Chapter 14
Prospects for Sustainability in Human–Environment Patterns: Dynamic Management of Common Resources

M. De Marchi, B. Sengar, and J.N. Furze

Abstract Models envisaged by policy makers and sustainability scientists cooperatively produce tools with desired practical implications. Models presented in the volume are summarized, with existing policy methods for resource management and Global perspective for resource planning methods in context. Models are discussed firstly in the framework of learning environments as an opportunity to test and practice sustainability, combining different tools from models, case studies, and scenarios. Sustainability asks for a multi-scale pragmatics; key elements of the multiple scale approach representing common ground in existing practice and frontier research have been identified. Two case studies are presented as a meta-summary of the issues presented in the book, being Rural South Asia (with special reference to India), and analysis of mega-diverse countries in Latin America, with special focus on Ecuador.

India's case study offers an account of policies implemented by the Ministry of Rural Development (MRD) and the Ministry of Tribal Affairs (MTA) since 1947, creating sustainable models for biodiversity and natural resource management. To comprehend the methods of resource sustainability usage in the present era, while enhancing resource utilization capacity of traditional practices, a tribal (indigenous communities) village—'Ajanta' (Western India)—is elaborated upon. The Latin America case study focuses on declinations of the *buen vivir* (good living) concept

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and the debate between putting nature to the service of a nation (extractivism) and Yasunization, the neologism coined in Ecuador by a civil society seeking territorial innovation combining community engagement, biodiversity conservation, and environmental justice.

Through the macro-cosmic to micro-cosmic approach, a 'north-south', 'developed versus developing regions' dichotomy and possible areas of accord for resource management and sustainability in the global perspective is presented.

Keywords Ajanta • Biodiversity • Buen vivir • Heritage • Model • Scale • Yasuní

14.1 Global Trends in Natural Resource Management: "Urban-Rural Cosmos"

The most important discoveries of the twentieth century exist not in the realm of science, medicine, or technology, but rather in the dawning awareness of the Earth's limits and how those limits will affect human evolution. Humanity has reached a crossroad where ecological catastrophes meet what some call sustainable development. A great deal of attention has been given to what governments, corporations, utilities, international agencies, and private citizens can do to help in the transition to sustainability; little thought has been given to what schools, colleges, and universities can do. Ecological literacy queries how the discovery of finiteness affects the content and substance of education. Given the limits of the Earth, what should people know and how should they learn it (Orr 1992)? Changing human–environmental relations and resultant bio-cultural spheres remains a serious challenge in the social policy formation and political–economic policing. Throughout human socio-cultural, civilizations' emergence, and history, there have been conflicts and negotiations to reach out to a consensus, either through political force or peaceful talks to reach a solution which could mitigate human–environment–human (HEH) differences and bring a possible stability. Over approximately the last two centuries during which there was massive production of an industrial and post-industrial society, the human–environmental balance has surpassed its equilibrium; the HEH model is being challenged by the environmental–human–environmental (EHE) challenge; there is increased human pressure on one hand challenged by a resource shortage. Ever growing populations are placing unrealistic demands on land-food-water-vegetative sources. Conversely, we are being consistently threatened by Global pressures of climatic change, which increasingly threaten the cultural landscapes with unpredictable climatic cycles. Threatening environmental challenges are happening in the terrestrial biotopes (Naveh 1998), questioning our economic models of growth based on globalization, causing irregular vulnerabilities on the rural cosmos (Leichenko and O'Brian 2002), and booming urban heat island (UHI). These are outcomes of massive and rapidly growing urban centers/cities/metros (Masson et al. 2014). The challenges of EHE stress are results of insensitive human interventions to their own environments which have caused severe results. Consequences are devastating for nature; the direct victims will be or are humans. With loss of adequate lands, water resources, and vegetation, the human cultures sustenance is null and void. Restoration can only be granted by efforts on all levels from micro-level natural terrain, forests, rural spaces, and large urban settlements. Naveh (1998) raised the aspect of ecological restoration with great emphasis. Thus, the restorative process was meant to mend that which is lost or vulnerable to loss. Restorations, according to the studies by Naveh, are only possible through trans-disciplinary methods; one discipline cannot possibly give practical solution to the vast human miscreants.

Human–community participation in conservation, restoration, and preservation of the ecological and biodiversity spaces is an essential component of environmental sustainability. The dependency of the rural/forest-based communities on natural resources makes it inevitable for them to be part of the precautionary measures to be adopted for the resource sustenance. Inclusive policies for the prevention of biodiversity loss remain one of the integral social phenomena, forest policy formation in South Asia biodiversity, and environmental conservation (Agarwal 2001). The natives of a region carry legacy of co-habitation with a certain ecological surroundings, creating a habitat for themselves that makes them privileged communities. Inclusion of the native or indigenous communities not only creates a balanced growth model, but also helps the planners to bring about result-oriented framework during sustainable environmental planning of regions (Kjosavik and Shanmugaratnam 2004; Moor and Gowda 2014).

Today's challenges are the outcome of collective disasters imposed by humans on their environment with their historically implanted interventions and skills. Cure for many of these disasters are laid in humans' cultural evolutionary methods (Naveh 1998).

Developing a model for human–environmental sustainability in the cultural landscapes requires the restoration of biological, ecological, and cultural diversity, together with structural and functional landscape integrity and heterogeneity—as total landscape eco-diversity. Combined analysis of water relations and cultural diversity represents an effort to examine the complex role water plays as a force in sustaining, maintaining, and also threatening the viability of culturally diverse people. It is argued that water is a fundamental human need, a human right, and a core sustaining element in biodiversity and cultural diversity. The core concepts utilized in this book draw upon a larger trend in sustainability science, a recognition of the synergism, and analytical potential in utilizing a coupled biological and social systems analysis, as the functional viability of nature is both sustained and threatened by humans (Johnston and Hiwasaki 2011).

The present volume is a collective effort to envisage a holistic model for global challenges in EHE studied through all land, water, and atmospheric paradigms. The details of these models will be given in detail in Sects. 14.2 and 14.3.

14.2 Learning Environments for Sustainability: Models and Case Studies

Models presented in previous chapters can be collected as common threads adopting the perspective of the learning environment as an opportunity to test and practice sustainability. The challenge of sustainability requires better use of tools and opportunities. Models (from computer models to theoretical models) are key tools for research and policy design and belong to a wide learning environment including case studies (from local to global) where people experience innovation and scenarios, from narratives to more sophisticated experiments of anticipation science (Boyd et al. 2015; Scolozzi and Poli 2015).

The challenge of sustainability is deeply rooted in the ability to creatively manage the human attitude of modelling and visualization (Di Biase 1990; Andrienko et al. 2013). Models vary in different sciences and different fields of knowledge and practice: from law, to theories, from computer based to mathematic models, from spatial, numerical, and discursive ones.

Modelling is a constitutive human ability from human history to personal life history; a space where generations may meet either privately among parents and children or in social space creating a place for exchanging visions and attitudes.

The social role of models for sustainability is rooted in the synergy among policy development and model management flow; models represent cornerstones in the toolbox of new governance offering an immediate experience of transparency and visibility in decisions and future images of present choices. Models facilitate inclusive decision making processes including actors, exploring interests and conflicts, which shows options related to position of different actors.

From the second chapter, James Furze develops an interesting model exercise of plant distribution and biodiversity combining variables of the plant world (life-history strategy, primary metabolic type, life-form) with location (water-energy topography dynamic). The modelling exercise is not only a crossroad of multidisciplinary paths among botany, ecology, geography, mathematics, and computer science, but is also a combinatorial approach where mathematical analysis is integrated with graphical and spatial representation. In this chapter, the reader cannot avoid to be involved into the theoretical deepness of the work recalling the seminal contribution of Alexander von Humboldt. Humboldt coined scientific communication to citizens (Farinelli 1998), inventing a new geography to avoid which simultaneously narrated fantastic savages and monsters and cold and the aseptic communication of geometrical mapping. The new geography of Humboldt brought intellectual models of the complexity of the world, resulting from the interaction between humans and nature. The *Ansichten der Natur* (1808) is a way to prepare people in understanding diversity, to improve and change the world into a heterogeneous *Kosmos*, not just a uniformed space. Understanding the double task of humans as creators and spectators in this Earth as a theatre is imperative, where humans can both perform and enjoy the performance (Turri 1998). Humboldt's book *Ansichten der Natur* is a manifesto about what a model is and what it could do. The German *Ansichten* means vision, opinion, idea, notion, judgment, and has been translated in different languages with different sensibilities. The Italian scholar of Humboldt, Franco Farinelli, edited the book as *Quadri della natura* (1998), stressing the concept of *Ansichten* as a scene or a sight. Models are painted as something which facilitate figurative and prefigurative issues and visualize the decision making process.

A sort of invisible Ariadne thread connects the reflections of Chap. 4 with Humboldt's *Ansichten* of Chap. 2. The authors highlight the issue of model as "clear box", overcoming the image of the scientist as "owner" of the "black box". This becomes social actors arguing with other social actors about the suitability of specific models to share visions and to avoid increasing error of using the wrong models. Absolute ranking in models should not exist, because each model has "its special capabilities" and the scientist has a social responsibility in offering criteria to choose the right model. The chapter offers an invaluable contribution, summarizing a wide spectrum of models used in water systems from predictive and investigative ones. Watersheds are a further element of climate change. The effect of climate change requires serious consideration, and the use of modelling is justified and elaborated as discussed in Chap. 10 by Mohammed Zareian. In the context of water systems, GIS and Remote sensing add spatial dimension to models: again the issue of visualization recall the consolidation in the past 20 years of 3D participatory mapping, participatory GIS, and community cartography (Craig et al. 2002; Simao et al. 2009).

All model flow steps can exit the specialist rooms and be discussed in the square of *Polis*; the transparent box in modelling requires social inclusive modelling involving people and locale. Over the last 50 years, post-normal sciences exit the cold rooms of government where decision makers and scientists meet to tailor better decisions. Since 1992 and the acclaimed United Nations Agenda 21, sciences share the awareness involved in the new governance of sustainability, visualizing and desiring sustainability before implementing it. The roads opened in Rio 1992 and were confirmed in Rio 2012, challenging society to meet the 2030 sustainable development objectives. The role of a learning environment is in the context of post-civil society characterized by the crisis of political representation and the charismatic drift in governmental affairs where debates are mere political fights between majority and opposition (Jameson and Speaks 1992; Echeverria 1995). Challenges for today and the future are the role of science and learning environments for sustainability, caring for the spaces of public and open debate. The issues of modelling interactions among natural and social system to build community resilience are well discussed in Chap. 11 with respect to the challenge of climate change. The author highlights the role of modelling in building awareness, discovering and improving coping strategies across genders, and linking climatic fluctuations with the rule of governance.

We need to visualize sustainability before, during, and after dealing with sustainability in territories and in different sectors without forgetting relations, as Kelly Swing reminds us in Chap. 6 with the words of John Muir: "When we try to pick out anything by itself, we find it attached to everything else in the universe". Diversity is a key element to understand the world as a complex network of aspects, coherent unity, and as model of organization. From ethno-taxonomy to binomial

Linnean taxonomy, there is a human scientific bridge looking to build coherent knowledge models to grasp the plurality of diversity. Chapters 5 and 6 focus on biodiversity and conservation, offering a reflection of ecological and biological models (Mayr 1997). The importance of modelling is in the field of mathematical symbolization, computer modelling, organism, laboratory or case studies, and before all as a way of thinking. Biodiversity is a combination of variety, variability, and processes (from ecological to evolutionary) and represents a challenge for human knowledge, the unbalanced race between the rate of cataloguing new species and the rate of extinctions. The author stresses the concept of "known" and "unknown" applied to organism diversity and the difference between cataloguing species and understanding the ecological functions and human values: "less than 5 % of the world's flora has been scientifically screened for biochemical activity or potential medical applications". Loss of species is not just about total number, but also about "which particular species are disappearing".

Swing highlights the geographical nature of biodiversity: the majority of species live in the tropics (Novotny 2009), while at the same time, here land cover changes have higher impacts considering the greater concentration of species per hectare. The uneven distribution of biodiversity in terms of species for area unit is one of the aspects of species area relations (more space, more species), which is critically endangered by the processes of habitat fragmentation. The challenge to conservation starting from the point that both "nature and human nature are quite complex" has to do with the spatial organization where normally society looks for separation of the space for humans and the space for ecosystems. Despite its origins in 1969, Environmental Impact Assessment is not unfolding all its potential as a tool to improve environmental performance of decision making, setting developments suitable to nature. Design with Nature (McHarg 1969) still maintains its character of a precursor not yet fully adopted in the quest for sustainability implementation.

Combining biogeochemistry and ecology to adopt a complex approach modelling entire ecosystems instead of individual interactions is the challenging topic of Chap. 7. The author asks for cooperation among ecologists, biochemists, and mathematicians to integrate the different scales: from atoms to ecosystems. The challenge is to develop an idealized model system with a wide array of explanatory power either in the domain of processes or in the domain of landscape system combining macrocosm, mesocosms, and microcosm. Beyond scale, this chapter offers interesting reflections about boundaries in modelling ecological systems.

Biologists use specific organisms as models, for example plant metabolic pathways are explored in Chap. 8 by Hanan Hashem and Dioscorea are elaborated upon in neutraceutical applications in Chap. 9 by Sanjeet Kumar. Ecologists work with communities and environments. The choice of the appropriate ecosystems for modelling is placed in the debate among realism and replication. Replication needs small habitats with clear boundaries (a natural microcosm) where it is possible to replicate experiments adopting solid statistic analysis. In contrast, realism works on unique case studies (learning environments), with long durations, qualitative approaches, flexible boundaries, and looks to grasp the dynamics of complex systems. At the kernel of complexity science, there is the observer and the observation process. The observer frames the area of analysis and defines boundaries among issues to be considered and outside of research interests. In complex systems, criteria of analysis should be clearly stated at the beginning of the modelling exercise (Maturana and Varela 1979; Nir 1990; Prigogine and Stengers 1997). The issue of boundaries is a common challenge in different categories of ecosystems well-represented; for example, in industrial ecology looking for the area of influence in material flow of firms, cities, or regions (Newell and Cousins 2015). Contrastingly, uniqueness, reality, and lack of replication are common elements in case study approaches used in social sciences; observation of specific case and extension to wide systems are not something new and a wide array of tools have been consolidated (Hesse-Biber 2010; Tashakkori and Teddlie 2010; Torrance 2012).

Case studies help in managing the challenge of scale in modelling, but we are developing tools to bridge the scale from operations to territory facing the challenge of sustainability: so we open the next thread—scale.

14.3 Multi-scale Pragmatics Challenges and Solutions

To weave the previous articulated threads of models and the thread of scale, it is useful to recall two interesting models ('Digital Earth' and 'Building Information Model') which combine complexity, spatiality, visualization, and multi-scale approaches. Firstly, the 'Digital Earth' commonly available in our computer from different categories of virtual globes, which are simultaneously so common and as unknown in potentiality for public debate, education, research, and professional sustainability practice. Diffusion as a common tool is encouraged by the International Society of digital Earth. Virtual globes allow people to pan, display, and exit the rigid limitation of cartographic scale. To analyze changes in time, we choose the cosmos to focus from crossroads to the globe; we share position, itinerary areas, share pictures, share changes, share future visions (Goodchild 2000, 2012; Grossner et al. 2008). Each event as a place combining information is referred by a system of four-dimensional coordinates. The other declinations of digital Earth are digital video globes available in schools, museums, or expositions. Digital video globes are powerful tools to visualize the common world and to view events, past, and future changes shared in a community setting (Butler 2006). Digital Earth is not new, launched on 31/01/1998 by Al Gore at California Science Centre of Los Angeles; it was a challenge combining the technology opportunities and Earth as a real learning environment for global knowledge (Gore 1992, 1998). Computer development in hardware and software evolution helped the creation of tools like 'Keyhole Earth viewer' (2001), NASA World Wind (2003), Google Earth (2005), and many other virtual globes (Atzmanstorfer and Blaschke 2013). Concurrently, there has been evolution of hardware with digital video globes (Grossner and Clarke 2007), additionally the consolidation of the conceptual change before and during the construction of digital Earth and the foundation of International society of Digital Earth (2006). The challenge of the collaborative initiative between Earth sciences, Geographic Information Science, human and life sciences offers an opportunity of a social collaborative platform connected by Internet facilitating exchange of data and information, implementing a multi-dimensional, multi-scale, multi-temporal and multi-layered system (Craglia et al. 2012). The digital Earth allows the construction of a global virtual representation of the planet to model Earth systems, including cultural and social aspects represented by the human societies living on the planet (De By and Georgiadou 2014; Mahdavi-Amiri et al. 2015).

Building Information Modelling (BIM) is a process developed starting in the 2000s by which “a digital representation of a building’s physical ad functional characteristics is created, maintained and shared as a knowledge resource” (Briscoe 2016). Principally a tool in the domain of architecture and engineering, it is the continuing evolution of modelling knowledge including the life cycle of a building (Miettinen and Paavola 2014; Rokooei 2015). It represents an ‘Information Modelling and Management’ developed to improve interoperability, coordination, quality, dialogue, and visualization; it is not just software (Wu and Kaushik 2015). BIM practitioners speak of 3D (classical three-dimensional representation derived from Computer Aided Design), 4D (inclusion of time in building operations from construction to maintaining), 5D (costs, economic and financial management of a building), 6D (the sustainability dimension of a building, at the moment limited to energy standards), and 7D (life cycle, from planning to decommissioning) (Jalaei and Jrade 2015; Liu et al. 2015). However, BIM is evolving and integrating with Infrastructure Information Management (IIM) for big operations (railway, water sewage, and others) and Landscape Information Management (LIM) (Blanco and Chen 2014; Briscoe 2016). We are living the transition and interoperability between BIM/IIM/LIM and GIS, developing frameworks and standardization. Clearly we enter a long trip; at the moment, preoccupations are about software, modelling authoring, standardization, definitions of interoperability. However, there is a potentiality not completely explored link with GIS, integrating human built environments with biological and ecological dimension of territories and secondly an opportunity to integrate visualisation and social inclusion (Gill et al. 2010; Zajíčková and Achten 2013). These two models open an interesting focus on scale: this conceptual tool is used in many social and natural sciences, sometimes used in different ways, but represents a possible common ground in shaping sustainability.

The concept of scale, apparently clear and unquestionable, can be split into three areas of complexity: the size, the level, and the relationships (Howitt 1998; Sayre 2005). Size is the most immediate issue that directly links territory and cartographical scale or world and models.

The issue of size is the first immediate contact people have with scale and models at the same time. As pointed by Mohammad Hadi Bazrkar in Chap. 4, scale models, or reduced representations of real world, are very common from children’s toys to scientific and technical operations. Scale models of building, infrastructures, machines, transportation, and raised relief maps were very important tools before computer development. Now, the world of 3D printers gives new life to many scale modelling operations, allowing the physical manipulation of models after elaboration and visualization on the computer screen.

Size still remains a central point in scale approach in space and time, so distances appropriate for walking are commonly elements used in architecture and planning to design sustainable spaces, allowing people to perform the majority of human activities through proximity without using individual cars and fossil fuels. Sustainability asks for an inversion of the shrinking world due to innovations in transport "annihilating space trough time" (Harvey 1989, p. 241). From the world explored at 15 km/h by horse coaches and sailing ships to the revolution of steam power applied to transportation around the 1850s (100 km/h for steam locomotives, 50 km/h for steam ships) to the mass air transportation based in jet aircrafts (1000 km/h), the challenge of sustainable living needs to manage the schizophrenia between speed (Virilio 1997, 1993) and accessibility. Speed is more related with power and exclusivity, accessibility with inclusion, and justice.

What may appear as a purely technical and quantitative aspect assumes knowledge (and operational) significance because the choice of the size of the representation defines the portion of territory and the elements to be represented (Monmonier 2005). Size matters (De Blij 2009), as stressed by Bazrkar in Chap. 4 for water system modelling. Spatial size from local to regional (from the meters of soil profiles to thousands of km for catchment areas) and time period (from the second of flashflood events to the hundreds years of long-term representation) should be accurately selected, despite the calculation power of computers in order to build credible and understandable models and representations. Space grid size and time units are not neutral to the systems to be modelled and the different steps of the modelling process (data collection, conceptual modelling, mathematical modelling, calibration and validation). Up-scaling and downscaling are common processes which bridge the gap between modelling scale and organizational scale; however, these operations should take into account heterogeneity in space and time, and from a sustainability point of view, social implications and policy challenges. Size in modelling biodiversity is another key element in what can be considered "known" and "unknown": we seminally recall that Kelly Swing in Chap. 5 highlights how scientists know more about "organisms that exceed 10 cm or 10 g" and Sam Bonnett in Chap. 7 stresses how microbial community dynamics are ignored in many ecosystem-level models and "that less than 5 % of microbial species or less than 1 % of operational taxonomic units in soils are described".

Another important aspect related to scale is the level of analysis and the choice of level made by the researcher to organize the observational dimension of territorial dynamics (Zhang et al. 2014).

The level of analysis in sustainability research and policies can be influenced either by the hierarchy of political and economic meshes chosen (observation at district, province, country, continent level, or just local, national, global), or by ecological meshes (climate, ecosystem, river basin). Different types of analysis take predefined scale levels as a result of a scientific tradition or consolidated professional practices. Alternatively, analysis is made upon research customer requirements (Higgins et al. 2012) as is the case of an organism for biologists.

Sam Bonnett in Chap. 7 stresses the need to integrate scale and disciplines to grasp the different levels at which processes operate. The authors suggest involving ecologists, biochemists, and mathematicians in modelling wide ecosystems and not just small interactions. From one side, the arena of disciplines needs to be enlarged to social and territorial sciences and, from the other side, the multi-scale tools and the concept of mesocosm, suggested by the authors, can facilitate interdisciplinary and social dialogue. There are disciplines more at ease with microcosm and others more at ease with macrocosm, while inside disciplines the situation is almost scattered. However, a mesocosm located in the field with easy boundaries and with a manageable size can improve realism, scientific rigors, and social implementations. Mesocosm can bridge the different elements characterizing scale: size, level, and relations. Oceanic islands, so useful for ecosystem modelling (and to models of climate change impact for physical sciences notwithstanding policy and inclusive decision making), are interesting examples of mesocosms managing reasonable size and at the same time multiple levels of social and environmental relations, opening the door to the framework of nested systems (Maturana and Varela 1979, 1984; Koestler 1980; Roos and Oliver 1999).

The third element of scale is determined from a primary focus on relationships and the dynamics of the analyzed phenomena. The perspective of the relationship is typical of the geographical approach based on the vision of network taking a multi-scale look. This approach involves placing the study area in a multi-area context from local to biosphere (Collinge 2006; Marston 2000; Marston et al. 2005; Raven et al. 2012; Santos 2008). To forget a scale, or to avoid a scale of analysis, means mauling understanding of the complexities.

Sustainable development research should address the need to analyze different observational and organizational levels of territorial dynamics, adopting multiple representations at different sizes to account for the wholeness of the conceptual implications of territorial scales. We refer to the case highlighted in Chap. 7—middled out modelling. Top-down and bottom-up approaches, from scientific modelling to sustainability governance, have represented a battle field of theoretical and pragmatic points of view in framing knowledge and in implementing practices. Middle-out modelling can be either a starting point for observational and organizational scales or a meeting point from different paths of knowledge building and implementation of practices, with the awareness that sustainability challenges do not ask sustainability actors to defend positions, but to share visions and proposals from above, from below, from outside, and from the middle.

The goal is to produce tools (including maps) offering the view on different portions of the territorial reality and at the same time offering the story of the relationship between actors and places involved in the networking of scale's pluralities (Helfenbein 2010; Marston 2000; Montesuma Oliveira et al. 2011; Santos 2008). Now with the evolution of models, especially digital Earth and Information Modelling, we face this challenge by building good, descriptive, integrative, and explanatory models (see Chaps. 3 and 7).

14.4 Developing Regional Modelling: Case Study of a Heritage Site, Ajanta in India

Models envisaged by policy makers and sustainability scientists cooperatively produce tools with desired practical implications. We comparatively evaluate models presented in the volume, with existing policy methods for resource management and Global perspective for resource planning methods in developing nations per se. Models are discussed in the context of a case study of Rural South Asia (with special reference to India). Since 1947, under the Ministry of Rural Development (MRD) and the Ministry of Tribal Affairs (MTA), India's policies were made to create sustainable models for heritage, biodiversity, and natural resource management. Through the MRD and MTA, methods of organic farming, sustainable water, and energy management and collaborative approaches of human participation are essential in rural/tribal areas of India. In the given region, emphasis is laid on human support for resource management—historically, humans are guardians of natural resources. The expertise of a community in sustainable development of resource management increases if the said community owes a legacy of living in the region for historical times (Selin 1999; Agarwal 2011). The ownership and sharing of resources with community participation helps in alleviating various challenges which are posed in a developing economy of the likes of India (Sunderlin et al. 2008).

A prospective superpower, India is still grappling with risks that threaten to hamper its progress. These range from environmental threats caused by GM crops and pollution; dangers to health from HIV/AIDS and maternal–child morbidity and mortality; safety concerns about natural hazards, nuclear power, and industrial disasters; and challenges to livelihoods and values. Some of the issues that this volume explores are: what counts as an 'acceptable' risk, and who decides? How should divergent perceptions of risks be reconciled? Where is the line between science and politics? We attempt to breach the interface between policy formation and direction. Advocating a more multidimensional approach to managing risks, the authors challenge many of the dominant perspectives in India.

The field of risk research, which has emerged over the last 40 years in the West, has been relatively unexplored in India. To bridge this gap, this volume brings together Indian and scholars and practitioners across the fields of biological sciences and social sciences to work on a common strategy and framework as a solution for the challenges of the environmental issues. With inclusion of qualitative research and suggestions from biodiversity, forestry, and anthropology experts, it intends to frame the models of sustenance in various environmental areas of the developed and developing regions of the world (Sunderlin et al. 2008).

Studies in India/South Asia related to forest and community participation have given favorable results. These are substantiated through HEH correlations in forest management; Joint Forest Management (JFM) has given pro-environmental results substantiating involvement of the community (Agarwal 2011; Kjosavik et al. 2004; Behera 2006; Kumar 2002). Native communities' role in ecological sustenance, in prevention of deforestation and bio-diversity loss and conservation remains one of the most sought after solutions in the forest policy of India. Additionally, results of studies carried out by the Forest Departments in India (Agrawal and Chhatre 2006; Joshi 1999; Agrawal and Gupta 2005; Poffenberger 1996) indicate potential solution to the ecological crisis.

14.4.1 Suitability Policies of Ministry of Rural Development and Ministry of Tourism Administration: Evaluating 'Ajanta and Around'

Ajanta has a combination of UNESCO Buddhist-cave heritage sites located at the sanctuary 'Gautala-Outram', a prominent biodiversity zone of the central-Western India (Hidaka 2007). The region of the UNESCO Heritage site is found in the hub of the forest and the biodiversity zone (Singh and Anand 2013). The cave site of Ajanta and its associated environment of forest and mountain range, with its flora–fauna tract and rivulets, provide natural resources of water and vegetation for the local communities in Aurangabad, Jalna, and Jalgaon (Kshirsagar et al. 2012). Historically, the region has been a major source of natural resources and an area of conservation. Regard for the sustainable development of the entire region is dependent on Ajanta and its forest resources (Sengar 2016), since becoming a UNESCO heritage site in 1983. Around 1982, the region received special attention for its monuments and also for its biodiversity value. The Ministry of Rural Development (MRD), Ministry of Environment and Forestry (MoEF), and Maharashtra Tourist Development Corporation (MTDC) gave special emphasis for the governance and sustenance of the region. Special measures to maintain an environmental balance remain a major objective of the regions' environmental policy. The survival and sustenance of the Buddhist cave of Ajanta as an UNESCO heritage site is largely dependent on the well-being of the environment of the region (Doug 2014).

The main objective of this case study is to understand the inputs of the community and the State approach in maintaining an ecological balance. Ajanta is a fine example of human architectural heritage in excellence in the vicinity of a forest area, which is rich in biodiversity and local landscape. It has a fine balance of the State-Community participation in ecological sustenance for a heritage site, a region which is core to the biodiversity in river Godavari valley region in Central-Western India (Deshmukh 2008). The study undertaken elaborates an impact evaluation of MRD, MoEF, MTDC, and MTA policies and how these could be enhanced through global genres of resource planning and management. To understand resource sustainability, while enhancing resource utilization capacity of traditional practices; the tribal (indigenous communities) village—'Ajanta' (Western India)—is elaborated upon.

The broader region of Ajanta hills and forests comprises the Buddhist cave heritage sites with 30 rock cut caves constructed during second century BC to fifth century BC. The hills and forests in and around Ajanta are closely connected to the heritage and regional history of the cave heritage sites. The prominent villages of Lenapur, Savarkheda, Dutt wadi, and Ajanta are inhabited by the forest communities of Bhil, Koli, and Banjara clans. Since 1954, the villages in and around the Buddhist cave heritage sites have been governed by the MTA and Department of Forestry. Local government administration, policies protecting biodiversity, and the environs of the region were formulated (Sengar 2011). The composite region of Ajanta presents an integrated ecological site where existence and well-being of a heritage site are inversely proportional to the life and well-being of the ecology of the region (Bharti 2013; Deshmukh 2008).

Ajantas' rock cut caves are world famous for the tempera paintings which are carved on inner walls of each cave. The paintings of the Ajanta caves are made with locally available mineral resources and flora. History speaks through the technique utilized in the caves. The communities' and resources contribution in making this unique heritage site is unquestionable (Deshmukh 2008; Bharti 2013). However, changing times and increasing touristic pressure ignore the role of the local people and resources, leading to severe and rapid deterioration in the cave sites (Doug 2014; Deshmukh 2008). The caves, which were excavated in hill ranges, are composed of chaotic piles of irregular basalt flows. The lower parts of some of the flows have several joints. As a result, although the paintings on the flows have a smooth appearance, the statues and pillars along the joints have developed cracks. Seventeen panels in Ajanta and 117 in Ellora are deteriorating. The presence of chlorophaeite in the basalt rocks has also contributed to the degradation. Chlorophaeite absorbs moisture, resulting in the formation of thin scales on the rock surfaces. The scales fall off in summer, disfiguring the paintings; 13 panels in Ellora and 6 in Ajanta have deteriorated (Bharti 2013; Deshmukh 2008).

The proportion of harmful reactive chemicals in the atmosphere has increased substantially, due to uncontrolled industrialization in the Aurangabad and Jalgaon districts of the state (Deshmukh 2008). This affects the paintings in the caves and its associated environment, bringing an UNESCO heritage site under threat and increasing the vulnerability of a naturally rich biodiversity zone. Deshmukh suggests healing of the cracks in the rocks with epoxy resin and applying a thin chemical coat on the affected panels to constitute a humidity-proof transparent film over the paintings. The restoration of many of the components of the cave site of Ajanta requires a sustainable ecological environment of the region. This will be feasible if the native communities and the local environment can be revived and conserved to their original form. A further concern is sustenance of the water level and geological structures of the terrain (Bharti 2013).

Declining water resources and depletion of the forest cover are major regional challenges for the heritage and biodiversity sites of the region. The excessive intake of tourism depletes resources, increasing erosion from foot pressure of visitors, and results in less community participation in the ecological terrain. Native people of the region are threatened by the decreasing resources in terms of water, vegetation, and fauna; their survival and their threatened eviction will further challenge the maintenance of the heritage site (Sengar 2016; Doug 2014). There are colossal challenges for a heritage site in a biodiversity zone, facilitating HEH relationships and visualization of qualitative models for maintenance of human-created heritage and coexistence with the ecological models.

14.5 Good Living (*buen vivir*), Extractivism, and Yasunization: Suggestions from a Latin American Mega-Diverse Country

The Yasuní National Park in the Ecuadorian Amazon is a paradigmatic case study of the complexities of land management in environments with high biological and cultural diversity. Conflicts are structuring and structured to effect the simultaneous activation of territorial policies. Established as a park in 1979, recognized as a Biosphere Reserve by UNESCO in 1989, it is the region in the world with the highest biological diversity (of all five kingdoms per hectare is incomparable). The park is the home of the un-contacted tribes, the Waorani (people of recent contact), Kicwa, and Shuar people (Bass et al. 2010; Narvaez et al. 2013; Pappalardo 2013; Villaverde et al. 2005).

In 2007, Ecuador was the first country in the world to reserve an area of 7500 km ^{2} as an Intangible area, reserved for the rights to self-determination of uncontacted people Tagaeri Taromenane. This perpetually prohibits any industrial activity. A buffer zone of 10 km to ensuring further respect to the area was also set up. Intangible zone and buffer areas partially overlap Yasuní Biodiversity Reserve (YBR). However, the nomadic people have for centuries moved on an area of about 20,000 km^2 between the rivers Napo and Curaray (north/south) and between the first Andean hills and the confluence of Nashino with Curaray (west/east). Hence, the Intangible Zone is not aligned on territoriality of Tagaeri Taromenane (Pappalardo et al. 2013). Political anthropology and self-determination rights of societies' minorities in isolation should be integrated to design adequate territorial policies and the protection and maintenance of appropriate ecosystem conditions for survival (De Marchi et al. 2013).

The territory of YBR established for the conservation of biodiversity and the recognition of human rights is simultaneously overlapped by petroleum activities, illegal logging, and hunting. A geographical representation (a model of understanding) not distorting the territory and allowing the comprehension of the system of large projects around the four sides of the park (Via Auca, Napo River, the border with Peru and southern Curaray) to develop alternative proposals for sustainable territorial development is required (De Marchi 2013; De Marchi et al. 2015). Yasuni Biodiversity Reserve, its biological and cultural diversity, is at the core of a paradigmatic process of inclusive sustainable policy design in Latin America.

This case study attracted attention to the concept of *buen vivir*/good living; conversely, it is the theatre of the first proposal of living oil under soil.

In the last 20 years, many Latin American countries' endogenous declination of sustainability has been shaped around the perspective of *buen vivir*/good living (*Ally Kawsay*, *Sumak Kawsay*) combining quality of life, social justice, and rights of nature. However, good living (*buen vivir*) is not a monolithic corpus of common vision for sustainable development. It is possible to identify three main perspectives: a good living of indigenous people (good living from below), a good living of State (good living from above), and good living of social scientist (good living from theoretical reflection) (Altmann 2013a, b).

The origins of the good living concept are rooted in the indigenous movement starting in the 1980s, reclaiming a political role and plurinationality in Latin American countries. In Ecuador, a paradigmatic country for its mega diversity in both biological and cultural domains, the issue of plurinationality and ownership of territory and natural resources was framed with high intensity and structure elaborated due to the weight of indigenous people inside Ecuadorian society (De Marchi et al. 2010c; Hidalgo-Capitán et al. 2014). The defense of territory, the strict relation between plurinationality and territorial autonomy, saw the good living (*sumak kawsai*) as a vision of harmonic life behind political struggles for autonomous control over natural resources by indigenous nations (Altmann 2013a, b; CONAIE 2007, 2010). The fight of the Sarayaku people against oil operations in their territories frames the *sumak kawsay* as a way of strengthening people's identity. This constitutes a renovated pact among humans and nature, where management of resources by hunting the necessary, shared rules, harmony, regeneration time, life renewal, life cycle are key concepts of a local knowledge declination of a world quest for sustainability (Sarayaku 2003).

Critical intellectuals of ecological economics prescribe that good living should be based on a circular economy, a wise management of natural resources, and the abandonment of extraction economy based on oil and minerals with heavy environmental and social impacts (Alier 2011; Acosta 2010; Gudynas 2011).

The debate about *buen vivir* consolidates the new constitution of Ecuador of 2008, recognizing the right to nature and the *sumak kawsai* as a constitutional principle of Ecuador Plurinational State (Acosta 2010). However, between constitution principles and implemented policies, the State enacted a different concept of *buen vivir* in operational terms. The three approaches can be distinguished by the role assigned to ecosystems and natural resources (renewable and not renewable) in shaping the new alliance between people, State, and ecosystems summarized in the polarities of extractivism and Yasunization.

Extractivism bases social justice on natural resource extraction putting nature to the service of Nation, while civil society struggles for Yasunization. The latter is a neologism avoiding the extraction of fossil fuels and the simultaneous construction of territorial development alternatives, which combines the fight against climate change with community engagement, biodiversity conservation, and promotion and protection of human rights and environmental justice.

Yasunization is a social response to climate crisis. For the period 2011–2050, cumulative carbon dioxide emissions, projectively, must stay within the limits of 2 °C above the average global temperature of pre-industrial times, between 870 and 1240 Gt of CO_2. In contrast, the carbon stored in global reserves of fossil fuels is estimated at 11,000 Gt of carbon dioxide (Jakob and Hilaire 2015). This discrepancy represents a conflict between policies for maintaining carbon unexploited in order to protect life on Earth and the foolhardy options for carbon capturing and geo-engineering to protect a growing carbon economy. As climate scientists say "the continuation of high fossil fuel emissions, given current knowledge of the consequences, would be an act of extraordinary willing intergenerational injustice" (Hansen et al. 2013). Scientific communities confirm the need to maintain huge amount of carbon reserves buried: more than 80 % of coal, 50 % of gas, and 30 % of oil reserves must remain underground to save Earth (Meinshausen et al. 2009; McGlade and Ekins 2015).

Impacts on climate change ensuing decades are detailed by scientific literature and IPCC research; however; fossil fuels are key drivers not only for future climate change, but also for past and current social and environmental impacts. The ecological footprint of fossil fuel production is increasing as accessible reserves are depleted due to greater use of water, energy, and diluents limiting positive effect of energy efficiency and consumption reduction (Davidson and Andrews 2013; Jordaan et al. 2009). Impacts on health, water, and biodiversity in conventional and unconventional fossil fuel operations in different geographical contexts are widely reported in scientific literature (Allen et al. 2012; Cooley and Donnell 2014; Finer et al. 2015; Hansen et al. 2013; Kelly et al. 2010; Kurek et al. 2013; Narvaez et al. 2013; Osborn et al. 2011; Pappalardo et al. 2013; Schmidt 2011; Vidic et al. 2013). From a socio-economic point of view, petro-violence and Faustian Pacts (Watts 2001), the illusion of production (Coronil 1997), the paradox of plenty (Lynn 1997) and resource course (Stevens 2003; Sachs and Warner 2001), accumulation by dispossession (Harvey 2003) are dynamics related to fossil fuel economies.

Energy is a key topic of sustainability, and the way of looking to energy represents an important contribution to imagine, plan, and implement the energy transition toward a postcarbon society. Raphaël Fonteneau (Chap. 3) focuses on framing energy options through a reflection on Energy Return on Energy Investment (ERoEI) and the implementation of MODERN, a model visualizing the deployment of energy transition. Looking at energy through the lens of ERoEI exhibits the vested energy investment costs of producing energy, normally invisible in the market where prices do not internalize environmental and energy costs. The precipitation of ERoEI by oil extraction in the last century declined from 1000 to 5 (ERoEI is dimensionless) and oil import from 1990 to 2005 declined from 35 to 12. The crude mathematics of ERoEI and the use of MODERN supply important elements of reflection from one side to the energy, environmental and social costs of energy transition, and the risk to kill renewable sources to maintain linkage with fossil: the waste of energy to produce energy. The authors highlight the 'geographicalness' of energy deployment to avoid generalized solution and to find the right energy system for each territory.

Despite actual and future social, environmental, and climate impacts of fossil fuels and the need to maintain carbon reserves buried, there has been only one policy experiment in the world: the Yasuni ITT Initiative implemented in Ecuador in the period 2006–2013 avoids the exploitation of ITT oil block (Ishpingo, Tambococha, Tiputini), partially located into the Yasuni National Park. Launched in 2006 as a citizen's initiative, it was adopted in 2007 by the Ecuadorian Government proposing international commitment; in the framework of United Nations, there is a monetary compensation for the avoided CO_2 resulting from leaving the ITT block untapped, thus creating a sustainable scenario designed to improve life conditions in the Amazon (Espinosa 2013; Larrea and Warnars 2009; Narvaez et al. 2013; Rival 2010; Vallejo et al. 2015). In 2013, considering the scarce results in terms of accumulated funds, the government abandoned the initiative. However, civil society and the scientific community still support the ITT initiative, coining the neologism "Yasunization" to describe either past experience or the need to maintain oil underground to reduce carbon emissions, thereby granting climate justice, human rights, and biodiversity conservation, through citizen involvement.

As pointed by Kelly Swing (Chap. 5 in this book), Ecuador (may be the most mega-diverse country in the world with only 10 % of all leaving species catalogued) is particularly vulnerable to extractive operations and habitat fragmentation, considering the limited knowledge on biodiversity and the potential risk to lose suitable resources for human development. It is impossible to notice an extinction if the existence of species has never been confirmed. Swing quotes Ed Begley Jr. about the perspective in loss and gain: "When we destroy something created by man, we call it vandalism; when we destroy something created by nature, we call it progress" and Aldo Leopold about the representation of development for industrial society: "to those devoid of imagination, a blank place on the map is a useless waste; to others, the most valuable part".

Yasunization is the citizen commitment from below to conserve apparently empty spaces, where cultural and ecological diversity are not yet noticed to build supply side policies for climate change and territorial sustainability. It pledges a connection between local and global quality of life: at the moment the unique policy experiment with so ambitious objectives; a case study to be diffused of possible sustainable futures.

14.6 Dichotomy and Accord: Weaving the Main Threads

The quest for sustainability incorporates the basic challenge of humanity in producing territory: to build bi-modular systems combining society and ecosystems through the use of technology. Humans learn ecological niche (Colinvaux 1993) and supply culture and ingenuity to the task of living in different ecosystems. From pristine Earth life to the robotics revolution, techniques and technology accompany humans in building the territory as a spatial machine for social reproduction. Territory is the result of combination between technology and space (ecosystems) through the manipulation of social institutions in regulating technical application (Santos 1994, 1996).

Incorporating humans into Earth's fragile habitats means constructing a co-evolutionary process between society and ecosystems (Ostrom 1990), and among society, ecosystems and technology (the other way of speaking about territory is the historical application of human work and technology to space). It requires weaving social institutions, ecosystem dynamics, and evolutions of technology; in other words, to tailor the socio-logics, the bio-logics, the eco-logics, and the techno-logics (Raffestin 1980).

Chapter 13 of this book "Intelligent and Robust Path Planning and Control of Robotic Systems" is not only a review of technical challenges for robotics research, but offers an important contribution to weave the main threads running across the different chapters. Authors highlight that allowing robotic performance of complex tasks in structured and predictable spaces does not feedback only to manage the sophisticated mechanics of actuators. These new technological organisms should be able to perform predicted behaviors and to learn from environment. Robots spread especially in industry and car manufactories from welding to spray painting, avoiding human works in dangerous environments. Despite not appearing as humanoid with biped motion, many type of robots are widely used in medicine (from surgical application to rehabilitation), civil applications, and commonly distributed in consumer market as toys, home, and outdoor devices. Mobile robots for land displacement are legged or wheeled; flying robots, water, and underwater robots are regularly used in warfare and in other civil applications.

Among the main topics of robotics development, there is the control to perform tasks in different environments granting control of motion and control of contacts. Borrowing ideas from biological systems gave robotics the key improvement of intelligent control as emulation of biological intelligence, either for performing planned tasks or to solve problems. Safannah Raafat remarks that artificial intelligence allows robots to "learn from what is happening rather than from what is predicted". Different learning paradigms are commonly used to make robots self-adaptive and perform autonomous capabilities using neural networks, fuzzy logic, genetic algorithms, and hybrid techniques based on integration. Robot vision and visual servoing (introduced in Chap. 12) are other applications of intelligent controls, based on sensor control instead of model control, developing an iterative learning control; combination of visual control and positioning systems with GPS is widely used, for example, in flying robots and not only in photogrammetric operations. Intelligent controls, robot vision, servoing, and serving are important elements to manage obstacle avoidance and motion planning: one of the key tasks of autonomous robot systems.

A further evolution of artificial intelligence detailed is the swarm robotics as emulation of biological swarm organization of insects to implement the self-organization and interactions of a large number of distributed autonomous and decentralized robot systems. Swarmanoid clusters of foot-bots hand-bots and eye-bots perform complex tasks dismantling the model of humanoid biped robots and recombine motion, manipulation, and vision in flexible and suitable ways to perform in different environments.

In robotics, with artificial intelligence, humans are reproducing evolution not only for anatomy combination and recombination, but also for intelligence, cognition, and enaction. Robots operate at the local scale of factory, house, office, and hospital and occupy the wide scale conquering wide spaces of land, water, and sky; at the same time, robotic systems cross the different contexts of structured and predictable spaces to spread on unstructured, unpredictable open environments.

The change of scale and context and related social and ethical implications of robot applications are particularly visible in Unmanned Systems (not only aerial), widely known as the “drone revolution” (Fahlstrom and Gleason 2014; Nonami et al. 2010; Tsourdos et al. 2011; Valavanis and Vachtsevanos 2014). Developed by military needs for a clean, ethic, safe, and effective warfare, drones contributed in redefining the right to kill, the just war, the spatial distance of enemies’ executions, and simultaneously consolidate war against civilians putting unprotected people under the drones (Bashir and Crews 2012; Chamayou 2015; Langewiesche 2011; Rae 2014; Yenne 2004). Conversely, drones enter everyday life in profession, home life, and spare time and are driving a parallel revolution in civil use of space and in the relation among humans, environment, and technology (Choi-Fitzpatrick et al. 2016).

Precision farming, for example, is a promising area of Unmanned Systems’ development (Whelan and Taylor 2013; Xiang and Tian 2011), offering a bifurcation between using technology to implement regulated supply of external inputs to environment or a wise use of ecological regulation of agro-ecosystems. Precision farming robotics does not turn humanity away from its allelopathic option, as highlighted by Kelly Swing in Chap. 6. Allelopathy is the production of chemical substances limiting or eliminating competitors, allowing control of space and resources reducing the life possibility of other organisms. Humans allelopathic nature is a successful strategy to dominate other organisms and landscapes, winning the games humans “are encouraged to continue using the winning strategy, hoard resources, eliminate competitors, occupy more space”. The lack of specialized organs producing chemical compounds, as other species, is supplied in humans by ingenuity developing a technological allopathy.

Technological opportunities put humans in front of the bifurcation, deepening the allelopathic strategy through territorial substitution; reestablishing a new alliance between society and ecosystems regulating flows and withdraws. The mis-match between technology, society and environment has social and environmental implications on environmental sustainability and social justice.

Unmanned vehicles are a well-known paradigmatic case study on technology and its social and environmental relations and implications. Flying robots are changing not only farm landscapes, but also urban sky, prospecting a new system of movement of people and goods and new options for delivering goods and services. Technological evolution has its own speed (Virilio 1997) compared to evolution of institution; despite twenty-first century technologies, societies are rooted in fifteenth century institutions (Beck et al. 1994) and the reflexive modernity of technology clashes with early modernity of institutions.

Robots developed occupying dangerous and unsafe working environments; however, this is not human achievement but an achievement of product relations; the luddite fight between workers and machines cannot be the solution to the freeing of humanity from working time. Sustainability is related with economy and institutions using technology to improve human quality of life. Technology can take many paths as clarified by the "Drones for good" approach (Choi-Fitzpatrick 2014) to find options consolidating human rights and avoiding geo-slavery.

Sustainability asks for a combined approach in weaving the threads of technology, scale, and modelling in ecosystems and institutions, putting technology into the framework of common pool resources (Ostrom and Hess 2007), and developing multiple co-evolutionary processes among technology as Global commons, ecosystems, and institutions together effect improvement of biological and cultural diversity (Ostrom 2005).

The challenge of human sustainable development highlighted in the 1994 Human development report opens into the framework of sustainable development objectives at 2030 and beyond.

This book allows the reader to tour theories, giving perspective on sustainability, places of implementation, scientific experimentation, and governance experiments between models and scales.

To close this chapter, we detail a case study from an European Alpine territory, which complements the tour of a sustainable development transition.

Trentino is an autonomous province in northern Italy and, together with the Autonomous Province of Bolzano, forms the Autonomous Region of Trentino Alto Adige/Südtirol. Trentino has an area of 6212 km^2 and around 530,000 people live in the province of Trento, distributed in 217 municipalities.

Trentino has one of the highest per-capita income and public expenditure at a national level. Thanks to the special situation of autonomy, in addition to the typical administrative functions of Italian provincial authorities, the Autonomous Province of Trento (PAT) has legislative powers in areas normally under state or regional jurisdiction. Health, education, training, employment, transport and roads, planning, energy, and environment have all been identified as particularly important competences. The special administrative grid is responsible for a special territory with high biodiversity from the Mediterranean ecosystem of the Lago di Garda to the tundra ecosystems of alpine cliffs. Forests cover more than 50 % of province surface and naturalistic forestry is widely applied to produce wood, protect territory, conserve biodiversity, and improve landscape quality for people and tourists.

Trentino is highly committed to an international quest for development and sustainability due to its historical background; additionally, a high rate of migration from Trentino in the late nineteenth and first half of the twentieth century, the widespread presence of social enterprises (cooperatives) commonly seen as the socio-economic mechanism, has lifted Trentino out of poverty in the last 50–60 years. Cooperatives in Trentino are active in different fields, particularly agriculture, credit, commercial distribution, and social services. Their presence in almost all economic sectors makes Trentino a "cooperative district" like few others in the world. Cooperatives are a cornerstone of a complex and diversified economic system based in quality food production (wine, cheese, meat, and fruits), community and industrial tourism (around 5,118,853 tourist arrivals and 29,668,503 tourist presences in 2013), industry, tertiary sector, research, and innovation.

On a national level, the Autonomous Province of Trento (PAT) has paved the way for territorial and environmental policies, adopting its first territorial plan in 1967 in Italy and its environmental impact assessment law in 1988. In 1999, Trentino prepared a first regional policy on sustainability and in 2010 prepared PASSO (*Patto per lo Sviluppo Sostenibile*—Pact for Sustainable Development).

PASSO was built in a dialogue among public administration experts, major groups, and civil society using face to face and online interactions. A common document and a set of indicators to monitor sustainability efforts to 2020 was developed around five areas of interest. To maintain an easy communicational approach, the five sustainability areas were simply represented with the first five letters of the alphabet: A, B, C, D, E (De Marchi et al. 2010a, b).

The first letter "A" represented the "Agenda setting" for sustainable development of Trentino as community looking for a multiple identity through sustainability. The commitment was around the development of a sustainable multiple citizenship, considering each inhabitant as alpine, Italian, European, and world citizens; the aim was to promote a declination of sustainability based on the sense of belonging and the responsibility to build Trentino as an alpine European cosmopolitan province. Indicators used for this topic were: Energy intensity and private transport (as a commitment for global climate change) and expenses in research and international cooperation as global commitment for innovation and sustainable development.

Letter B was related to Biodiversity as a corner stone for sustainability of life, supporting systems, and improving provincial ecosystem and landscapes for ethical, cultural, economical, and environmental reasons. If a landscape is an economical valuable asset for tourism and agriculture, the local community should not forget its importance for health, culture, and ethics, in a holistic reconnaissance of complex values of ecosystem services. Indicators for monitoring sustainability efforts in this area were: index of birds in agricultural habitats, soil consumption, area occupied by organic farming, water withdrawn, and tourist beds for 1000 inhabitants.

Closing the cycle of consumption and production (the letter C of the spelling book of Trentino sustainability), circular economy, and social metabolism, industrial ecology reproducing circulation in natural ecosystems was the declination of a topic of social responsibility for resource use. The need to create conditional innovations in social practices and adopt a different approach to consumption and production necessitates change both in the private and public sphere through the development of appropriate cultural, technological, regulatory, and economic models. Indicators for this component were: resources productivity, pro-capita waste production, certifications, and cars for 1000 inhabitants.

Democracy (letter D), information, participation, sustainability, and social innovation were declared as essential. Trentino participated in research of effectiveness of democracy, analyzing space for representative and deliberative democracy. PASSO intend to consolidate sustainable citizenship through responsible re-appropriation of the places, the development of an active territoriality, social inclusion, openness, transparency, and accountability of decision making. Indicators were participation to election, lifelong learning, e-government use, and environmental taxation.

Finally, "E" represents the "energy challenge" represented by the triangle: energy, transportation, and climate. PASSO attempts to define a perspective of sustainability and complete 'de-carbonisation' of the polarities moving and living in Trentino. The key issue is around sustainable mobility integrating territorial planning and transportation planning playing at the scales of accessibility and proximity. Indicators for this topics were: greenhouse gas emissions, greenhouse gas emission on transport sector, population exposed to particulate pollution, freight transport by roads, energy consumption from renewable sources.

PASSO defined strategies, objectives, and actions to be integrated into day-to-day policies to make sustainability "ordinary policy" of a consolidated direction for change.

The model of Trentino collated with the biodiversity and heritage site details of Ajanta in India meets the objectives of the environmental studies. The objectives of the Trentino model and detail of biodiversity and heritage of Ajanta help to develop a parallel construction of policies for sustainable ideals and possible implementation of models working on the practical grounds. The objective of sustenance could be achieved by bringing the developed and developing nation's models in a common platform. This certainly provides 'food for thought', which should be considered by international and developmental governance bodies such as the UN and smaller national or regional bodies, for formation and implementation of sustainability policies.

It is important to stress the contribution of different authors of this book in looking for the roots of a science of sustainability with more than two centuries of thickness before the framing of sustainability policies in international institutions starting from the seminal Bruntdtland report of 1987. This secular knowledge is another baggage of world cultural heritage we can combine with the wisdom of local knowledge to navigate the challenge of sustainability objectives at 2030 and beyond.

Linneus, Humboldt, Darwin, Muir, and many others contributed to complex thinking that subsequent authors have recalled, bringing us a culture not completely new, a scientific contribution to roots and long duration, and the discovery of the world cultural heritage of some exponents of the republic of letters.

The confusion and misunderstanding of using cosmos and universe as synonyms and interchangeable words do not help us in understanding the complexity of models and knowledge attached to the deep meaning of this word, resulting from the contribution of more than 25 centuries of formalized philosophy and thousands of years of *animus mundi* inside local knowledge.

As Hillman (1992) says cosmos is a Greek world meaning something of harmonious, beautiful, pleasant nature, offering something coherent and aesthetically appreciable, cosmos has more to do with cosmetic than with sidereal space. The cosmos is related to a Greek culture of harmony between space, organization, and policies. Universe is a Latin name, the uniform space of Roman Empire, Universus, and is a set of rules and structure commonly joining a unique empire with roads, language, and water distribution. Exchanging cosmos and universe is not useful in a questing for human sustainability. Cosmos enshrines beauty and diversity, from the cosmic scale of the city to the cosmic scale of the Earth and the nested hierarchy of complex systems. Kosmos (1845–1858) was the title of the work of Humboltd refunding geography and natural sciences in the nineteenth centuries. *Kosmos*, *Entwurf einer physischen Weltbeschreibung* in German can be translated as "Cosmos, project for a physical description of the world". *Entwurf* maintains all the dynamic characters of something not defined but under construction: a project, outline, blueprint, and sketch. *Beschreibung* is the description and *Welt* is the world; many translations use the word universe as synonymous with the world.

Advances in mathematic research are married to challenges of sustainability in this book, with both socioeconomic/human dimensions and enhanced sustenance of ecological systems. Seminally, De Marchi and colleagues established PASSO as an example of a refined system which may be used to detail sustainability categories in a grouped approach. The different chapters and contributions in this volume represent a global effort to further refine key areas which must be taken into consideration to facilitate ongoing sustainability efforts.

There is prediction potential both for past and future systems from the combined intuition of each chapter separately and also in holistic terms. Qualitative description and quantitatively refining elements of sustainability serve the purpose of enabling an accurate multi-criteria decision making process to be formed. If one considers each chapter as a 'block' of information within the wider concept of a sustainable Earth model, accurate Ariadne threads supply the information with which we can expand and contract models for further information value on specific areas and the wider management of the Earth system, as the human population increases into the future. Forming policies with use of the tools such as Digital Earth frameworks and GIS helps to harmonize interdisciplinary methods, with use of both social (including historic) and scientific approaches. Much synergy can result from this book. We highlight the use of specific computer-aided tools and thinking; however, it is important to retain understanding of the underlying systems in order that we can program and form coding for application to all developing technological platforms and hardware. This book is essential in helping to bridge the gap between policy formation, direction, and implementation; hence, the information and combinatorial approaches are pertinent for organizational units such as international organizations and other bodies, national and regional governments as well as the general public or 'man on the street' in both developed and developing contexts. Throughout this articulated volume, there are many paths challenging the quest for sustainability around the building of cosmos of knowledge and practices combining opportunity or fate to find a balanced combination among communities, institutions, ecosystems, and technology.

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