A case study was considered significantly successful, if the publication reviewed stated that there was a reduction in deforestation and forest and land degradation activities, transformation of degraded land into productive lands and income generation. Projects carried out in the resource-poor area of Bangkalan region of East Java (2012–2014), concerning the development of renewable energy plantation (Boucher et al. 2014), and in fire-prone areas (peatland) in 2011 in the two largest

peatland regions (Sumatra and Kalimantan), i.e. Jambi and Riau Provinces of Sumatra and Central and South Kalimantan (Ministry of Agriculture [MoA] 2011), were selected to be reviewed. The projects were conducted by the Ministry of Forestry and Ministry of Agriculture in cooperation with ICCTF (Indonesian Climate Change Trust Fund) as the project donors. Analyses were made with regard to the drivers behind climate-smart communities, i.e. the successful community empowerment in mitigating and adapting to climate change.

22.2.2 Overview of Project Sites

Bangkalan district of East Java in Indonesia is constrained by the physical landscape of critical land and is thus faced with a difficult challenge in terms of ensuring adequate food, energy and water. Since the 1970s, the local community (farmers group) was active in restoring these critical lands. As a result, they have received an environmental award due to their efforts to transform some of the critical land into sustainable community forest of Geger sub-district of Bangkalan, and in 2010 the community forest was certified based on LEI (Indonesian Ecolabelling Institute) certification scheme. The forest was planted with teak, acacia and mahogany assisted by the local Forestry Service. However, such efforts were considered insufficient. In addition, the income-generating activities cannot return cash in the short term. The local motivation that was driven by the community has urged the Indonesian Ministry of Forestry in collaboration with the ICCTF to establish other pro-environment activity but at the same time to ensure that it can return a positive cashflow within a short period of time.

The development of a renewable energy plantation/biomass energy estate using red calliandra (*Calliandra calothyrsus*) was introduced to the local communities. The communities were familiar with the plant but had never used it to its greatest advantage. Within the 2 years of the project activities, a total of 214 ha of degraded land were planted with calliandra. Calliandra was used due to its advantages, especially in restoring critical lands; it is fast growing and is able to produce high-calorie heat.

Similar to the Bangkalan project but with very different land physical conditions, the Indonesian Ministry of Agriculture has also successfully conducted climate-smart empowerment in the peatlands of Kalimantan and Sumatra. Peatlands have been used intensively for agricultural activities such as for food production, horticulture and plantation (Maftu'ah et al. 2014). The land use changes of peatlands have significantly contributed to the increased greenhouse emission and have resulted in degraded peatlands.

The marginal productivity of peatland due to its poor soil chemical and physical characteristics (Sabiham 2010) can be enhanced by adding ameliorant (Sabiham 2010; Attiken et al. 1998) which is a material added to the marginal soil to improve soil fertility and to enhance plant growth (Lange et al. 2012). Moreover, the use of ameliorant could reduce greenhouse gas emission on peatland. Land use in Jambi

and Riau Provinces was oil palm with intercrops (maize-groundnut), in South Kalimantan was wetland rice with *palawija* (mix crops) and in Central Kalimantan was rubber plantation with intercrop (dryland rice). Ameliorant added includes manure (chicken), peat fertilizer, mineral soil, *oil palm empty fruit bunch* (EFB) and dusty loosened up paddy. One basic consideration in community empowerment is to use the local available resources. Since manure was the only ameliorant applied that was readily available at no cost in the four project sites, this chapter only analyses the results based on the application of manure.

22.3 Results and Discussion

22.3.1 Benefits on Climate Change Mitigation, Ecosystem Improvement and Social-Economic Improvement

22.3.1.1 Reduction in CO_2 Emission and Increased CO_2 Sequestration

In the face of further land intensification to meet global demand for food, water and energy, it is important to be able to maintain soil carbon. It is estimated that by 2025, Indonesia would require a total of 3.75 million ha of wet rice paddy, and by 2035, Indonesia would require a minimum of 3.5 million to be set aside for a new wet rice field and 6.083 million ha by 2050 (Wahyunto and Dariah 2013). Unfortunately, the total area of fertile agricultural lands in Indonesia has been limited. The total wet rice paddy per capita in Indonesia is only 0.03 ha, as compared to 2.63 ha (Australia), 0.61 ha (USA), 0.34 ha (Brazil), 0.11 ha (China), 0.16 ha (India) and 0.10 ha (Vietnam) (Balai Besar Litbang Sumber Daya Lahan Pertanian (BBLSD) 2011). Thus the use of degraded lands and abandoned critical lands became very important.

Peatland is one potential alternative land to be used to grow food, especially in areas that were dominated with peat. Agronomically, about 40–50% of peatlands have the potential to be developed as agricultural lands (Kasimir-Klemedtsson et al. 1997). According to the Presidential Decree No. 32/1990 and Minister of Agriculture Regulation No. 14/2009, peatland with peat depth of <3 m that were not set aside for protection areas, peat that is not sapric or hemic and substrate that is not quartz sand could be used as agricultural lands. Unfortunately, for several areas such as Riau, Jambi and Central Kalimantan provinces, these have become a dilemma since the local people are very dependent on peat. According to data (Iiyama and Osawa 2010), out of the total 3.75 million ha of degraded peatland, about 3.02 million ha has the potential to be converted for agricultural purpose. However, if peatlands were brought under cultivation, there is an accelerated decomposition and increased CO_2 emission; hence they become large emitters of CO_2 (Sunkar 2008; Paavilainen and Päivänen 1995) even the highest among all soil types worldwide. A study by (Comeau et al. 2013) demonstrated that after the

Table 22.1 Total CO_2 percentage reduction at end of projects in Sumatra and Kalimantan project sites (Nelson et al. 2009)

Ameliorant	Jambi (%)	Riau (%)	South Kalimantan (%)	Central Kalimantan (%)
Manure	18.4	9.4	44.8	16.6

conversion of peatlands into oil palm, the soil respiration almost doubled. Therefore ameliorants must be added to increase the fertility of the peat soils.

All experiments conducted in all five project sites were proven to be able to reduce CO_2 emissions. In Bangkalan Madura, the estimated emission reduction was 69.69 CO_2eq/ha/year (Ministry of Forestry [MoF] 2014). The CO_2 reduction in Bangkalan occurred as more and more critical bare lands were planted with calliandra as cover crops. As a plant grows, it absorbs CO_2. Research in Bangkalan (Ismail 2014) found that the potential biomass stock was 147.56 tonnes/ha, and carbon was 64.95 tonnes/ha. The CO_2 absorption was 153.87 tonnes/ha, indicating the potential of calliandra to reduce CO_2 gas emissions. Calliandra is carbon neutral, meaning the CO_2 emission is very low and can be avoided.

If the Bangkalan site suggested the ability of plants to improve soil fertility of critical lands without the use of any fertilizer, while at the same time sequester CO_2, research on Sumatra and Kalimantan sites indicated that organic animal manure has a significant effect in reducing CO_2 emissions, as it allowed better growth of plants. The CO_2 emission reductions for Sumatra and Kalimantan project sites, before and after treatments, are given in Table 22.1.

22.3.1.2 Transformation from Unproductive to Productive Lands

A total of 214 ha of critical land in the Bangkalan region were planted with calliandra (Ministry of Forestry [MoF] 2014). Calliandra is a very fast-growing pioneer species from the family of Leguminosae, meaning that they are able to enhance soil fertility through nitrogen fixing. It has been known to rehabilitate erosion-prone areas (Ismail 2014). Prior to the calliandra afforestation programme, the land was basically left barren, because it was unproductive. Currently, the farmers can harvest calliandra several times within a year. Moreover, the area which used to experience flood during heavy rain has experienced few floods after the growth of calliandra. The local people also state that they can easily find water as there are many springs that emerged (Ministry of Forestry [MoF] 2014). These results showed that calliandra has improved the ecosystem functions from what used to be critical lands. *Calliandra calothyrsus* were termed 'economically important nitrogen fixing tree species' (Brewbaker and Styles 1982).

Nitrogen fixing was also shown by the application of chicken/poultry manure on projects sites in Kalimantan and Sumatra. It improves soil fertility by adding nutrients and soil organic matter. In fact, out of all animal manures, chicken manure has the highest content of nitrogen, phosphorus and potassium, the three essential

nutrients for plant growth. Due to these properties, chicken manure has long been recognized as the most desirable organic fertilizer (Farhad et al. 2009).

Although this chapter would only discuss manure ameliorant, it is worth mentioning that out of all types of ameliorants that were given, manure showed the highest positive results. In South Kalimantan, from the perspective of plant productivity, giving manure as an ameliorant provided the highest increase of wetland rice. Manure application also resulted in the highest growth of wetland rice. Although manure application resulted in low grain weight per clump, however, since it produced high numbers of tillers per clump and lowest empty grain (33.59%), the resulting dry grain production per hectare was the highest (3.46 tonnes/ha). Manure showed positive relationships on the growth of rubber trees in Central Kalimantan, as well as for the maize grown as an intercrop. Manure is comprised of high nitrogen, phosphorus and potassium and is thus able to produce the highest corn kernels and biomass. Similar results for corn were also shown by the corn intercrops in Jambi and Riau sites. Manure application resulted in the highest cornstalk diameter, i.e. 1.51 cm or increased by 29% than control. The manure application also resulted in the longest corn cob and cob diameter, as well as the highest corn tillers. Whereas, in Riau, application of manure produced the highest corn stover (leaves and stalks left in the field after harvest), which makes up about half of the yield of a crop. These results supported similar results of previous researches (Farhad et al. 2009; Mitchell and Tu 2005; Warren et al. 2006). All of these results indicated that manure ameliorant is effective in improving the chemical and physical characteristic of peatlands that have been grown with rubber plantations and intercrops.

22.3.1.3 Sustainable Income Generation

Douglas (1989) considers that in small, resource-poor rural households faced with the primary need to survive and satisfy basic needs, socio-economic circumstances are generally more important considerations in designing effective conservation methods than the constraints imposed by the physical environment. This reinforced the point that conservation efforts must be designed with local social-economical consideration in mind. Food is one of the factors that determine why the poor take decisions to spread risk and how they finally balance competing needs in order to survive. This is shown by their adoption of a specific farm system that defines the way a rural community copes with the environment to produce food. Therefore, when talking about sustainable development in a rural area, we are really talking about food security (Sunkar 2008). Income generation is a key concept in sustainable food security (ACF International 2013), because it can overcome food insecurity due to economic difficulties.

Prior to the calliandra afforestation, the people of Bangkalan Madura, specifically in Geger sub-district, were dependent socio-economically on hardwoods that they grew within the community forest. Previously, they could enjoy the harvest only in the long term, 50 years to harvest the teaks and 8 years to harvest batay tree

(*Paraserianthes falcataria*). With the planting of calliandra, they could now enjoy the benefits of economic return within a very short period of time. Calliandra is fast-growing species, which does not require much maintenance. It can be harvested within a year after growing. Calliandra could produce 15–40 tonnes/ha/year or in average 27 tonnes/ha/year if using a planting space of 1 m × 1 m (Tangenjaya et al. 1992). One hectare of calliandra in Bangkalan could produce 30 tonnes of wood that could be harvested every 6 months (*personal communication with the Head of ICCTF Secretariat*). Within a day, the wood pellet industry in Bangkalan was able to produce as much as 8–12 tonnes of wood pellets per day, where each ton would be sold at IDR 1 million (current rate at approximately USD 75). The local people could enjoy the income-generating activities due to the wood pellet industry, since the raw materials for the wood pellets were taken from the community calliandra. In the case of the project sites on peatlands, the increased productivity of the intercrops as well as rubber plants as sources of income for the local people would automatically increase their profits, thus increasing their income.

22.3.2 Drivers Behind the Successful Implementation of Climate-Smart Community Empowerment

Reducing deforestation and forest degradation would require that ongoing conservation activities and development be actor-led (Sunkar et al. 2015). Research showed that deforestation rates inside community forests with strong legal recognition and enforcement were dramatically lower than for forests outside those areas. Success stories on reducing deforestation all around the world (Boucher et al. 2014) indicated that nearly every success story involved empowering local communities.

Community empowerment is a concept, which is principally concerned to be 'people-centred, participatory, empowering, and sustainable'(Lambin et al. 2001). According to the community empowerment definition (Directorate General of Protection and Nature Conservation (Dirjen PHKA) 2007), community empowerment indicates three main objectives, namely, developing the ability of a community, changing their behaviour and self-organizing that community. Possible approaches could include:

- The creation of an atmosphere that allows the potential within the community to be developed (enabling). This is very much related to the improvement of local community welfare. Here, the point of departure was the recognition that every human being, and every society, has the potential to be developed. Empowerment is an effort to build such power, by encouraging motivation and raising awareness of individual and group potential, as well as efforts to develop this.
- The strengthening of the potential or power possessed by the people (empowerment). If the community were empowered, they would be able to exploit the potential of their environment and thus would protect their own land and everything on it. This could help ensure the attainment of forest sustainability,

especially in the case of peat swamp forest. Within this framework, more positive steps would be required, beyond just creating a favourable atmosphere. These should include concrete steps and involve the provision of various resources, as well as opening access to various opportunities that would make people become more empowered. Empowerment should not only consider the strengthening of individual members of a community but also its institutions. Instilling modern cultural values, such as hard work, thrift, transparency and accountability, are fundamental parts of empowerment.

- Empowering, with a concomitant element of protection. In the process of empowerment, the weak must be prevented from getting weaker, due to lack of power. This is related to the enhancement of human resources. Therefore, protection and a pro-poor bias should embody the fundamental importance of the concept of community empowerment.

22.3.2.1 Use of Local Resources

Community empowerment should not cause people to become increasingly dependent on a variety of donations. Therefore, community should be empowered using their own resources, including physical resources as well as human resources. Such use of local resources has been proven to enhance the sense of togetherness among the people within a community and to change their mindsets and behaviour and has resulted in a sense of shared responsibility due to place attachment (Carr 2002; Pooley and O'Connor 2000; Walker and Ryan 2008). The use of local resources would also mean low spending of resource use, meaning that the people did not have to spend a lot of money to acquire the necessary resources. In fact, reference ([UN] United Nations 2014) stresses that local people can contribute their traditional knowledge for the effective and sustainable management of the environment.

The uses of local resources to enhance the ecological, social and economical importance of land have been shown in all project sites. The Bangkalan community is dependent on their high social capitals which already existed prior to the project, while the local people in the peatland project sites enjoyed the increased crop productivities due to the use of chicken manure, something that is readily available, since most of the people raised chickens. The use of local resources would also ensure the sustainability of the income-generating activities.

22.3.2.2 Increased Frequency of Land Visitation

In the case of agricultural development in the project sites at Kalimantan and Sumatra, one of the indicators of successful climate change mitigation is the significant reduction of forest fire incidents (*pers. comm. with the extension service worker from the Provincial Agricultural Service*). The farmers were practising an intercropping system. Intercropping is the simultaneous growth of more than one species in the same field (Yoe 2013), which is the practical application of basic

ecological principles. The greatest advantage of intercropping is that the crops are not necessarily sown at the same time, and the harvest might differ. Since the productivities of their crops were currently increasing, the local farmers enjoyed the increased harvest. Thus the frequency of visits to their land also increased, due to the different time of harvest, as well as maintenance. The increased frequency of harvest had positive impact on lowering the frequency of fire incidents, since more and more people were present on their land and they could detect even the smallest fire if they occurred.

22.3.2.3 High Social Capital

Research by (Dzanja et al. 2013) specifically concludes that social capital has a positive influence on household food security. Social capital is believed to enable households to gain access to needed supplies and allow them to work together for increased efficiency and security. Efficiency is getting the most from its scarce resources (Ahuja and Staal 2013). Therefore, social capital is an important concept underlying socio-economic factors and its broader context of food insecurity (Misselhorn 2014).

An effective alternative household coping strategy was suggested by reference (Tibesigwa et al. 2014) to strengthen their social capital. Similar suggestions by (Chen et al. 2014) also indicated that higher social capital in a farm household has significantly increased their adaptive capacity against environmental perturbation. Various forms of collective action, as one form of social capital, have also been a central mechanism for improving market access and productivity of smallholder producers (Ahuja and Staal 2013).

The people of Bangkalan Madura have shown that they have high social capital. The four essential elements of social capital, i.e. trust, collective action on pro-environment behaviour, social norms and networking, were present. The Bangkalan people grew within a religious environment, where the local leaders are religious leaders. The trust that the communities established especially for their leaders has assisted them to function well as a society. Trust is the foundation of moral behaviour on which social capital is built. The ability to maintain trust has empowered social cohesion between the community members themselves. The social norms that existed in the area especially religious norms have increased their shared responsibility. Strong positive relationships within and between social groups could significantly increase collective action. Since the 1970s, they have started to rehabilitate their land into a successful sustainable community forest management. The community also has an established local institution which governs the organization of calliandra wood to be sold to the wood pellet industry. Markets and trade increased access to food, thus contributing to achieving food security (Hebebrand et al. 2010). Thus, social networks are indispensable for increasing food security. With such high social capital, introducing a climate mitigation action to the people did not find too much resistance.

22.3.2.4 Replicability and Scalability

The impacts of the climate-smart community empowerment programmes in all project sites can be replicated to other communities or regions in Indonesia and abroad. The results can be applied in other provinces in Indonesia due its low use of technology and hence its capability to be easily applied by the local human resources. The use of local resources would require the local communities to efficiently use family members as labourers. Furthermore, the use of plants to enhance the community's welfare is easily accepted, as Indonesia is an agrarian nation, where plants play a big part of daily life survival and are closely related to local culture. Thus, the approach of using local plants would be easily applied in other parts of Indonesia. Furthermore, there are a total of 24,303,294 ha of critical lands in Indonesia ([KLHK] Kementerian Lingkungan Hidup dan Kehutanan 2013); hence this concept can be extended more broadly. This concept can also be extended to become a model farming system for Industrial Forest Plantation (HTI) lands set aside to be grown with crops for livelihoods (*tanaman kehidupan*), which is one of the legal requirements that must be met by companies using these lands, as specified in the Ministry of Forestry Decree No. 70/Kpts-II/95 on the Spatial Arrangement of Industrial Forest Plantation.

The activities can also be scaled up to have national even international value. Since the low resource use and high yield concept embraces the significance of developing local resources, this means that the concept can be scaled up to national level. Development of the islands would mean that development and environment should be closely related and interdependent. Opportunities to achieve the economies of scale in the islands were often constrained by high cost transportation, due to the archipelagic form of the country. Using the concept that is offered in this chapter, such constraints would be reduced, since the main idea is developing each area using its own local resources, and thus would reduce the dependency on other areas. The wood pellets of Bangkalan Madura even have the potential to be scaled up not only at national level but also at international level because the pellets could be sold for overseas customers/demands.

22.4 Conclusion

Community empowerment involved all efforts to allow a community to continue to develop their capacity, independence and sustainability. The success implementation of climate-smart community empowerment programmes in Madura, Jambi, Riau, Central and South Kalimantan provinces were well rooted on the use of the available local resources. Such resources would require low resource spending, both in terms of financial and human resources, yet produced high yields. Since economy often underlies the problem of food insufficiency, the concept that this chapter brought up, that is, low resource use yet high yield, should form a better

approach in implementing community empowerment programmes. Throughout the implementation of the projects, the people in all five sites have become more capable, more powerful and more able to enhance their economic welfare. The community also became more knowledgeable in mitigating climate change through agricultural/farming systems. The results of the research have shown that such concepts, if implemented on critical and degraded lands, could transform the community into a climate-smart community. These results implied that with appropriate approach, local communities could be transformed into communities that were secure in food and water and self-sufficient in energy. The research has indicated that using local resources to enhance the local agricultural/farming system has produced various multiplier effects as well as pushed for resource utilization efficiency, which put fewer burdens on the local community. This study also suggests that the low resource use and high yield concept can be applied more broadly and extended in other areas and provinces of Indonesia as a livelihood strategy as well as for climate change mitigation to reduce poverty. The concept can also be scaled up to national even international scales. The application of such concepts would have practical implications for the extent to which the local community requires greater control over their valuable resources, which would mean greater protection of land rights.

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Part V
Sustainable Disaster Management and Prevention

Chapter 23
Preference for Information During Flood Disasters: A Study of Thailand and Indonesia

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Abstract The world is encountering climate change and severe natural disasters. Floods have been one of the most disruptive disasters these decades. The 2011 flood in Thailand affected 13.6 million people and caused damage of USD 46.5 billion, while the 2013 flood in Jakarta, despite its short period, affected more than 45,000 people. This study intends to examine the changes of disaster information preference before and during each disaster. Questionnaire surveys were conducted in July 2013 in Thailand and Indonesia. The results found that the preferences for information increased once the disaster approached, except for preparedness plans and warnings in both cases and waste disposal in the Indonesian case. While most of the information preferences show no significant difference in mean between the two disasters, the results found significant differences in preferences for traffic/transportation infrastructure both before and during the arrival of disasters, availability of food and water, waste disposal before disaster impact, and overall damage information during the impact. The findings are crucial in terms of information

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gathering and dissemination to maintain the lives and livelihoods of human being during disasters. This study can contribute to both research and practice in terms of disaster information analysis and better preliminary examination of the preference for information needs from similar disasters with different scales and geographies.

23.1 Introduction

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations 2009, p. 29) is the meaning of sustainable development as defined by the United Nations International Strategy for Disaster Reduction (UNISDR). The concept covers various areas including disaster management and resilience. When considering information as a resource, access to information is a preliminary foundation for *understanding disaster risk*, one of the priorities for action in the *Sendai Framework for Disaster Risk Reduction 2015–2030*. While access to necessary core information can increase the efficiency of response actions and coordination (Comfort et al. 2004), when disaster impacts, ordinary people also try to gather as much information as possible about the current situation and news. However, *information dearth* is quite common for in any disaster, especially in rural areas that the national news could not reach (Sutton et al. 2008). Lack of information is a fundamental assumption of disaster management (Comfort et al. 2004). In order to promote disaster mitigation and resilience as well as sustainability of livelihoods and human security, it is important to determine what people prefer to know in an emergency situation. Pipes (2007) found two distinct problems in disaster management: information disasters and the flow of disaster information, which demand extensive study. Thus, this study seeks to examine the preference of information needs of survivors of flood disasters. This study picked two cases, the 2011 Thailand flood and the 2013 Jakarta flood in Indonesia.

The first case (*see* Fig. 23.1) was severe flooding during the monsoon season, between July 25, 2011 and January 16, 2012. During this time, five storms struck Thailand (DailyNews 2012). About 85% of the country's population from 66 provinces out of 77 were affected including the capital city, Bangkok (The World Bank: Thai Flood 2011). In addition to these storms, the disaster can be considered an "unusual case because of the failure of management" (Raungratanaamporn et al. 2014), p. 666.

The second case (*see* Fig. 23.2) occurred during January 15–23, 2013 in the capital city of Indonesia causing 47 deaths (Muhari et al. 2014). In Jakarta, poor urban planning increased the urbanized area, which contributed to large-scale infrastructure and environmental problems (International Research Institute of Disaster Science (IRIDeS) 2013; Godfrey and Savage 2012). Steinberg mentioned

Fig. 23.1 2011 Thailand flood

Fig. 23.2 2013 Jakarta flood

that major causes of flooding in Jakarta include "lack of carrying capacity of flood control infrastructure," "reduction of capacity of existing systems," "due [to] uncontrolled garbage dumpling," and "reduction of rainwater absorption due to urbanization and deforestation" (Steinberg 2007, p. 360). Trash and pump failure was also another factor that caused this disaster (International Research Institute of Disaster Science (IRIDeS) 2013; Bricker et al. 2014). During the disaster period, "there was no flood early warning [or] official evacuation sites developed and applied by the provincial government. Thus, awareness and evacuation response is mostly based on people's judgment and their personal risk perception at the time of the flood" (Muhari et al. 2014).

This study aims to contribute to research and practice in terms of examining the preference for disaster information needs. By examining what people prefer to

know during a disaster situation, the related stakeholders can prepare and provide those useful data and information systems, which in turn strengthen the foundation for a safe and sustainable community. This move can increase the ability of society to resist and survive during disasters.

23.2 Background of Disaster Information

Information means data, facts, and ideas including any message or meaning that influences people to understand their (Sutton et al. 2008). Wilson defined "information seeking behavior" as "the purposive seeking for information as a consequence of a need to satisfy some goal" (Wilson 2000, p. 49), while information searching behavior was defined as "the 'micro-level' of behavior employed by the searcher in interesting with information systems of all kinds" (Wilson 2000, p. 49). Principles of guide information management in disaster include "accessibility," "inclusiveness," "interoperability," "accountability," "verifiability," "relevance," "objectivity," "humanity," "timeliness," and "sustainability" (Barrantes et al. 2009).

Lu et al. (2007) studied the factors influencing online information seeking when disaster impacted. They found that Internet dependency and attitude toward information significantly affected the intention of information seeking (Lu et al. 2007). Imran et al. (2013) extracted information from tweets during the 2011 Joplin tornado (USA) and found that half of them were caution and advice, followed by the information source, donations, and causalities and damage, respectively. Acar and Muraki (2011) analyzed tweets during the 2011 Great East Japan earthquake and found that most of them were related to "warning," "help requests," and "reports about the environment." Leelawat et al. (2013) analyzed the mobile applications which were available during the 2011 Thailand flood. They concluded that those applications provided information including warning, medical and health information, evacuation, monitoring information, food supplies, and relief Leelawat et al. (2013). The literature was examined to find the necessary information needs determined by previous disaster research. The necessary information included the following.

23.2.1 Overall Damage

Once a disaster occurred, people preferred to check their damage situation and count their casualties as well as report their damage situation to the public. Shim et al. (2011) developed a reporting and status transmission system based on smartphones to let people input their damage situation. Then, those data were managed for decision support (Shim et al. 2011). Damage information is also

important especially for rescue teams to make decisions. It can give an idea of risk to people far from the site of the disaster.

23.2.2 Safety of Family Members and Friends

Asian cultures consider family a vital unit. When disaster approached, people sought to find out if their family members and friends were safe. Qu et al. (2009) found that one of the main topics posted online after the 2008 Sichuan earthquake (China) was the search for family members and friends. Thirty-three percent of those posts were replied to with useful information.

23.2.3 Availability of Food and Water

The logistics of distributing food and drinks may encounter some problems during a disaster. As a result, people may experience lack of food supplies. Uchida et al. (2011) considered that food and supplies, as well as shop information, was one of the pieces of information that needed to be collected after disasters.

23.2.4 Distribution of Donations and Relief

In an emergency situation, especially the post-disaster period, it is important to know the supply of and demand for goods and relief. The *Sahana Disaster Management System*, an open-source software, was developed in order to provide distribution and relief information during disasters (Currion et al. 2007). Qu et al. (2009) also found online posts associated with the seeking of information on donations and rescue efforts after the 2008 Sichuan earthquake. Among those posts, more than half of them were replied to with useful information (Qu et al. 2009).

23.2.5 Waste Disposal

For long-period disaster such as floods, people want to know how to manage the waste from their households or evacuation shelters. The generation of waste may also obstruct drainage water flow and increase the flood problem. Without proper waste management, other problems such as epidemics can occur.

23.2.6 Reliability of Utilities and Lifelines

After a disaster, a building damage status report should be provided, and fires, electrical dangers and outages, and damages to utility lifelines should also be reported (Currion et al. 2007). Uchida et al. (2011) considered that information on lifelines was desired after disasters.

23.2.7 Traffic and Transportation Infrastructure

In many cases of evacuation such as the 2011 Great East Japan earthquake (Uchida et al. 2011), after the disaster warning, people encountered traffic jams and transportation problems. Information about traffic and transportation can inform evacuees of what routes they should take.

23.2.8 Hospitals and Medical Centers

Disasters can generate various kinds of loss and damage to human beings. When there is a case of injury, people seek to find hospitals, medical centers, or mobile first aid sites. Nevertheless, many medical centers could be fully occupied. Quickly locating available medical professionals and medicines can save lives and reduce risk.

23.2.9 Current Disaster Situation and Affected Area Monitoring Map

Kongton et al. (2012) collected Twitter data during the 2011 Thailand flood and found that the majority of tweets were about the flood situation itself.

23.2.10 Existing Disaster Preparedness Plan

If there is a disaster preparedness plan, people can follow the instructions in the manual and make quick decisions during the emergency period. Training courses, online classes, or practical disaster drills can make people understand on how to survive disasters.

23.2.11 Disaster Warning

For all kinds of natural disasters, it is necessary to warn people to let them know and prepare for the upcoming disaster. The reaction or response to such warning is a social process (Mileti 1995). Mileti (1995) proposed the factors influencing public response as "warning source," "warning message consistency," "warning clarity," "certainty of the message," "sufficient information," "guidance," "warning frequency," "risk location information," and "channel of communication." Warning information should come from the official agencies working on monitoring. In a disaster-prone country like Japan, it is important that warning messages reach the people in the affected areas on time (Imamura and Abe 2009). Yun and Hamada (2015) found that the majority of their sample survivors from the 2011 Great East Japan tsunami knew about tsunami, even without preparedness, because of the tsunami warning and alarm. In Thailand, the *National Disaster Warning Center* (NDWC) is the agency authorized to make the decision to issue warnings (Leelawat et al. 2015). The *National Disaster Management Authority* (BNPB) has this duty in Indonesia.

23.2.12 Availability and Accessibility of Evacuation and Emergency Shelters

The availability and accessibility of evacuation shelters is another important piece of information to know (Uchida et al. 2011). The *Sahana Disaster Management System* includes shelter information (Currion et al. 2007). The system helps users organize evacuation information such as registration and map location (Currion et al. 2007).

23.3 Research Design

23.3.1 Item Development

Categories of information were mainly adapted from previous literature (Noda 2000; Mobile Society Research Institute 2012). The original English version was translated into the local languages (Thai and Bahasa Indonesia), and the results translated back. The pilot test was done with eight graduate students at the Tokyo Institute of Technology. The questionnaires were then revised based on the comments from the pilot test. The following questions were asked in the questionnaires.

Which information is considered to be important for all disaster-related decisions 'before' the 2011 Thailand flood (the 2013 Jakarta flood)?

Which information is considered to be important for all disaster-related decisions 'during' the 2011 Thailand flood (the 2013 Jakarta flood)?

The items to answer ("Yes," "No," "Not sure") for the mentioned questions include "overall damage," "safety of family/friends," "availability of food and water," "distribution of donations/relief," "waste disposal," "reliability of utilities/lifelines," "traffic/transportation infrastructure," "hospitals/medical centers," "current flood situation and affected-area monitoring map," "existing disaster preparedness plan," "disaster warning," and "availability and accessibility of evacuation and emergency shelters."

23.3.2 Data Collection

In Thailand, the electronic-based and paper-based questionnaire surveys were conducted through the Climate Change and Disaster Center of Rangsit University during July 8–16, 2013 in various cities throughout the country through the center's network of partners. As a result, there were 135 responses through the online survey and 91 responses through the paper survey (226 responses in total).

In Indonesia, the questionnaires were distributed in Jakarta by the Tohoku University's Jakarta Flood Survey Team. The paper-based questionnaires were gathered during July 1–8, 2013. The sampling was allocated door-to-door in the surveyed area. There were 152 responses in total.

23.3.3 Demographic Description

Incomplete responses were excluded. In addition, four responses who answered that they were not in Thailand during the disaster period were also excluded since this study focused on the perspective of people who experienced the disaster. Therefore, complete responses ($n_{ThailandFloods} = 188$, $n_{JakartaFlood} = 137$) were subsequently analyzed. Table 23.1 displays the demographic description of the complete responses.

For the samples in Thailand, there were more male respondents (56.4%) than females (43.6%). Most of the respondents were between 21 and 40 years old (70.7%). More than half of the respondents had completed undergraduate university education (57.4%). For the samples in Indonesia, there were more female respondents (59.9%) than males (40.1%). Most of the respondents were between 41 and 60 years old (46.0%), followed by 21–40 years old (43.8%), 61–80 years old (8.8%), 0–20 years old (0.7%), and greater than 81 years old (0.7%).

Table 23.1 Demographic profile of Thai samples ($n = 188$)

Characteristics	Items	Percent (%)
Gender	Female	43.6
	Male	56.4
Age (years)	0–20	11.2
	21–40	70.7
	41–60	18.1
	61–80	0.0
	81–	0.0
Education	Not attended school	0.0
	Elementary	0.0
	Junior high school	0.0
	High school	3.2
	Diploma	5.9
	Bachelor's degree	57.4
	Master's degree	30.3
	Doctoral degree	3.2
Occupation	Government officer	12.2
	State enterprise personnel	11.7
	Company employee	28.2
	Business owner	8.5
	Student	34.0
	Other	5.3
	Unemployed	0.0

23.4 Results

Table 23.2 presents the results from Thailand. The results show that all these categories of information were necessary both before and during the disaster. When considering the answer of "Yes" as agreement and "No" as disagreement, the result found that the maximum score of "Yes" before the flood approached was for "existing disaster preparedness plan" (92.6%), followed by "availability of food and water" (92.0%) and"'disaster warning" (92.0%). On the other hand, the maximum score of "No" was for "distribution of donation/relief" (13.8%) followed by "overall damage" (12.8%), and "waste disposal" (10.6%).

"Yes" responses to all information categories increased when the flood approached except the "existing disaster preparedness plan" and "disaster warning." The maximum score of "Yes" during the flood impact was for "availability of food and water" (96.8%), followed by "safety of family/friends" (94.7%) and "distribution of donation/relief" (94.1%), while the maximum score of "No" was for "waste disposal" and "hospitals/medical centers" (4.8%).

Table 23.2 Demographic profile of Indonesian samples ($n = 137$)

Characteristics	Items	Percent (%)
Gender	Female	59.9
	Male	40.1
Age (years)	0–20	0.7
	21–40	43.8
	41–60	46.0
	61–80	8.8
	81–	0.7
Education	Not attended school	5.1
	Elementary	24.8
	Junior high school	22.6
	High school	40.1
	Diploma	7.3
	Bachelor's degree	0.0
	Master's degree	0.0
	Doctoral degree	0.0
Occupation	Government officer	2.2
	Company employee	14.6
	Business owner	39.4
	Student	0.0
	Other	13.1
	Unemployed	39.4

Next, Table 23.3 presents the results from Indonesia. The results found that the maximum score of "Yes" before the flood approached was for "waste disposal" (94.9%) and "availability and accessibility of evacuation and emergency shelters" (94.9%), followed by "existing disaster preparedness plan" (92.7%). The maximum score of "No" was for "traffic/transportation infrastructure" (36.5%), followed by "availability of food and water" (15.3%) and "overall damage" (14.6%).

All categories of information except "waste disposal," "existing disaster preparedness plan," and "disaster warning" received a higher score of "Yes" during the flood impact than before the flood approached. The maximum score of "Yes" during the flood impact was for "safety of family/friends" (98.5%), followed by "availability of food and water" (97.1%) and "availability and accessibility of evacuation and emergency shelters" (96.4%). The maximum score of "No" was for "traffic/transportation infrastructure" (25.5%), followed by "disaster warning" (13.1%) and "waste disposal" (9.5%).

The independent *t*-test was performed with an alpha level of 0.05. The answer "Yes" was valued 1, while the answer "No" was valued 0. The answer of "Not sure" was excluded. As for the country classification, "1" was used for Thailand, and "2" was used for Indonesia. The result can be seen in Table 23.4. When comparing the two disasters, the results show mainly no significant difference in mean except the traffic/transportation information for both before ($t = 6.756$; $p<0.001$) and during floods ($t = 5.635$; $p<0.001$); in addition, before the arrival of floods, there were

Table 23.3 Results from Thailand ($n = 188$)

Category of information desired	Before disaster approached			During disaster impacted		
	Yes (%)	No (%)	Not sure (%)	Yes (%)	No (%)	Not sure (%)
Overall damage	75.5	12.8	11.7	81.9	13.8	4.3
Safety of family/friends	88.3	7.4	4.3	94.7	3.2	2.1
Availability of food and water	92.0	6.9	1.1	96.8	2.1	1.1
Distribution of donation/relief	82.4	13.8	3.7	94.1	2.7	3.2
Waste disposal	83.0	10.6	6.4	86.7	8.5	4.8
Reliability of utilities/lifelines	89.4	7.4	3.2	93.6	3.2	3.2
Traffic/transportation infrastructure	88.8	7.4	3.7	93.6	3.7	2.7
Hospitals/medical centers	88.8	6.9	4.3	93.6	1.6	4.8
Current disaster situation and affected area monitoring map	85.1	8.5	6.4	94.1	4.3	1.6
Existing disaster preparedness plan	92.6	4.3	3.2	89.4	8.0	2.7
Disaster warning	92.0	4.3	3.7	89.9	7.4	2.7
Availability and accessibility of evacuation and emergency shelters	88.8	7.4	3.7	93.6	3.2	3.2

Table 23.4 Results from Indonesia ($n = 137$)

Category of information desired	Before disaster approached			During disaster impact		
	Yes (%)	No (%)	Not sure (%)	Yes (%)	No (%)	Not sure (%)
Overall damage	81.0	14.6	4.4	94.9	2.9	2.2
Safety of family/friends	89.1	8.0	2.9	98.5	1.5	0.0
Availability of food and water	82.5	15.3	2.2	97.1	2.2	0.7
Distribution of donation/relief	91.2	8.0	0.7	93.4	4.4	2.2
Waste disposal	94.9	2.9	2.2	88.3	9.5	2.2
Reliability of utilities/lifelines	89.1	8.8	2.2	91.2	5.1	3.6
Traffic/transportation infrastructure	53.3	36.5	10.2	66.4	25.5	8.0
Hospitals/medical centers	92.0	7.3	0.7	94.9	3.6	1.5
Current disaster situation and affected area monitoring map	81.0	11.7	7.3	86.1	7.3	6.6
Existing disaster preparedness plan	92.7	5.1	2.2	88.3	10.9	0.7
Disaster warning	92.0	7.3	0.7	86.9	13.1	0.0
Availability and accessibility of evacuation and emergency shelters	94.9	2.9	2.2	96.4	2.9	0.7

significant differences for availability of food and water ($t = 2.367$; $p<0.05$) and waste disposal ($t = -2.975$; $p<0.01$). During flooding, there were significant differences for overall damage ($t = -3.803$; $p<0.001$) (Table 23.5).

Table 23.5 Results from mean comparison analysis

Category of information desired	Mean of Thailand group	Mean of Indonesia group	t	Mean of Thailand group	Mean of Indonesia group	t
Overall damage	0.86 ($n = 166$)	0.85 ($n = 131$)	0.194	0.86 ($n = 180$)	0.97 ($n = 134$)	-3.803^{***}
Safety of family/friends	0.92 ($n = 180$)	0.92 ($n = 133$)	0.159	0.97 ($n = 184$)	0.99 ($n = 137$)	-1.080
Availability of food and water	0.93 ($n = 186$)	0.84 ($n = 134$)	2.367^{*}	0.98 ($n = 186$)	0.98 ($n = 136$)	0.034
Distribution of donation/relief	0.86 ($n = 181$)	0.92 ($n = 136$)	-1.787	0.97 ($n = 182$)	0.96 ($n = 134$)	0.828
Waste disposal	0.89 ($n = 176$)	0.97 ($n = 134$)	-2.975^{**}	0.91 ($n = 179$)	0.90 ($n = 134$)	0.230
Reliability of utilities/lifelines	0.92 ($n = 182$)	0.91 ($n = 134$)	0.403	0.97 ($n = 182$)	0.95 ($n = 132$)	0.879
Traffic/transportation infrastructure	0.92 ($n = 181$)	0.59 ($n = 123$)	6.756^{***}	0.96 ($n = 183$)	0.72 ($n = 126$)	5.635^{***}
Hospitals/medical centers	0.93 ($n = 180$)	0.93 ($n = 136$)	0.044	0.98 ($n = 179$)	0.96 ($n = 135$)	1.071
Current disaster situation and affected area monitoring map	0.91 ($n = 176$)	0.87 ($n = 127$)	0.979	0.96 ($n = 185$)	0.92 ($n = 128$)	1.240
Existing disaster preparedness plan	0.96 ($n = 182$)	0.95 ($n = 134$)	0.341	0.92 ($n = 183$)	0.89 ($n = 136$)	0.855
Disaster warning	0.96 ($n = 181$)	0.93 ($n = 136$)	1.079	0.92 ($n = 183$)	0.87 ($n = 137$)	1.567
Availability and accessibility of evacuation and emergency shelters	0.92 ($n = 181$)	0.97 ($n = 134$)	-1.916	0.97 ($n = 182$)	0.97 ($n = 136$)	0.179

Note: * Significance at level $p < 0.05$, ** Significance at level $p < 0.01$, *** Significance at level $p < 0.001$

23.5 Discussion and Conclusions

Yun and Hamada (2015, p. 1258) mentioned that "human damage and impact depend on how people make a decision to behave during disasters." This study attempted to examine the preference of information needs from the perspective of survivors. Especially in this era of climate change and various large-scale natural disasters, knowing what people expect is one of the vital bases for disaster mitigation and preparedness, which helps maintain the sustainability of human livelihoods, as well as promote resilience in terms of enhancing the ability of society to resist and survive during disasters.

Consistent with previous works (Shim et al. 2011; Qu et al. 2009; Uchida et al. 2011; Currion et al. 2007; Kongton et al. 2012; Mileti 1995; Leelawat et al. 2015; Noda 2000), certain information categories are preferred by disaster survivors. Most of the results appear to be reasonable according to the disaster management cycle. The preference for information increased once the disaster approached, except the categories of existing preparedness plan and disaster warning in both cases and waste disposal in the Indonesian case. It is no surprise that the preference for a preparedness plan and warning received lower scores once the floods arrived since these information categories are more useful in the preparedness phase than the response phase.

Before the disaster approached, Thai people mostly preferred to know the disaster preparedness plan, while Indonesian people preferred waste disposal and information on evacuation centers. It can be interpreted that Thai people had fewer experiences with large-scale floods, and thus they required knowing instruction on what to do when disaster arrived.

As trash was one of the causes of past flood disasters in Jakarta (Bricker et al. 2014), people tend to require information regarding waste disposal. Their frequent flood experiences might influence them to require information on evacuation.

In the Thai case, the traffic and transportation infrastructure information category is most highly preferred both before and during flooding, but in the Indonesian case, only about half preferred it. In fact, due to the Jakarta flood, most mass transportation (i.e., trains and buses) were suspended, and roads were closed off. However, the Jakarta flood was much shorter in duration than the Thailand flood. It may be assumed that people in Jakarta preferred higher priority information to transportation because transportation was for the most part suspended.

A previous study was conducted in the Philippines for the case of the 2013 Super Typhoon Haiyan (Leelawat et al. 2014). Through a similar list of items asked from the survivors of the typhoon, the results found that the safety of family/friends received the highest score, followed by availability of food and water, then hospitals/medical centers (Leelawat et al. 2014). Both safety of family/friends and availability of food and water received the same score before and during the disaster (Leelawat et al. 2014).

Despite these findings, there is also a need to pay attention to the limitations of this study. The questionnaire survey was not randomly distributed. Through the

collaboration of the Climate Change and Disaster Center of Rangsit University, the questionnaires were allocated to organizations only in the network of this center. In Jakarta, the questionnaires were distributed to all houses in specific areas of the city. These can be viewed as biased survey sampling.

The reasons behind the findings in this study will be investigated in upcoming research. In order to design and develop sustainable information systems providing necessary information to people when disaster approaches, further study of disaster information systems as well as big data analysis for disaster management should be conducted.

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Chapter 24
Socio-ecological Aspects Informing Community Resilience in a Disaster-Prone Area: A Case Study of the Traditional Koa Community in East Nusa Tenggara Province of Indonesia

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Abstract The purpose of this study is to attempt to understand how the socio-ecological aspects existing in a traditional community contribute to that community's resilience when facing natural hazards. This paper views resilience through a socio-ecological perspective. Here, resilience is defined as the capacity of a community, potentially exposed to hazards, to adapt to threats of a disaster by retaining its essential function, structure, identity, and ability to deal with negative feedback. The discussion is based on a case study of the traditional community of Koa that has a history of being regularly exposed to volcanic hazards, as the community is located downhill from the volcano known as Mt. Rokatenda, which is in East Nusa Tenggara Province, Indonesia. This paper suggests that resilience is a dynamic condition, and therefore it may shift due to the changing nature of the hazards faced. The study identified four socio-ecological aspects that play important roles in maintaining resilience of the traditional community of Koa, these being (i) utilization of natural resources, (ii) changing in consumption patterns, (iii) local knowledge and practices, and (iv) disaster management policies set up by the local authorities. The study concluded that the characteristics of a disaster change over time, which led to changes in the effects of a disaster. Eruptions and tsunamis damage the environment and thus affect the community's way of life, particularly a traditional community like Koa, whose life mostly depends on natural resources available in its environment. Therefore, adaptation measures based on identified

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socio-ecological aspects are strongly advised as a key to strengthen resilience of traditional communities, when they are obliged to deal with survival-threatening situations.

24.1 Introduction

Indonesia has many volcanoes scattered across its islands. Its people are familiar with volcanoes and the threat of their eruptions. People living around volcanoes have been recognized as having complex relationships with "their" volcano, even growing to adore its existence. The relationship and adoration manifest themselves in the local beliefs and traditions that somehow make the communities remain in the region, even at the risk of being subjected to volcanic hazards (Donovan 2010).The proximity of communities with the volcanoes in Indonesia, which has resulted in the loss of a significant number of lives, can be traced through the history of volcanic disasters in Indonesia.

In 1963, over 1200 people died due to the eruption of Mt. Agung in Bali Island, where hundreds of inhabitants who were exposed to lava flow refused to leave because they regarded that life-threatening lava as the embodiment of gods who were coming down from the mountaintop. Another event occurred in Central Java, where in 2006 the local community of Mt. Merapi refused to be evacuated, because they had more trust in the traditional knowledge of *juru kunci*, the gatekeeper of Merapi, compared to the scientific information provided by a government agency (PVMBG, the Center of Volcanology and Geological Hazard Mitigation of Indonesia) regarding the threat warnings from Mt. Merapi at that time. (Donovan 2010). Another example of a community failing to take evasive action was in Ternate Island. Since the 1600s, Mt. Gamalama in Ternate Island has erupted 60 times, producing lava and pyroclastic flows, with a rest period between eruptions averaging 10 years. History records that phreatic eruptions in September 1775 were highly destructive, completely wiping out the village of Soela Takomi which was located 1.5 km from the summit, along with its 141 inhabitants (Pratomo et al. 2011).

Volcanic threats in Indonesia are indeed so vast that this issue needs specific attention. Based on the report of the study of hydrometeorology in Indonesia, the International Strategy for Disaster Risk (ISDRR) (The Asia Pacific Disaster Report 2010) noted that Indonesia has more than 500 volcanoes, 127 of which are active. This is 15% of the world's volcanoes. In 2014, the Ministry of Energy and Mineral Resources (KESDM) reported that the status of 19 volcanoes was above normal: 4 were at "high alert" and 15 at "alert" status. The warning included the semi-dormant Mt. Rokatenda which, at the time of this research, was in "high alert" status (level III), meaning the possibility of a large eruption occurring was potentially high.

The purpose of this research is to provide insights into how the dynamic interaction of man and nature, in socio-ecological systems, contributes to the resilience of a traditional community exposed to volcanic hazards. The research was performed by analyzing a case study of the Koa community being exposed to the Mt. Rokatenda volcano in East Nusa Tenggara Province, Indonesia. Socio-ecological aspects were identified in the context of locality that are expected to be able to contribute to disaster management strategies at the community level, primarily in traditional society. The researcher examined historical data, made direct observations, and conducted interviews with selected informants.

24.2 Literature Review

The natural ecosystem is defined as "a network of interactions among and between organisms with their environment." It is where a dynamic relationship between the different individuals and environmental factors (Redman et al. 2004) takes place continuously, consequently forming a complex system of social ecology (Gaillard 2007). The existence of ecosystems is used to support and meet the provision of the basic needs of human life. Moreover, ecosystems can function as a buffer that protects the environment, as well as any humans within it, from harmful natural events. When there is perturbance that disturbs the equilibrium of the said ecosystem, it will impact the human lives that depend on that system. Disruptions on a massive scale can be disastrous, ruining livelihoods, causing loss of property, and even bringing death to humans and nonhumans alike (Texier-Teixeira et al. 2014; Adger 2003).

Perturbance can occur as shock and stress. A shock is defined as a sudden event that impacts on the vulnerability of a system and its components, while stress is a long-term trend that undermines the potential of a given system to function effectively, as well as increasing the vulnerability of the actors within it (Roussy 2013). The system will gradually recover by adjusting to the changes, reorganizing itself by maintaining essential functions, identity, and structures and regaining resilience (Holling 1973). A traditional community has its cultural identity where there is a set of socio-ecological relationships derived from the collective experiences of the past and which still retains its authenticity to maintain a way of life that is unique and different from the other communities outside its territory (Plieninger et al. 2014). When the ecosystem is changing, then the community that depends on the environment will renew their local knowledge and its application for adjustment (Carpenter et al. 1999).

The concept of resilience has developed from physics (Alexander 2013; Gunnestad 2006) and psychology to social and environmental contexts (Ungar 2005). Resilience, meaning *strength* and *ductility*, was later adopted in natural

ecology (Holling 1973; Alexander 2013). In this latter field, resilience has come to be defined as "the ability of a system to absorb disturbance yet still be able to survive or adapt to changes by maintaining its essential functions and structures" (Holling et al. 1995; Berkes and Folke 1995). A system makes changes to its structure by changing variables and controlling the characteristics of the variables (Holling 1996) that mutually strengthen to become a different structure and process (Anderies et al. 2006). At the same time, a system is still, or should be, able to retain, and/or deal with, important functions, structures, identity, and feedback (Walker et al. 2004). Such interconnections and feedback between nature and society are essential in order to reach sustainability (Eidem 2012).

Resilience is a dynamic concept. A continuous disturbance in a given system will affect its capacity for resilience, and this will create vulnerability, a condition where a system becomes fragile. If no measures are taken to address this issue, it can result in a system passing beyond its tipping point, which ultimately leads to disaster (Adger 2006). Vulnerability refers to the gaps, or the absence of potential capacities, that establish resilience.

The relationship between social and ecological resilience is especially evident in social groups or communities that depend on ecological resources and their environments as sources of livelihood. In traditional communities, this dependency on nature is associated with the concept of identity, i.e., indigenous peoples are the first to occupy the land and thus have a strong attachment to the land and the environment (Adger 2000). Resilience, in the context of socio-ecological systems, is defined as "the ability of a community to survive against repeated external interferences on the social infrastructure" (Adger 2000). That said, the nonlinear dynamics, thresholds, and uncertainty factors of a disaster play a role as catalysts for rapid change in a community that, over time, create the instinct of survivability. (Folke et al. 2002; Folke 2006). In a traditional community, this instinct of survivability is shown through the local ecological wisdom which is a collection of knowledge, beliefs, and practices that moves through the process of adaptation and is passed down from generations through the time-honored process of cultural transmission.

There are external factors that occur and create risks that may shock the system, thereby disturbing both social process and structure. However, by recalling its potencies as strengths, traditional communities are able to accept change(s) and still keep their essential structures, functions, and feedback in place (Walker et al. 2004; Adger et al. 2005). Most traditional societies have changed their way of life in order to survive/to recover from the damage caused by disasters (including modernization?). Changes may be small or large and may, or may not, occur in a timely manner. The need to establish and to develop resilience in the mountainous region cited in this paper refers to the capacity to learn and to adapt, using all forms of knowledge by firstly defining two things: (a) "resilience against what?" and (b) "resilience for whom?" (Rotarangi and Stephenson 2014; Pike et al. 2010).

24.3 Method

The study was performed in Palue Island, Sikka District in East Nusa Tenggara Province. The island was selected because of its unique condition, a volcanic island which has had a "high alert" status for more than 2 years, between 2012 and 2014. The focus of the research was the traditional community of Koa, located approximately 3 km from the top of Mt. Rokatenda volcano. The selection was based on the criteria of a traditional community that refused to be relocated from the highest risk area on the island and which chose to stay in the event of eruptions.

24.3.1 Data Collection

The study employed a qualitative approach involving descriptive designs. All qualitative data were collected by conducting in-depth interviews with selected informants from the three kampongs (villages) in Koa. Focus group discussions were used to verify the data collected through the interviews, emphasizing specific findings based on the informants' responses, and to observe interactions of community members in social settings. In order to complement the data, and to describe the land settings, the researcher mapped the settlements and land coverage. Table 24.1 describes the informant groups and main topics.

The data used in this research are the historical data of Mt. Rokatenda's eruptions from the period 1928–2014, a profile of the Koa community, and primary data obtained from interviews and FGDs. A profile of the traditional Koa community was provided in order to offer a description of the people, the land coverage, and relevant sociocultural dimensions. The data from the interviews and FGDs were developed from general to specific topics, which were analyzed by grouping them into two categories: (i) relevant to vulnerability and (ii) socio-ecological aspects of community life. Vulnerability analysis was focused on the volcanic eruptions' impacts on the community at large, as well as on the community's knowledge and awareness regarding volcanic threats. Analysis of the socio-ecological aspects of traditional community life will focus on the aspects that generate community capacities, basic needs, livelihoods, traditional beliefs, and regulations.

24.3.2 Eruption History of Mt. Rokatenda

The semi-dormant Mt. Rokatenda lies at the center of Palue Island, a subdistrict consisting of eight villages in Sikka District, East Nusa Tenggara Province, Indonesia. The island is formed from the top part of an underwater volcano that rises 3000 feet from the seabed; the tip of the volcano is 875 meters above sea level. The Center of Volcanology and Mitigation of Geological Disaster of Indonesia

Table 24.1 Data of informants and topic of interviews

General information	Target group and informants	General topic for interview and FGD	Specified topic for interview and FGD
	Depth interview		
Number of households: 104	Local community (head of the family, represent three kampongs, heterogenic, age 34–78	Understanding on Mt. Rokatenda risks	Knowledge and awareness
		Socio-ecological factors	Types of risks, natural resources, ecosystem services
	Number of informants: 15 persons (m, 12; f, 3)	Traditional knowledge and practices	Food and clean water's storage and protection
		Domestic activities	
	Decision-makers (key informants: village head, subdistrict secretary, district disaster agency), number of informants: 3	Regulations	Disaster management, environmental protection
	FGD		
	Traditional leaders and members: 15	Traditional and social relationships	Roles and involvement in traditional events, kinship, and daily practices
		Regulations	Knowledge and awareness on
	Women: 5	Traditional and social relationships	Women
	Total informants (represented households): 37 (35% of total households)		

(PVMBG) declared the entire island of 41km^2 as a level II disaster-prone zone. Such a classification indicates that the area is at risk from lava flows, heat, clouds, incandescent materials, and volcano ash. In fact, most of the settlements are classified as being in a level III disaster-prone zone, since most of settlements are located within a radius 3 kilometers from the center of the volcano, as per the PVMBG's classification levels of areas vulnerable to disaster.

Recorded eruptions of Mt. Rokatenda are shown in Table 24.2. Existing documents and some research-based data record the 1928 eruption as the biggest and having the most impact on people living in Palue Island; the shocks from the eruption were felt up to the coastal mainland of Flores, which is 16 miles or 27 kilometers away. More than 160 people died from the tsunami that followed the shocks (Van Padang 1983; Vischer 1992; Sutawidjaja and Sugalang 2007). However, it was the eruptions in the 1980s and 2012s that forced the local

Table 24.2 Eruption history of Mt. Rokatenda

Year	Hazardous materials	Impacts	Resources			
	Volcanic ash	Gas clouds	Heat incandescent	Lava flow		
2012–2014	√	√	√	√	Five deaths and 2754 people relocated	PVMBG
2005	√	–	–	–	–	PVMBG
1984–1985	√	–	√	–	–	Interview
1980–1981	√	√	√	√	One death and ± 1850 people relocated	Sutawidjaja and Sugalang 2007
1972–1973	√	–	–	–	–	Interview
1963–1966	√	√	√	√	One death	Sutawidjaja and Sugalang 2007
1928	√	√	√	√	± 160 deaths and thousands evacuated	Sutawidjaja and Sugalang 2007 and Van Padang 1983

authorities in Sikka District to initiate a population relocation strategy. Starting in 1980, more than a thousand people originally from Palue now live outside the island. Most of them live in the mainland of Flores; the newest settlement recently provided by the local government is located in a small island called Pulau Besar, which is still a part of Sikka District.

24.3.3 Profile of the Traditional Community of Koa

Koa is one of the three sub-villages of Rokirole village, in Palue subdistrict. The total population recorded at the beginning of 2013 was 104 households, with a total of 345 inhabitants. At the time of the study, the researcher mapped existing house buildings in Koa sub-village: a total of 54 houses spread over three kampongs in Koa. These kampongs are named Toke, Nata Ca, and Todho Pabha (see inserted picture in Fig. 24.1). The current settlement observed in this study is the third establishment (*Kampung Koa III*). The first settlement (*Kampung Koa I*) was established just 500 meters below the rim, right at the foot of Mt. Rokatenda, and was known as Powo Wawo (see Fig. 24.1). The name of Powo Wawo also marked the first settlers who built the hamlet and were acknowledged as the first clan. The four following groups, Kaju Male, Roka Roi, Mangge Base, and Sari Koa, were then recognized as the other clans that make up the Koa community.

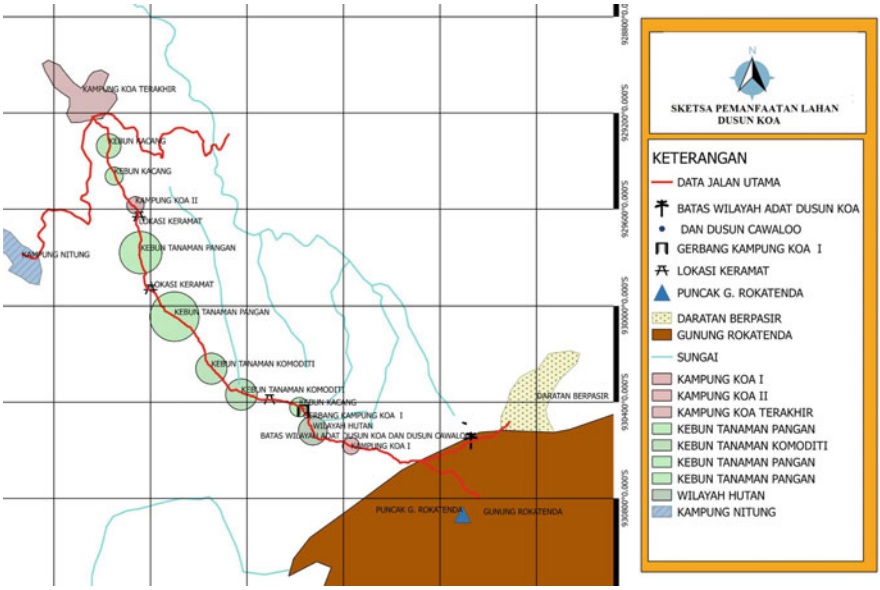

Fig. 24.1 Land coverage by Koa community with inserted Koa settlement (author's collection, 2015)

Among the five clans mentioned above, Powo Wawo was accepted as the oldest and also the leader of the five. There are three levels of community groups, based on sociocultural orders: First is *lakimosa*, which defines the main leader of the clans and also identifies subleaders at traditional ceremonies. The second is *ina*, which defines the "advisory" council to the main leader, providing support at traditional ceremonies and other important social and cultural gatherings. These *ina* are the subleaders that people recognize by the same nickname as *lakimosa*. The third order is *wai walo*, simply defined as the community, the common people, the *hoi polloi*.

Koa is well known for still holding fast to the original cultural ceremonies associated with Palue Island. In particular are the offerings to *Era Wula Watu Tana*, who was and is the supreme being in the mythology of Palue, described as the protector of the people and the island, and who exists in the pit of Mt. Rokatenda, as do the people's ancestors. The ceremony was popularly known as *Pua* and *Pati Karapau*, referred to as the "buffalo offerings." Of all the traditional groups in Palue, it is only the Koa people who still proudly celebrate the event regularly, keeping to its original 5-year cycle. Other traditional groups have rarely celebrated this ceremony, and if they choose to do, so the cycle is shortened to 1–2 years. Koa is also the only community that performs the ceremony at Powo Wawo, the first settlement right at the foot of Mt. Rokatenda. It makes the community unique and vulnerable at the same time.

24.4 Results and Discussion

24.4.1 Vulnerability Analysis

Koa is located approximately 3 km from the peak of Mt. Rokatenda. The majority of Koa's area, and particularly its agricultural lands, is in a level III disaster-prone zone (1–2 km from the epicenter), while the settlements are classified as being in a disaster-prone zone, level II (3–5 km from the epicenter). Koa is located adjacent to a route of lava flows called *Oje Ubi* at the northwest part of Mt. Rokatenda. The directions of the previous eruptions in 1985 and 2013 were to the volcano's northwest side, which means material from those eruptions was directed at Koa. The eruption in 1985 spewed hot ash and covered the soil up to 3 mm thick, while rocks and other material were thrown as high as 2000 m into the air. The other eruption in 2013 unleashed hot ash all over the island, including at Koa. It produced lava flowing through *Oje Ubi* and down to the coastal area, where it killed five fishermen from a nearby sub-village who were asleep in the coastal part of the Koa region, as well as injuring four people of Koa, due to their negligence in ignoring the risk warnings. The summary of the impacts of previous eruptions is shown in Table 24.3.

The eruptions in the 2012–2013 period were considered the worst for Koa, because they damaged more than 24 hectares of the community's agricultural lands (see green areas in Fig. 24.1) and forced the authorities to evacuate people to the mainland of Flores. The land was covered with volcanic rocks that damaged all the crops, including commodity crops such as cocoa, cashew, and coffee, as well as the corn and bean food crops. Those same eruptions also killed cattle and damaged the water supply's infrastructure. Of the three Koa kampongs, Kampong Toke, which consists of nine houses, was the worst affected. Because of its geographical setting in the open, Kampong Toke was directly exposed to the eruptions' fallout, such ash, rocks, and *pyroclastic flows*.

Table 24.3 Impacts of Mt. Rokatenda's eruptions in Koa

Year	Human	Settlement	Agricultural Land
2012–2013	Four injured, women and children evacuated for 1 year	All houses' roofs were damaged with ash thickness up to 2 cm	±24 ha were damaged, covered by volcanic rocks, and can no longer be planted, damaged crops and water containers
1981–1982	No victims, refused to evacuate	Roofs of houses damaged, thin ash covered the settlements	Covered with volcanic ash, damaged the crops
1963–1964	No victims, evacuated for 1–2 weeks	Ash covered the settlements	Covered with volcanic ash, damaged the crops
1928	No victims, people evacuated to the next hamlet	Ash covered the settlements	Covered with volcanic ash, damaged the crops

Table 24.4 Vulnerability assessment of the Koa community

Topics	Specified	Responses
Knowledge on the risks	The history of eruptions	Able to explain
	Hazardous materials	Able to explain
	Most vulnerable groups	Able to identify
	Impacts	Able to explain
Awareness in facing volcanic hazards	Sharing experiences with others	Eager to share
	Family's evacuation planning	Not available
	Evacuation route	Not available
	Emergency savings	Not available

The results of the vulnerability assessment for the Koa community are summarized in Table 24.4. All informants interviewed had knowledge on the history of Mt. Rokatenda's eruptions; all knew of the 1928 eruption and the tsunami that followed it. All informants have experienced more than one big eruption from 1964, 1982, or 1983. They were able to identify a trend in major eruptions; there was an average of 18–35 years between each one. Families shared stories of the 1928 eruption, when the people of neighboring Nitung sub-village were swept away and killed by the high waves not long after the eruption. The story has changed and disorganized the families' evacuation route; now they prefer to avoid the coastal area and choose to cross around the volcano's sides. The same route was also used in 2013 when some people chose to return to Koa just hours after the eruptions, an act which resulted in four people being injured by stepping on hot lava. Even though all informants have experienced major eruptions and have witnessed how destructive those events could be, there was never any initiative or attempt to develop an agreed evacuation system or a safe exit route. The Koa community always refused to be evacuated, with the exception of the 2013 eruption, where the authorities were obliged to forcibly remove women and children to mainland Flores. Four informants stated that they did not follow the instruction to evacuate due to their cultural beliefs, as people of Koa are "not allowed" to leave a house empty during a volcanic eruption. It will cause the anger of the spirits, and as a result, any empty houses will burn.

The community's generally held perception that the eruption-related risks were actually caused by the spirits has, in reality, greatly increased the community's vulnerability. Despite the proximity to the source of a major hazard and destruction to houses and land, no human deaths have ever been recorded in the sub-village of Koa. The community believes that this statistic was due to the protection coming from their ancestors' spirits; in fact, it was concluded that the eruptions' directions and geographical settings, with the exception of Kampong Toke, had protected the community from bigger disturbances. Another high risk was observed related to the community's agricultural lands that were so close to the volcano, a risk not only to the land but also for the owners of the land, given the time and space context of an eruption event. The analysis shows that although the community's knowledge on volcanic hazard is very high, the lack of awareness on the preparedness for dealing

with an emergency situation, particularly relating to personal safety, has ensured the community remains in a highly vulnerable situation.

24.4.2 Analysis of Socio-ecological Aspects

The community of Koa is aware of the natural resources available in the area; they believe that they are entitled to utilize all resources subject to the regulating concept of *phije* (prohibition to do an action), a local wisdom that regulates access to, and use of, specific land and natural resources within a period of time. *Phije* is usually applied before and after the buffalo offering ceremony. The period of *phije* may vary based on context, a short term (from 3 days to 6 months) when related to deaths and burial events and a longer term, from 2 to 4 years, after *Pati Karapau*. The *Phije* that applies to the "after-buffalo offering ceremony" period includes (1) prohibition to disturb nature by, for example, cutting trees and digging the earth/soil, (2) prohibition to do any construction activity, and (3) prohibition to do farming in the sacred agricultural lands – the protected lands just below the volcano. The main leader only allows people to work there once in 5 years, the year before the ceremonial event takes place.

Local regulation, which is manifested in *phije*, was developed by the main leader in consultation with *ina* (the advisory council). In relation to volcanic hazards, permission to do farming only once in every 5 years in the sacred land is a way to reduce the community's vulnerability; a reduction in the number of activities in high risk areas will limit the community's exposure to volcanic threats. The 5-year period also gives time for the land to recover from the impact of eruptions. However, in another context, *phije* can also serve to increase the vulnerability of the community. For example, at the time of the study (in April 2014), the researcher observed damaged houses after the eruption, which cannot be reconstructed due to the *phije* period. That restriction will only end a few weeks after the next ceremonial event in 2018. This prohibition has caused the owners to live in their half-damaged houses or move away to stay with relatives. The situation was not comfortable and was not safe for a long period, since the volcano was still in a state of high activity. Of course, if it is really necessary, a *wai walo* can ask the leader of the clan to temporarily suspend the *phije* in order for the owner to finish constructing or repairing their house. This can be done in discussion with *ina*, and the respective *wai walo* may be asked to pay a cultural fine. That way, *phije* becomes *pii*, which is a permission to do particular activities in a specific time during *phije*. However, the fines are usually very heavy, thereby ensuring that not many people ask for *pii*. To sum up, the regulation was beneficial in providing time for nature to recover from human activity but was not helpful in protecting people from other potential threats.

In relation to the provision of basic needs, Koa is unique. Before the 1960s, the community members consumed tubers, beans, and fruit (mostly banana), as their main food. Since the introduction of rice to the people in the island, the people

slowly changed their diets. Nowadays tubers and beans are still available, but rice has become the main food, despite local laws that prohibit people to grow rice in any part of Palue lands, including Koa. To break the rule is believed to bring misfortune to the community. Rice stocks were and are brought across the sea from other islands by boat. In extreme weather, such as high waves or storms, no boats can travel to the island, thereby limiting the rice stock. Meanwhile, in favor of local traditions, specific tubers called *uwi* are a "must serve" in each family, especially during local ceremonies. Therefore, all families must grow and store this type of tuber all the time. That is why, despite the modern diet, so far there has never been a food crisis in Koa, even at the time of a reported food crisis supposedly affecting the whole island in 1998. Food stocks for families have always been available, because every family always grows and keeps the *uwi* tubers. This local tuber is a resilient crop that grows easily in Koa soil, even after an eruption. The community has a traditional technique for protecting the food stocks, which is known as *poa*; the technique involves a local practice of burying tubers that are covered with banana leaves in the ground. People can consume the tubers up to 1 year after they have been stored. There are also other practices, such as steaming the corn and peeling the beans before placing them in a dry place. These traditional practices have been shown to keep the family's food stock safe over the long term.

There are no fresh water resources to be found in Dusun Koa. In the 1890s, it was identified that the people consumed coconut water and palm juice to replace fresh water. In the 1960s, the community learned to distill geothermal steam using bamboo as the construction material; one bamboo construction may produce up to 40 l of safe water per day. This method has been another local strategy to collect clean water, especially during the dry season. The practice went on until the introduction of permanent water storage facilities, such as water tanks, to collect the rain water and to keep it for the household's needs. This type of water storage has been practiced for years now. Since the rainy season only occurs for 4–5 months in a year, almost all families have a water storage facility of some sort. The community also constructed a communal water storage facility with the help from the local government, a tank built with bricks and cement, which measured 3x3x4 meters. The community stated that there was never a water shortage in Koa. The strategies put in place allow the people to collect enough clean water for domestic use, and for their cattle's needs, to last for the whole year.

Koa people were used to building elevated houses, but more than 90% of the houses in the community are now designed as ground-based dwellings. Change was also observed in the types of housing materials used. The community said that traditional houses made of traditional materials such as wood, with bamboo walls and roofs of interwoven coconut leaves, were no longer a protection against the threat of damage from volcanic materials. Now, about 70% of the houses are of permanent construction, with stone walls and tin roofs. However, this change has had only a minimal impact when it comes to protecting the houses' occupants from an eruption. The eruption in 2013 showed that even modern materials were unable to resist the impact of volcanic materials; tin roofs were damaged by hot clouds and volcanic ash. So, as part of the relocation campaign, the local government provided

grants for people who wanted to build houses away from the island. Some of the families in Koa accepted the grant but with a condition that the "grant house" is only an alternative dwelling in the event of a disaster.

The changing of consumption patterns was supported by the diversification of sources of income. The community's main livelihood was from agricultural activities, the growing of food and commodity crops. Food crops such as corn, tubers, and beans are usually for family consumption. Meanwhile, commercial commodity crops such as cashew nuts, coconuts, and cocoa are for selling. The community can only grow its food crops in the rainy season; if the harvest is good, they may sell some of their surplus foodstuff in order to buy salt and sugar. They mostly harvest commodity crops in the dry season, selling them to benefit the family's income. An interaction with outsiders in 1970s introduced Koa people to work as laborers. Almost all male informants said they had worked outside of the island as laborers when they were younger. The practice has been continued by the next generations, both male and female. It was identified that each family has one or more members of the family working outside the island, who regularly send remunerations back to their Koa-based families. Another activity is weaving, which is a skill commonly practiced by Koa women. Weaving was usually performed for self-consumption; however, due to the increasing number of visitors attending ceremonial events, women now weave to generate income. They save some of their woven cloth and other articles to sell at special events, such as on important cultural occasions. A summary of these socio-ecological practices is shown in Table 24.5.

24.4.3 Socio-ecological Aspects for Community Resilience

Knowledge relating to all local practices in Koa is passed from generation to generation; cultural knowledge and practices are taught to younger generations, and the elders ensure that information is preserved. The data analysis provided insights into the conditions of vulnerability identified in Koa, as well as to the existing capacities developed from the interactions of the community with its environment, all of which are regulated by traditional cultural knowledge and practices. Some of the practices contribute to community survivability during crisis, while others contribute to adaptation to changes caused by Mt. Rokatenda's volcanic hazards. The identified socio-ecological aspects informing community resilience in the Koa community can be summarized as four aspects:

- *The utilization of natural resources.* These resources are easily accessible, and the community's acceptance of new technology helps to maximize the resources in order to adapt to the existing risks.
- *Changes in consumption patterns.* Some changes implied the resilience building of the community. The dynamics and social interaction may disrupt the existing system. However, when they are used to develop adaptability, changes will in turn create opportunities to develop community resilience.

Table 24.5 Socio-ecological factors identified in Koa

Elements	Sub-element	Practices
Natural resources	Types to natural resources	Able to access
	Utilization	Housing materials, family's consumptions
Environmental services	Tourism services	Geological and cultural sites
	Benefits	Has yet to realize the potentials
Basic needs	Food	Food diversifications (tubers, corn, rice) and food storage (*poa*, dried corn, peeled beans)
	Clean water	Adopted technology and protection
	Housing	Shifting to permanent materials Protection strategy and alternative Housing for emergency
Livelihoods	Source of incomes	Alternatives available, weaving, laboring
	Protection on livelihoods	Seeds storage
Local knowledge	Understanding of the local environment	Maintain local practices on agriculture activity
		Adopted technology to get clean water
	Cultural beliefs	Still maintaining traditional practice with regard to volcano and human relationships
Regulations	Existing environmental and disaster management regulations	Not aware
	Involvement in developing local regulations	No involvement

- *Local knowledge and practice shared and preserved in the families and even in bigger groups*. Such factors have the potential to create both vulnerability and resilience for the community. It is suggested that local knowledge and practices can be positively managed into actions that help to build capacities which, in their turn, can develop and maintain that resilience.
- *The policy setup*. The community is still listening to and obeying the decisions made by its traditional leaders. The community's members are not resistant to recommendations related to disaster as long as the authorities communicate and coordinate with, and through, the traditional leaders. Negligence regarding the traditional leaders' roles will impact disaster management, as that negligence can cause negative feedback, turning capacity into vulnerability. Therefore, it is essential to maintain good communication among all the actors involved in policy formation in order to develop better strategies based on local contexts.

The existing socio-ecological aspects of the Koa community contribute to increase capacities such as knowledge and utilization of natural resources to maintain or strengthen the process of resilience. However, there are knowledge gaps in the community regarding a lack of awareness relating to preparedness actions, ignorance that may result in being exposed to significant risks. These

gaps can weaken the socio-ecological aspects and the community members' existing capacities, that in turn will weaken community resilience.

24.5 Conclusions

The existing socio-ecological aspects of the Koa community, when wisely maximized, may contribute to increase the capacities of the community: (1) to be prepared for eruptions based on local knowledge of early warnings, (2) to protect themselves in the event of disaster, and (3) to rebuild better after the disaster (post-recovery actions) by using local resources. Those capacities, which were utilized to develop adaptation, preparedness, and mitigation measures, can maintain or strengthen the process of resilience development. However, there are gaps in the community's knowledge regarding their lack of awareness of preparedness actions that may result in the community members being exposed to even greater risks from volcanic and other natural events. These knowledge gaps can either weaken community actions in reducing the risks of eruptions or weaken the individual's existing capacity to protect himself in the event of eruptions.

In conclusion, socio-ecological aspects existing in Koa contribute greatly to developing community capacities to live with existing threats coming from Mt. Rokatenda. The community manages to reduce the negative feedback from its knowledge gaps or vulnerability factors by maintaining the traditional socio-ecological aspects in order to continue strengthening their capacities to overcome the threats from eruptions, even in times of the event itself.

In a mountainous region with an active volcano, life has never been easy; the communities will always face the possibility of volcanic eruptions, together with their literal fallout. The question is not if but when the volcano erupts. Therefore, there is an urgent need to increase local community members' awareness of their vulnerability to such hazards. Having knowledge of those risks is useless without also having awareness of how to manage the knowledge and apply it to damage avoidance preparedness and complementary mitigating action(s). Access to external resources, particularly local authorities, is mandatory. Such authorities should be involved in providing support to develop strategies for protection of vulnerable communities, such as Koa. Each community's effort to manage disaster risks should be taken into account in order to maximize local knowledge and local practices, as well as recognizing each community's existing damage control capacity.

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Chapter 25
Tsunami-Resilient Preparedness Index (TRPI) as a Key Step for Effective Disaster Reduction Intervention

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Abstract Recent efforts in disaster risk reduction focused on risk and vulnerability assessment rather than the capacity of community analysis based on cultural and social-psychology aspects. This study provides a new framework and approach for creating a culture of tsunami-resilient preparedness assessment/index (TRPI) to support decisionmakers and community in evaluating and preparing action to respond to the potential impact of a tsunami disaster. This research study involved households living in the tsunami-prone areas in Banda Aceh ($n = 305$) and Bantul Yogyakarta ($n = 173$), Indonesia, and Kushimoto, Japan ($n = 117$). To develop the TRPI, theoretical and practical references were used as the first draft of preparedness indicators consisting of 35 aspects of preparedness. Twenty-one disaster experts were asked to judge the content relevancy and urgency before tested to 33 residents. Three dimensions of tsunami preparedness covering TEWS, Emergency Plan, and Capacity consisting social level/interaction including individual, family, community, and society are introduced as TRPI. In general, Kushimoto community is better than Aceh and Yogyakarta, in three dimensions of TRPI. In terms of TEWS, using cutoff point of not prepared, prepared, and very prepared, communities in Aceh are only prepared in regard to TEWS-individual and in Aceh and Yogyakarta for TEWS-society. In Kushimoto the highest percentage of TRPI Emergency Plan is Plan-community followed by Plan-individual, Plan-family, and Plan-society. Aceh and Yogyakarta community shows a similar pattern with the highest of tsunami-resilient preparedness which is Plan-individual and the lowest which is Plan-community. Community in Kushimoto shows the higher percentage of tsunami-resilient preparedness in most of the elements except for Capacity-community. The maximum proportion of social-level preparedness in Kushimoto is Capacity-family. TRPI providing multidimensional behavior allows disaster

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managers to focus on specific weaknesses that the community needs to address to improve their level of readiness. Similar to other indices, it can be used to make a comparison of the relative overall preparedness in different regions and communities, yet it is more people-centered as suggested in literature of effective disaster risk reduction.

25.1 Introduction

There has been increasing infrequent and unpredictable natural disasters severely affecting human life, economic, social, and cultural aspects in the last two decades. While humans cannot prevent natural disasters, reducing disaster risk is an inevitable solution by adapting and changing human life. Although efforts have been made to promote disaster risk reduction, a common finding in research on natural disasters is that people fail to take preparations for particularly infrequent disasters such as tsunamis (Paton 2003; Shaw et al. 2004; Coppola and Maloney 2009). Tsunamis are one of the deadliest and most destructive disasters; however studies on tsunami risk reduction has not paid attention to creating a culture of preparedness instead of early warning response and evacuation. Recent efforts in disaster risk reduction focused on risk and vulnerability assessment rather than the capacity of community analysis based on cultural and social-psychology aspects (Kulatunga 2010). Given the availability of the preparedness assessment using social, economic, and physical parameters, effective disaster reduction suggests not to neglect the importance of human factors such as religion, risk perception, culture, attitude, and behavior toward disaster. This study provides a new framework and approach for creating a culture of tsunami-resilient preparedness assessment/index (TRPI) to support decisionmakers and community in evaluating and preparing action to respond to a tsunami disaster. The main research question is to what extent the culture of tsunami-resilient preparedness can be assessed? How does TRPI explain the differences of tsunami-resilient preparedness in cross-cultural communities? How can the culture of TRPI better assist in developing disaster risk reduction intervention program?

25.2 Conceptual Framework

Tsunami-resilient preparedness assessment as a part of the hazard and vulnerability concept in reducing disaster risk has not paid sufficient attention to the theoretical and practical context. Increasing concern about the importance of reducing disaster risk has been attracting scholars to develop disaster and vulnerability indices that can be used to analyze relative risk in different places and to provide a rational basis for

developing program intervention and monitoring and evaluating the progress of disaster risk reduction programs (Twigg and Benson 2007). However, many efforts have been focused on hazards and vulnerability assessment instead of capacity assessment. Although more countries provide HFA-related instruments and guidelines such as the HFA monitor, the Global Assessment Report on DRR and platform guidelines, there has been an absence of assessment of capacities (UNISDR 2010: 18).

There has been a change to the paradigm of vulnerability assessment shifting from physical and technical to the social perspective that gives a holistic and comprehensive view of the causes of and solutions to disaster reduction (Birkmann 2006; Phillips and Fordham (2010). Phillips and Fordham (2010) suggested that the concept of social vulnerability that emphasized nonphysical conditions of the community should incorporate insight from the physical perspective. Social vulnerability reflects the classical problem of the allocation of resources such as the economy, poverty, and public health. Phillips and Fordham (2010) describe social vulnerability as a problem of initial well-being, livelihood and resilience, self-protection, and social and political networks. Twigg (2009) identifies four sectors of capacity (vulnerability) such as social, physical, economic, and environmental. In terms of the social sector, capacity includes "social capital, coping mechanisms, adaptive strategies, memory of past disaster, good governance, ethical standards and local leadership, ...well-developed disaster plans and preparedness" (Twigg and Benson 2007: 103).

Another issue in the vulnerability concept is associated with whether coping capacity is a part of vulnerability or should be viewed as different features (Birkmann 2006, p. 40). A traditional concept of measuring risk is represented by a generic formula as risk = hazard × vulnerability. However, this concept has been criticized because it only focuses on the physical perspective of hazard, neglecting the human ability to reduce the impact of danger. A current model of this risk formula has included capacity as one of the components in the risk concept, formulated as risk (disaster) = hazard (H) × vulnerability (V)/capacity (C). The risk will be reduced if the value of the vulnerability is eased or the capacity to cope is increased. Twigg and Benson (2007: 103) proposed vulnerability and capacity analysis (VCA) as a key component of disaster risk analysis. VCA's aim at identifying communities and the vulnerable aspects that affect them.

In terms of scale, the development of vulnerability indices can be categorized into macro- (international, national), meso- (regional), and microlevels (Lassa 2010). While macro vulnerability assessment is developed to measure and identify the distinction between countries, meso-level focuses on the subnational or regional characteristics. Importantly, because most disasters occur at the local level, vulnerability assessment and capacity assessment should cover the local characteristics and resources (Lauwe and Queste 2010). Effective disaster risk reduction requires knowledge about vulnerabilities at all levels in order to accurately formulate a disaster risk reduction intervention program. However, vulnerability/capacity assessment has rarely been focused on the local context. It is also suggested that vulnerability/capacity assessment should be conducted using participatory approaches to provide more opportunity for local communities and other stakeholders to participate in assessing

vulnerabilities and capabilities. Assessment is not a checklist of categories and factors to be analyzed by external organizations with limited input from local communities (de Dios 2002). One example, the Disaster Risk Index (Birkmann 2006) "proposes a methodology to capture both vulnerability and coping capacity within a single human security index." Wisner introduces a more qualitative and participatory approach to assess vulnerability and coping capacity using self-assessment tools (Bogardi 2006: 3). A community-based disaster management approach was introduced by Bollin and Hidajat (2006) to measure the level of risk in a certain community.

Given that the theoretical framework gave guidelines on how to develop, assess, and measure the vulnerability/capacity assessment, there are no specific general rules on how to do it. In addition, the current framework has limitations with regards to involving disaster experts, local government officers, and the community in developing indicators. It is argued that a better indicator should not only be based on a theoretical framework but should also be able to capture the characteristics of the local community. As more vulnerability assessment has focused on earthquakes, hurricanes, climate changes, floods, and human security (Simpson 2008), tsunami-resilient preparedness has rarely been assessed.

25.3 Toward a New Tsunami-Resilient Preparedness

Building tsunami disaster preparedness is one of the crucial issues confronted by policy makers and communities across the world. Tsunamis are a rare event yet can be the deadliest disaster. They only happen infrequently, from generation to generation, or even hundreds of years, so people tend to forget their occurrence. As natural hazards are a social construct, it requires an understanding of how people perceive, view, and respond to a natural disaster (Douglas 1992). Kulatunga (2010) stated that how humans view hazards is influenced by personal and cultural factors shaping community structure and relationships.

It is argued that to build a tsunami disaster-resilient community, it is necessary to create and promote a "disaster culture" embedded in the community that is able to assess, prepare, and cope with hazards. Murata et al. (2010) suggested that in terms of tsunamis, the only way to protect from the tsunami is by having accurate knowledge on how to react to the tsunami integrated into daily habits or "lifestyle culture." Murata et al. emphasize how people should learn and acquire correct knowledge about tsunami behavior and how to respond to it. Another critical point of the concept of disaster culture is that it is necessary to convert the disaster knowledge that has been attained into protective action. This process comprises the "learning step," "drilling step," and "exercising step." Effective action is achieved if people follow the process from the learning step through to the exercising step.

Many kinds of literature and government policies have recommended different action in developing tsunami-resilient preparedness. For example, tsunami early warning systems (TEWS) are the leading significant factor in reducing the possibility of fatality events such as injury and loss of life (UNISDR 2010). The

International Strategy for Disaster Risk Reduction (ISDR) underlined the importance of TEWS that must be people-centered and apply four interrelated elements of the model: (i) understanding and detecting hazards (risk knowledge), (ii) checking and developing warning tools, (iii) communicating risk and how to respond (dissemination of communication), and (iv) ability to respond.

An Emergency Plan is another critical element in tsunami-resilient preparedness. Tsunamis can happen at any time; all family members should understand the warning system and how to respond and where. In Japan, for example, the word "tendenko" is a measure suggesting that people should evacuate by themselves without waiting for other family members wherever they are located when a disaster occurs (Fraser et al. 2012). The family Emergency Plan should also ensure that family members know the safer places, in case of separation, and know the phone number of emergency services and other family members. Most of the conventional tsunami-resilient preparedness measures recommended only focus on TEWS and evacuation plans. In this framework, in the tsunami-resilient preparedness context, it is indispensable to prepare disaster kits, as also recommended in earthquake-preparedness measures. However, it is important to note that disaster kits in tsunami-resilient preparedness should be only limited to the most valuable goods and easy to carry when a tsunami strikes. Recent tsunami disasters have shown that preparing disaster kits and bringing them when evacuating are important. For example, after the March 11 tsunami in Japan, some evacuees were isolated and delayed in getting food, because they did not have sufficient stocks of food and water (Teiki 2012). It is argued that under a new paradigm of resilience as a process (Manyena 2006), review of this tsunami-resilient preparedness concept, that tends to be reactive rather than active, is crucial. Tsunami-resilient preparedness should be measured including the dynamics of human behavior so that intervention programs can effectively address the root of the problems in tsunami-resilient preparedness.

Another preparedness action is the importance of community capacity. Referring to the concept of community development, the main reason why community involvement is important is that collective action can generate a better solution to provide a more sustainable basis for the meeting of human needs (Adiyoso 2010). Community capacity ultimately addresses the problems of the community looking for alternative ways of providing a more sustainable basis to meet human needs based on ecological perspectives as a foundation of community resilience.

Research on disasters has pointed the role of social levels such as the family and community level (Phillips and Fordham 2010), yet it tends to focus on responding and recovery processes. The concept of self-help, mutual help, and public help explain how people should respond to the disaster – whether it should be done individually or involving other people (Erlich and Schneiderbauer 2006). It is argued, therefore, that the role of the individual, family, community, and wider society also plays a major part in tsunami-resilient preparedness. Paton and Johnston (2006) suggested that the link between individual and community factors is effectively influenced in preparing, responding, and recovering processes.

Table 25.1 Basic indicators of tsunami-resilient preparedness based on social level

	TEWS	Emergency plan	Capacity
Individual	Knowing natural signs of tsunami	Knowing tsunami sign-boards, evacuation route/shelter	Knowing about causes of tsunami
	Knowing communication means for TEWS	Knowing emergency phone numbers	Knowing hazard conditions (map) in their areas
Family	Sharing TEWS information with family	Preparing disaster kits (flashlight, radio, food/water, etc.)	Sharing hazard conditions (map) with family members
	Sharing evacuation route/shelter with family		Discussing and sharing past tsunamis with family members
Community	Understanding TEWS developed by community	Discussing how to prepare for tsunamis with neighbors or community	Attending community meetings organized by local community at least three times a year
	Participated in tsunami drill held by community or visited/practiced evacuation route/shelter	Have agreed with family and community members on the safe meeting point	Visiting/finding information in tsunami facilities (poles, escape building) in local communities
Society	Understanding TEWS developed by government	How to contact local government or find information before and during tsunami disaster	Attending meeting (dissemination, workshop, training) organized by non-community at least once a year
	Participated in tsunami drill organized by government	Family should have phone numbers for contact with family/people in outside community	Searching/updating tsunami information from different source information/media

Building from the link between the three elements of tsunami-resilient preparedness (TEWS, Emergency Plan, and Capacity) and social level (individual, family, community, and society), this study proposes tsunami-resilient preparedness indicators reflecting "disaster culture." Every element of tsunami-resilient preparedness consists of activities involving individuals, family members, community, and society (external community). Table 25.1 shows indicators in a cross-section between the element and social level. Indicators for an individual in any activities related to tsunami-resilient preparedness element can be done without the direct assistance of others such as knowing information related to the elements of tsunami-resilient preparedness. While family and community activities involve family and community members, society in tsunami-resilient preparedness activities is involved in the external community such as local government, nongovernment organization, and other communities.

25.4 Methods

Three communities were involved in this study including Kushimoto, Japan, and Aceh and Yogyakarta, Indonesia. Firstly, authors developed tsunami-resilient preparedness thematic indicators based on the existing theories, best practices, and government policy or recommendations. There are three core tsunami-resilient preparedness capacities that should be equipped by residents living in coastline areas: TEWS, Emergency Plan, and Capability that can be done and involve the individual, family, community, and society. The next step was that three Japanese and three Indonesian disaster experts were consulted to discuss the contents of indicators. In general, there was no significant difference between the initial concept of indicators proposed by the author and the experts' viewpoints. However, some indicators have been revised as suggested by the experts.

As a result, a draft of 36 tsunami-resilient preparedness indicators for Japanese and 35 for Indonesians were prepared. These two drafts were sent to 11 Japanese and 21 Indonesians who have expertise and experience in disasters, such as scientists, researchers, local governments, and practitioners. Online survey questionnaires were used to evaluate the relevancy of indicators in the set to assess the tsunami-resilient preparedness by giving a rating from 1 = not relevant, 2 = less relevant, and 3 = relevant. In general, an indicator that was rated relevant (3) by more than 50% of experts was regarded as valid and used to assess community tsunami-resilient preparedness. Experts also had an opportunity to add indicators and give comments, suggestions, and input related to indicators and measurements. The number of indicators of tsunami-resilient preparedness for Japanese was not changed, while for Indonesia's indicators, it was reduced into 30 indicators.

The next step was that these two sets of indicators were discussed with community members. Four residents in Kushimoto and five residents in Yogyakarta and Banda Aceh were involved in discussing the indicators. The discussion also involved local government officers responsible for disaster management (two people in Kushimoto and four people in Yogyakarta and Aceh). This step was critical to ensure that indicators contained in the questionnaires were appropriate in regard to the local context in terms of ethical concerns, content, language, and other issues. Before the questionnaire was used to gather data in the general population, 34 people in Kushimoto and 32 people in Aceh were involved in testing the indicators. There was no indication of problems in the field.

In developing indicators, it is also important to know how to measure the indicators. Instead of using a scale measurement as used by Bollin and Hidajat (2006), this assessment used simple answers "Yes," "No," and "I am not sure" to measure the level of preparedness. This decision was made based on suggestions from local government officers, experts, and the community during testing of the questionnaire. Respondents who answered "Yes" are taken as "being prepared" and "No" and "I am not sure" answers are regarded as "not prepared." The more respondents answered "Yes," the more she/he will be prepared and vice versa.

In order to easily understand the score of the overall index, the percentage was used in the resulting score between 0 and 100. Subjective judgment (Davidson 1997) has been made to identify preparedness level by applying a cutoff point of 33 resulting in score classes: 0–33 categorized as "not prepared," 34–66 as "prepared," and 67–100 as "very prepared." Given that all elements of tsunami-resilient preparedness are equally important, the index was composed by summing all of them and dividing by three. This study involved 305 households in Aceh, 173 households in Parangtritis Yogyakarta, Indonesia, and 117 households in Kushimoto, Japan.

25.5 Tsunami-Resilient Preparedness in Three Communities

Kushimoto is located along the southernmost point of Honshu island, the mainland of Japan, and has been prone to natural disasters such as tsunamis, earthquakes, typhoons, and landslides. With a population of about 10,000 based on 2010 data, it has experienced tsunami disasters many times (Kushimoto Local Government 2012). Kushimoto and neighboring regions are expecting a Tokai and Tonankai earthquake (8.0 M) predicted to occur within 50 years that can trigger a tsunami of maximum height 17 meters, based on an assessment in 2012 by Wakayama Prefectural Government (interview with Kushimoto local government officer 2013).

Another community involved in this study is Aceh. The 2004 December tsunami triggered by an earthquake measuring 9.0 on the Richter scale in northern Sumatra Island severely impacted on society, economy, and people's livelihoods in Aceh. Among countries situated along the Indian Ocean affected by the tsunami, Aceh was the worst-hit area leaving 123,000 people killed, 113,000 people missing, and 406,000 people displaced (Rachmalia et al. 2011). A high number of people were believed to be killed because of the absence of an early warning system and their lack of preparedness (Kurita et al. 2007).

The last community is Bantul Regency, Yogyakarta Province, a special administrative region in Indonesia. In 2006, the 6.3 SR earthquake hit Central Java and the Special Region of Yogyakarta Province which left 5778 people killed, 1,649,420 people displaced, and more than 50,000 people injured (UNDP-Indonesia 2008). The earthquake also severely damaged 190,025 houses and cost about USD 3.1 billion in total. While natural disasters do not discriminate on geographic differences, Bantul Regency, Yogyakarta, was one of the areas most-impacted by 2006 earthquake causing from small to serious damage, and thankfully no one was killed.

The community in Aceh and Yogyakarta has experienced tsunami early warnings several times since the 2004 tsunami hit Sumatra Island. For instance, on April 11, 2012, a magnitude 8.5 earthquake struck the northern part of Sumatra Island which triggered a small tsunami. On July 17, 2006, the southwestern coast of Java

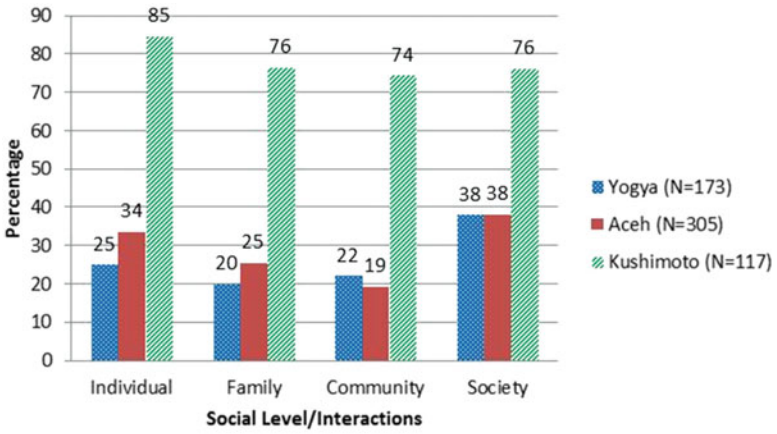

Fig. 25.1 Tsunami-resilient preparedness TEWS (source: authors)

was hit by a magnitude 7.7 earthquake that generated a tsunami and killed approximately 668 people, while 65 were missing and 9299 injured in Pangandaran, West Java Province (Bappenas 2008). This earthquake was also felt by the community in Bantul, Yogyakarta, Indonesia.

Figure 25.1 provides a direct comparison between the three communities in the TEWS element of tsunami-resilient preparedness. In general, Kushimoto community in preparing TEWS is better than Aceh and Yogyakarta. Using the cutoff point of not prepared, prepared, and very prepared, communities in Aceh that are only prepared in regard to TEWS-individual accounted for 34% and in Aceh and Yogyakarta for TEWS-society about the same percentage, 38%. The three communities share the same pattern of tsunami-resilient preparedness TEWS with the lowest proportion in TEWS-community with 74% in Kushimoto, 22% in Yogyakarta, and 19% in Aceh. Kushimoto TEWS-individual is the highest, while TEWS-society has the most tsunami-resilient preparedness for people in the Aceh and Yogyakarta communities.

This finding indicates that the TEWS in Kushimoto has been done mostly individually compared in Aceh and Yogyakarta that is done involving society (external community). Kushimoto and other places in Japan historically have developed TEWS many years ago, so the community has been familiar with such early warning systems. TEWS in Aceh and Yogyakarta are something new, so people are dependent on the government (external community) in dealing with TEWS issues.

The result of the assessment of tsunami Emergency Plan (Fig. 25.2) shows that data reported is slightly different to TEWS. While in Kushimoto most of the tsunami preparedness Emergency Plan is lower than TEWS, Yogyakarta and Aceh reveal that the tsunami Emergency Plan is higher compared to the TEWS. The percentage of tsunami-resilient preparedness in the three communities can be

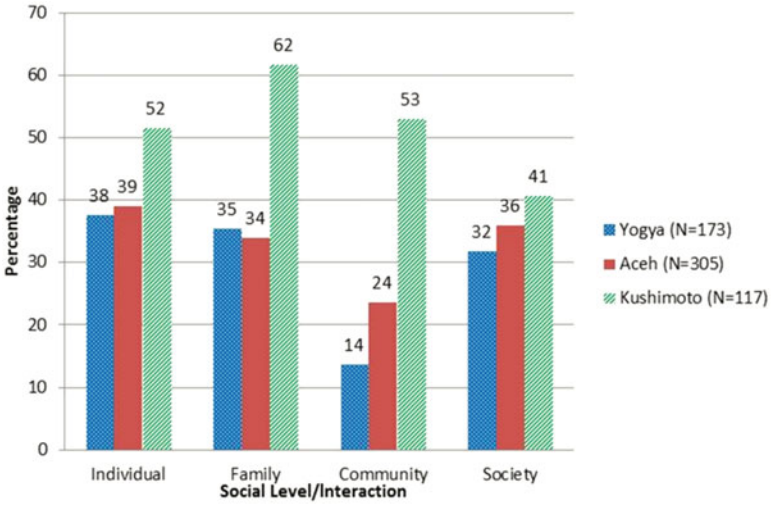

Fig. 25.2 Tsunami-resilient preparedness Emergency Plan

categorized as a just "prepared" except for Yogyakarta in the Plan-community categorized as "not prepared."

In Kushimoto the highest percentage of preparedness is in the Plan-community (62%) followed by Plan-individual, Plan-family, and Plan-society with 53%, 52%, and 40%, respectively. Aceh and Yogyakarta communities show a similar pattern with the highest level of tsunami-resilient preparedness being Plan-individual and the lowest being Plan-community. Emergency Plan in Aceh is rated at 39% in Plan-individual, 36% in Plan-society, 34% in Plan-family, and 24% in Plan-community. The most preparedness items done by the community in Yogyakarta are in Plan-individual accounting for 38%, Plan-family accounted for 36%, Plan-society accounted for 32%, and Plan-community about 14%.

This finding shows that the community in Kushimoto has better preparedness in the family through discussing the hazard map and other tsunami issues with family members. On the other hand, tsunami-resilient preparedness Plan in Yogyakarta and Aceh is mostly done by individuals, meaning that most people knew about hazards in their areas and emergency phone numbers. In terms of interaction with the community to address the problem of a tsunami-resilient preparedness Plan, in Yogyakarta and Aceh, people were involved in the wider community.

In terms of tsunami-resilient preparedness capacity, the three communities have different features of tsunami-resilient preparedness level (Fig. 25.3). The community in Kushimoto shows a higher percentage of tsunami-resilient preparedness in most of the elements except for Capacity-community. The highest proportion of social-level preparedness in Kushimoto is Capacity-family with 75%. The second rank is Capacity-individual with 65% and Capacity-society is

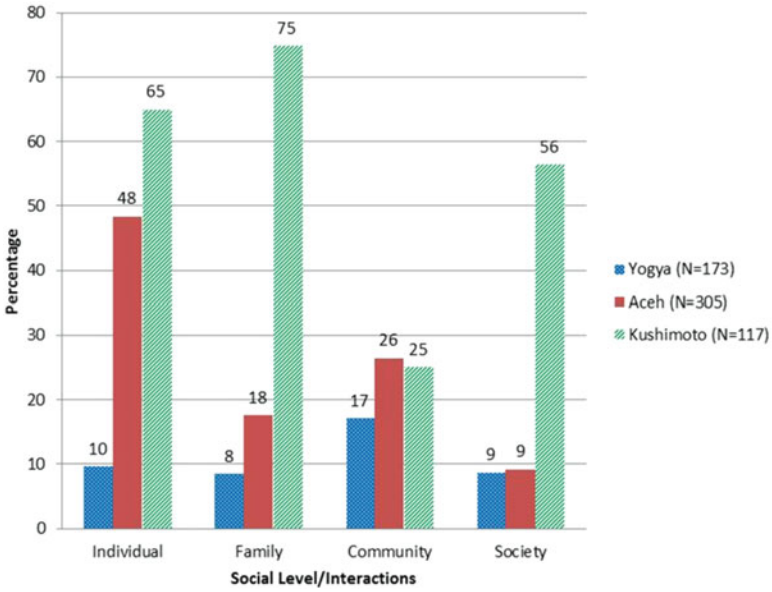

Fig. 25.3 Tsunami-resilient preparedness capacity

third with 56%. Surprisingly, Capacity-community in Kushimoto is slightly lower (26%) than in Aceh (25%). Similar to Kushimoto, the highest percentage of tsunami-resilient preparedness is Capacity-individual (48%), and the lowest is Capacity-society (9%). The other social level is Capacity-family with 18%. In contrast to these two communities, in Yogyakarta, Capacity-community is the highest with 17%. The second and subsequent ranks are Capacity-individual (10%), Capacity-society (9%), and Capacity-family (8%).

Figure 25.4 provides the result of direct comparison of the elements of tsunami-resilient preparedness and the complete index in the three communities. The first step to composing the index is by composing each tsunami-resilient preparedness social level (individual, family, community, and society) based on each element. For example, in the case of Yogyakarta, the TEWS element results from an average score of TEWS-individual (25%), TEWS-family (20%), TEWS-community (22%), and TEWS-society (38%) divided by four comes to 26%.

The next step is to compose the cumulative index for each community. Given that the three elements of the index are regarded as equally important, the total index is produced by the summation of each of the tsunami elements (TEWS, Emergency Plan, and Capacity) and dividing by three. Thereby the total index is calculated. In general, the Kushimoto community with a total index of about 60.8% can be categorized as prepared (33–67), and Yogyakarta with 22% and Aceh accounted for 29% are regarded as not prepared at all.

The highest percentage of tsunami-resilient preparedness elements in Kushimoto is TEWS (78%), while Emergency Plan and Capacity are almost the same with 53%

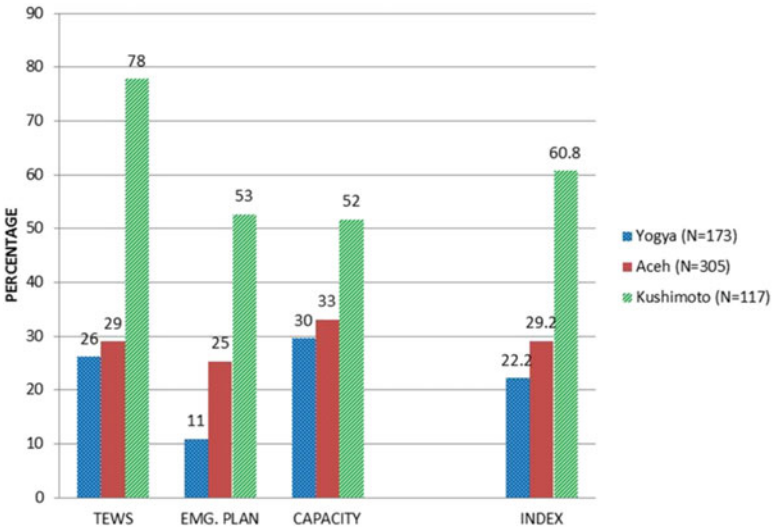

Fig. 25.4 Tsunami-resilient preparedness index

and 52%, respectively. Both Yogyakarta and Aceh have a similar result where Capacity is the highest score with 33% in Aceh and 30% in Yogyakarta. Tsunami-resilient preparedness of TEWS is the second rank with 29% in Aceh and 26% in Yogyakarta. Emergency Plan is the lowest score with 29% in Aceh and 26% in Yogyakarta.

25.6 Discussions

The findings are based on a tsunami-resilient preparedness index composed of three different elements of preparedness with each element contributing equally to the index. As shown in Kushimoto, having TEWS as "very prepared," the fact that the total index of tsunami-resilient preparedness in Kushimoto is categorized as only "prepared" is because the Plan and Capacity are only "prepared." In addition, the tsunami index also provides information on the relative scores of preparedness elements between communities. For example, although tsunami-resilient preparedness of TEWS and Capacity in Aceh and Yogyakarta is about the same, because the gap between tsunami-resilient preparedness of Plan in Aceh and Yogyakarta is significantly different, with Yogyakarta being very low, the total index in Yogyakarta is lower than Aceh.

Birkmann (2007) stated that vulnerability assessment is not only useful for developing disaster risk reduction but also for evaluating the progress of community preparedness. By using the social level of community in preparing for tsunamis, the current study gives more detail than previous vulnerability assessment. The

preparedness based on a social-level approach provides information about in what level (position) people are preparing for tsunami – individual, family, community, or society.

The index is also useful in giving a comparison between communities. As can be seen in Fig. 25.4, the total index in Aceh and Yogyakarta is almost the same. However, if we look closely at the element of Plan, the level of tsunami-resilient preparedness in the Yogyakarta community is very low. Therefore, policy makers should focus on the Plan when dealing with addressing disaster risk reduction in Yogyakarta. This approach is applied not only in developing the disaster risk reduction intervention program but also in evaluating the progress of the community in tsunami-resilient preparedness.

The index gives a new picture of disaster risk reduction progress. Although predicted that the community in Aceh is expected to be better than in Bantul, Yogyakarta, the small relative TRPI, has raised concern about effective public campaigns, education, and recovery programs received by the community in Banda Aceh after the 2004 tsunami. In terms of facilities, there have been tsunami evacuation signs, tsunami-escape buildings, and tsunami monuments built that reflect people in Banda Aceh's greater access and opportunity to use such resources to develop the capacity to respond to tsunamis. However, it is still apparent that both communities in Yogyakarta and Aceh show low levels of tsunami-resilient preparedness in the total index.

The low score of TEWS and Emergency Plan in Yogyakarta and Aceh shows that although in the two communities the advanced TEWS has been installed, it raises questions about the effectiveness of disaster risk reduction. In other words, without proper response and involvement of the community toward the disaster facilities, such technology will fail to protect the community from a tsunami. This TRPI has shown how important it is to assess the frequency of the household to heed warnings and practice visiting evacuation routes and shelters regularly. By using a traditional preparedness index focused on mere output such as how many tsunami evacuation shelters were built, how many disaster trainings conducted, and how much public education was implemented does not address the root of the problem of disaster risk reduction.

The indicators developed have been adopting the local characteristics of the community. For example, visiting a disaster museum as one of the indicators in maintaining awareness for tsunamis can be replaced with disaster facilities (such as the disaster emergency office of local government) providing tsunami information regularly and facilitating lessons learned for residents. The format of the questionnaire containing response answers "Yes," "No," and "I am not sure" was useful in helping respondents, especially elderly ones, in filling out the questionnaire. Therefore, the indicator and index approach can be used by the policy makers in local government to gain better understanding for dealing with tsunami disaster.

The significant finding is that tsunami-resilient preparedness assessment is able to show the progress of tsunami-resilient preparedness in every social level of communities, so policy makers can accurately address the fundamental problem of tsunami-resilient preparedness. Providing distinction of tsunami-resilient

preparedness based on social level will be valuable for policy makers to address the problem of providing tools for intervention in reducing tsunami disasters. It helps to determine which aspect of preparedness is low or high and in which position community has weaknesses and strengths with regards to tsunami-resilient preparedness elements. This also gives additional information for disaster managers in local government evaluating the progress of preparedness in the community as feedback for decisionmakers.

This tsunami-resilient preparedness assessment consisting of social level contributes to the current social vulnerability assessment focusing on social, economic, and political aspects impacting the community in reducing the incidences of a hazard. It is important to identify how communities are resilient and what enabling environmental factors generate and reduce vulnerability and create sustained resilience.

25.7 Conclusions

The TRPI has benefits from the practical and research perspectives. It helps policy makers in planning and developing community programs in relation to disaster risk reduction intervention. The index provides social-level involvement allowing disaster managers to focus on specific weaknesses that a community needs to improve in their level of preparedness. Similar to other indices, it can be used to compare the relative overall preparedness in different regions and communities, yet it is more people-centered which is expected to be more effective to reduce tsunami disaster risk. It is also useful for a community to recognize the strengths and weaknesses in anticipating tsunami hazards.

One limitation of the TRPI approach is that data should be gathered using a population survey, raising issues about cost and time. It may create resistance for residents in filling-out such questionnaires if they are frequently undertaken. However, it is suggested that to avoid the community persistence, tsunami-resilient preparedness assessment can be carried-out by representative local organizations or groups that exist in the community. Community and local government should collaborate to manage and implement the tsunami assessment that matches and suits the community interests.

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