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AJG Library 10

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Nature, Culture, and Food in Monsoon Asia

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International Perspectives in Geography

AJG Library 10

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Nature, Culture, and Food in Monsoon Asia

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Preface

Monsoon Asia is a specific region of the world where the summer rainy season is predominant—a vast area stretching from the deep tropics right up to the mid-latitudes, including Japan. Allow me to describe some personal visits to this region. I first visited Bangladesh in December 1987 after it was severely attacked by, at that time, the century's worst flood. After that flood, the Disaster Prevention Research Institute of Kyoto University organized a research team to investigate the causal mechanism of the flood. I was nominated as one of the research team members. That was my first solo experience of participating in overseas research. Time flies—more than 30 years have passed since then. I stayed for approximately 2 weeks in Dhaka, Bangladesh, and New Delhi in India, including a one-night transit stay in Bangkok both on the way to and from Bangladesh. I felt the difference between the tropics and Japan when I saw public buses being run with their doors wide open. Although my stay in these countries was short, it was marked by many precious experiences, particularly in India, to which I paid a solo visit. There I experienced a strong culture shock, a different atmosphere, which can be expressed as *fudo* in Japanese. Please refer to prologue for the meaning of this Japanese term. After that, I visited monsoon Asian countries almost every year with the total number of my visits exceeding 160 in 2018. The only countries I have not visited that are located to the east of India are Sri Lanka, Bhutan, Brunei, East Timor, and North Korea. The content of chapter "Rainfall, Floods, and Rice Production in the Ganges-Brahmaputra-Meghna River Basin" is the result of my visit to Bangladesh with Prof. Haruhisa Asada, an undergraduate student on his first visit at the time.

In 2008, I was elected as a director of the Japan Geoscience Union (JpGU), a body constituted from over 40 academic societies. At the time, the Union tried to enhance their activities, as they had just become a public interest incorporated association as defined under Japanese law. The science section under human geosciences was newly organized, and I was nominated as its board member. Needless to say, the earth is the only planet where living creatures exist. Among its creatures, the power of human beings is enormous, as can be clearly seen through global warming and the nuclear plant disaster of March 2011. Our future is highly dependent on a sustainable environment on earth. During the initial days of the

JpGU, the Union was organized by several academic societies mainly in the physical sciences. Then the question arose as to how can we develop the human geosciences, including human and social scientists, in this Union?

In the JpGU meeting held in March 2009, the Geopark session was a great success. Geopark is a geo-heritage park that possesses high value not only from the geological, geomorphological, and other natural scientific aspects but also because of its archaeological, ecological, and cultural aspects. The nomination of Geoparks started in 2008 in Japan. One of the important cultural values of Japanese Geoparks was local food. I have partaken of local food in various countries and have always experienced the wealth of the food culture in monsoon Asian countries. This led me to think of the next step as "food!" I immediately e-mailed my colleague, Prof. Hitoshi Araki, a specialist in food geography, who then introduced me to Prof. Satoshi Yokoyama. This led to a session titled *Fudo and food in monsoon Asia*, which was organized in the JpGU meeting of May 2010. The session was quite impressive, and also very pleasant. Later, we released a Japanese book entitled *Food and Fudo in Monsoon Asia* in 2012. In 2017, we organized a study group "Climate and Culture in Monsoon Asia" aiming at a deeper understanding of monsoon Asian nature and culture in the Association of Japanese Geographers (AJG). This book that you hold is the first outcome of this study group. It consists of both physical and human geographers' contributions that are indispensable for understanding *fudo*. Although the regions and topics targeted are somewhat limited to only part of the diversity that exists, I believe the fascination of monsoon Asia can still be felt in this book. We hope this book will be a cue to learning more about the region. Visit monsoon Asia, and discover its uniqueness for yourself!

Finally, we thank the editorial committee members of the International Perspectives in Geography: AJG Library, in AJG who reviewed the contents of this book.

Tokyo, Japan

Jun Matsumoto
On behalf of editors

Prologue

The Nature and Culture of Food: *Fudo* in Monsoon Asia

Keywords food, *fudo*, Monsoon Asia, nature, agriculture

The enormous Asian monsoon has formed diverse climates and environments. The Asian monsoon manifests itself in myriad ways, not only as a result of different latitudes and altitudes but also because of factors such as the distance of a place from the sea, its location relative to a mountain range, topology and vegetation, and the size of the population. Given such environments, the lifestyles of people in Monsoon Asia also differ.

Introduction

Travel around Monsoon Asia. Experience its moist winds and clouds. See vivid sceneries and landscapes. Also see the lives of people in rich natural environments. The authors of this book share these passions. We seek to convey our fascination for Monsoon Asia from the perspective of each of our own specialties. Broadly speaking, our specialties can be grouped under the discipline of geography or human geoscience. Yet, in terms of specifics, they are wide-ranging and disparate. In short, the researchers are participating in fields subsumed under both the humanities and the sciences, and for which connections between "cultural anthropology" and "teleconnection" seem difficult to make at first glance. However, there is something that we share in common: Monsoon Asia, a large and alluring research theme. Even though research areas and methods differ, all of us share the same excitement in exploring Monsoon Asia. We wish to share this excitement, together with the results of case studies steeped in the traditions of fieldwork.

In this Preface, I explain the keywords that tie together each separate chapter, at the same time presenting the theme, aim, theoretical background, and framework of

this book. Each chapter stands on its own and presents an aspect of Monsoon Asia and its appeal. If you keep in mind the themes running throughout each chapter, however, you will be able to have a greater appreciation of the fascination of each chapter. At the same time, you will deepen your understanding of a broader way of thinking about human beings and the environment as revealed through multiple chapters. These themes are (1) the geographic area of Monsoon Asia, (2) food as a perspective, and (3) *fudo*[1] as the preeminent framework for understanding humans and the environment.

Why Monsoon Asia, why "food," and why *fudo*? Each of these ideas has its own meaning, which I wish to explain as simply as possible, although it is necessary to touch upon their conceptual underpinnings. First, we can turn to Monsoon Asia.

The Asian Monsoon and Monsoon Asia

Here I wish to describe the boundaries of Monsoon Asia introduced in this book. In short, Monsoon Asia is the region under the influence of the Asian monsoon. This may seem somewhat like an answer to a *Zen koan (Zen question for meditation)*. This book does not examine the whole of Asia, nor does it seek to debate what is meant by "Asia". The region under discussion here is the region under the influence of the monsoon. A monsoon is a vast land and sea wind that arises between a continent and an ocean on a yearly cycle. The Asian monsoon examined here covers an extremely broad region.

The continent affected by the Asian monsoon, the Eurasian continent, warms easily and cools easily. In contrast, it is difficult for the bordering oceans (Pacific Ocean and Indian Ocean) to warm up or cool down. Owing to the temperature difference between the continent and the oceans, moisture-laden winds blow from the sea to the continent in the summer, and in the winter wind blows from the continent to the oceans. Winds crossing the ocean run into mountains and form clouds, causing rain to fall. Monsoon from the Indian Ocean flows into the Indian subcontinent and hits the peaks of the great Himalayan massif. Furthermore, it travels beyond to Southeast Asia, and then reaches the Japanese archipelago. This giant agglomeration of winds and clouds and rains is the Asian monsoon, and the region experiencing the effects of these forces. As you can easily imagine, Monsoon Asia's vast boundaries mean that when it is used as a single term Monsoon Asia encompasses extreme diversity.

[1]Regarding the idea of *fudo*, Watsuji Tetsuro's *Fudo* may be the most well-known academic work for Western readers. It gained wide readership with its English translation, Climate and Culture: A Philosophical Study. However, for the Japanese people, *fudo* is not an academic term but an everyday word. There is no academic definition. For example, we Japanese say "*Fudo ga kotonaru* (the *fudo* is different)" to mean "a different locality". In addition, medieval gazetteers of Japanese regions were called *fudoki* (records of *fudo*). The authors would like to use the word *fudo* in its popular sense. The significance of our approach in using this word is expounded in the third section of this chapter.

As expected, the giant Asian monsoon has formed diverse climates and natural environments. As mentioned at the start of the Preface, the monsoon manifests itself in different ways depending not just on the latitude or altitude of an area but also on its distance from the coast, location relative to mountain ranges, topology and vegetation, and the size of its human population. Likewise, the lifestyles of people living in Monsoon Asia are not uniform. For example, Japan, the country in which the authors of this book live, is enveloped by a rainy season front as a result of the monsoon. This front lies at the northeastern edge of the Asian Monsoon, whose southern edge drenches the Indian subcontinent with its assemblage of clouds and winds.

The boundaries of the monsoon span about 50 degrees latitudinally and about 100 degrees longitudinally. Its area extends from the subarctic region, which includes the snow-heavy Hokkaido and Tohoku regions in Japan, to the tropical and subtropical regions, which encompass Southeast Asia and India. The temperate and subarctic regions further include mountainous islands like Japan as well as vast expanses like the North China Plain. Similarly, the tropic and subtropical regions include a variety of small and large islands extending from Taiwan to the Philippines and the Greater Sunda Islands, mountains in the Annamite Range from Yunnan, the Indochina peninsula composed of great plains in which major rivers such as the Mekong and Chao Phraya flow, and, furthermore, the Malay peninsula, which extends from the continent. Shifting our gaze to South Asia, we see the Deccan Plateau at an elevation of 500 meters and the Indo-Gangetic Plain, through which the Ganges River flows. Further in the distance stand the Himalaya Mountains. This is Monsoon Asia, which has rich diversity not just in terms of climate but also topology. It truly includes mountains, valleys, and oceans.

If we zoom in on the diversity woven by this climate and topology, we see more refined details. Even if two different persons live in the same climate zone, or on the same latitude, the effects of the monsoon they experience are not the same. In the vast Asian monsoon, it can be said that latitude, elevation, and topology form a mosaic, and this mosaic blankets the whole vast area of Monsoon Asia.

I think you now have an idea of the diversity of the natural environments in Monsoon Asia. It would be easy then to also imagine that the people living in such manifold natural environments would naturally have diverse lifestyles. However, we must not simply think that because the natural environment is diverse the lifestyles of people are also naturally diverse. This is the reason we use the word *fudo*.

Fudo: The Relationship Between the Natural Environment and Human Beings

Underlying our use of the word *fudo* is the sense of the limits of conventional human and environmental studies, which see people's lifestyles and activities as diverse simply because natural environments are diverse. Of course, we do not deny the fact that lifestyles and activities are significantly affected by the natural

environment. However, we do not want our thinking to be confined by this framework. We believe that there should be a little more flexibility. To avoid misunderstanding, I would like to add a little more explanation here.

An example illustrates what I mean about conventional human and environmental studies. It is well recognized that people living near the sea consume foods gathered from the sea, and people living near the mountains eat foods gathered from the mountains. Similarly, it is widely recognized that in Japan, where rice is grown, rice wine (*sake*) is brewed, and in Europe, where wheat is grown, wheat liquor (whiskey and beer) is produced. In short, it is believed that the activities of human beings are influenced by the natural environment in which they live. This notion is simple and easy to understand. Certainly, people lead lives affected by the natural environment, and this awareness is probably the basis for conventional human and environmental studies. However, in accepting such an interpretation we may lose sight of more fascinating aspects of the human-environment relationship.

To speak in more concrete terms, can the conventional notion comprehend the lifestyles of people living in Monsoon Asia? For example, traditional Okinawan cuisine makes heavy use of kelp. However, kelp is not harvested in Okinawa. As is well known, Hokkaido, the northernmost region of Japan, is a leading region of kelp production in the country. Behind this development was trade between Japan and continental Asia during Japan's early modern period (seventeenth to eighteenth centuries) and the connections forged as a result with Okinawan traders. The Okinawan people thus came to use kelp, which was not grown in their own region, as a part of their cuisine.

Fig. 1 shows traditional homes in Guangzhou. While not unusual for Chinese-style homes, they are located in subtropical Guangzhou, which experiences average summer highs of over 30 ºC and monthly rainfall of nearly 300 millimeters. There are homes similar to those in cold regions of China. It cannot be said that

Fig. 1 Traditional homes in Guangzhou

such homes, made of bricks and having few openings, are suited to the subtropical environment. Actually, minority ethnic groups in the South China region, such as the Zhuang people, live in wooden houses with large openings. The appearance of domiciles similar in form to those in North China is due to the immigration of the Han people from that region a long time ago. They have maintained an uninterrupted tie to their own housing and settlement forms. While emphasizing their own identity as the Han people more than building homes suited to their new environment, they have engaged with the natural environment in South China for several hundred years now.

What should we think about such an aspect of the human-environment relationship? It cannot be sufficiently explained by the conventional conception in Fig. 2a. Instead, do we not need a perspective similar to that depicted in Fig. 2b or, as shown in Fig. 2c, should we not assume that culture and traditions underlie how people accept the natural environment and their responses to it? Human beings do not just accept conditions of the natural environment unilaterally. Instead, they are involved in the natural environment as they assert themselves. In the context of Monsoon Asia, it means that interpreting the diversity of activities of the people living in the region as an expression of the diversity of Monsoon Asia's natural environment is insufficient. The diversity of the natural environment is certainly important. However, it is also necessary to pay attention to the human perspective in terms of the various ways people perceive the natural environment.

To put it in slightly more extreme terms, people's lifestyles, specifically involving the necessities of life, are expressed differently even in the same natural

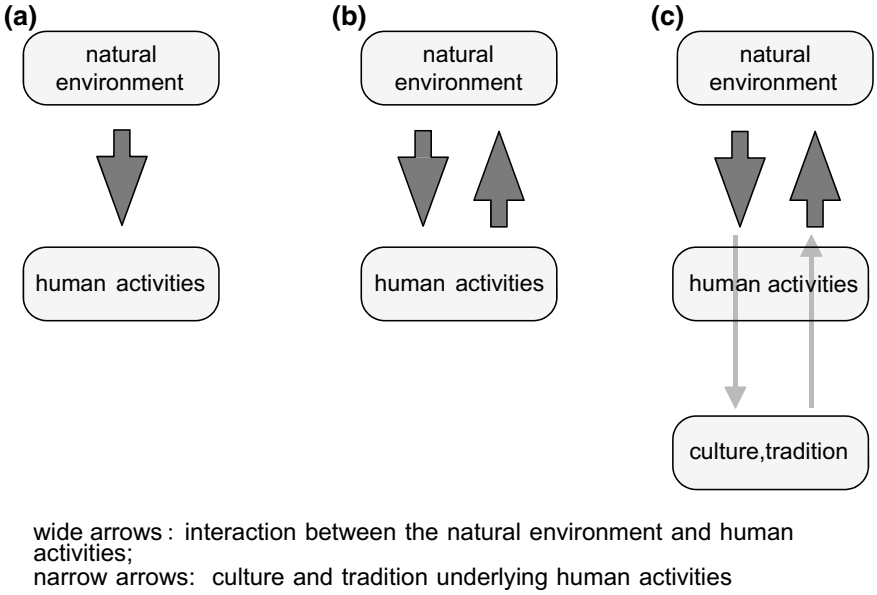

Fig. 2 Human-environment relationship

environment as a result of differences in their philosophy of how to confront the natural environment, in their social ideals, and in their traditional and cultural backgrounds. Lifestyles are not the same even if the natural environment is the same. I wish to pay attention to this aspect and particularly to aspects that tend to be overlooked because of the notion that the natural environment determines people's lifestyles. As a framework for this purpose, in this book, we employ the term *fudo*, which has a slightly different meaning than the idea of "natural environment".

I would like to point out what would become possible by adopting this perspective. In a word, we could rethink our conception of the human-environment relationship and stereotypes about the natural environment. Let us look at Monsoon Asia as an example. We were taught in school that rice is grown in southern China, which experiences high temperatures and heavy rainfall, whereas wheat is grown in cool northern China, and, furthermore, that sorghum is grown in the northeast region of China, where the climate is also cool. However, northeast China has become a vast region for growing rice, an originally tropical crop. To understand this trend, a thorough examination of human agency is needed in place of a simple deterministic interpretation of the environment. A comprehensive perspective makes it possible to directly review such conventional interpretations.

Moreover, *Fudo* affords us a slightly larger perspective. This is extremely important when considering current global environmental issues. Natural disasters of similar scale are a case in point. Earthquakes of the same intensity may cause great damage in one place but little damage in another. Or a drought may cause great agricultural damage in one place, while another place may not experience damage to the same degree. It is readily understandable that the extent of damage depends greatly on how well homes (traditional or modern) withstand earthquakes, as well as the location of settlements, crop planting methods, crop planting periods, etc. Not only is it the case that the same environment does not cause the same results (damage), but the same environment also brings about different results (the damage may be slightly less). An approach that transcends different research fields like the humanities and the sciences is needed to grasp this framework.

Furthermore, this perspective can examine not only environmental issues but also our lives today. Earlier I presented the example of northern Chinese-style houses in a wet, subtropical environment. This may seem to you to be an unusual case, but think about it. In developed countries like Japan, our surroundings are filled with square concrete buildings with almost no openings. This architectural style was originally developed for living in a cold climate and is certainly not suited for warm and humid regions. Yet this style of building is just as likely to be found in the tropical regions of Asia and Africa as it is in the temperate and subarctic regions of the world. In hot regions, air conditioning in every room is essential for operating such buildings. Nevertheless, despite the cost, square buildings line up side-by-side in cities around the world.

In the same vein, how many Japanese people live in traditional Japanese-style houses today? Would many of you not prefer to live in completely air-conditioned steel-and-concrete buildings or in two-by-four houses with few openings? Why has this Western-style housing become widely adopted in hot and humid Japan? The

concept shown in Fig. 2a certainly cannot provide the answer. Of course, the same can be said of other cases besides housing. Wearing a suit and necktie, a custom originally adopted in cold-climate regions, is now characteristic of businessmen worldwide. No matter how hot it is, business discussions will not begin until the participants appear with stifling neckties.

The natural environment is an extremely important factor, and we should not underestimate it. However, by adding the perspective of how people living in the environment encounter it based on their thoughts, we have more nuance and flexibility and can obtain a more robust and comprehensive framework. This belief is encapsulated in the word *fudo*.

Food: Agriculture, Processing, Cooking, and Eating

First, what I would like you to keep in mind is that the word "food" here does not simply include foodstuffs, but also comprehensively embraces agriculture that produces the foodstuffs, the processes of preparation and cooking, and the act of consuming (Fig. 3). Originally, the series of actions such as farming, processing, cooking, and eating was not separated or fragmented. It may be called living. However, in our lives today, agricultural work and eating have become completely severed. When we consider the idea of food, we basically pay attention to the act of eating, and are indifferent to preparation and cooking, not to mention the production (agriculture) of ingredients that become foods. Actually, does every reader know where the foods they ate yesterday came from, or where they were processed and cooked? For most of us, this question is impossible to answer. However, when looking at the mutual relationships between the natural environment and human activities, the acts of eating, processing, and cooking, and, in the first place, that of creating foodstuffs (agriculture) and acquiring foodstuffs (hunting, fishing, gathering) cannot be separated.

The following is our conceptual scheme when focusing on food. The geosciences (including human geoscience) with which we are associated to a certain extent can be expected to contribute to addressing problems such as earthquake prediction and environmental issues, and there is great interest in those areas. On the other hand, interest in the connections between the geosciences and the problem

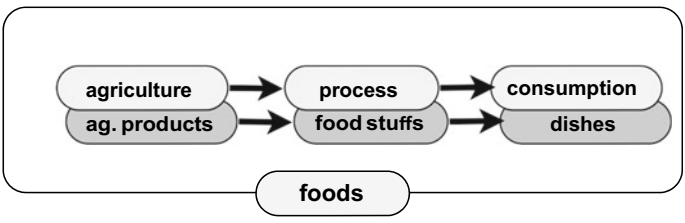

Fig. 3 The idea of food

of food is not very high. However, because food cannot be obtained by humans from any method other than by interacting with nature, the problem of food, like the problems of natural disasters and the environment, should be considered one of the major themes of the geosciences. Thus, we wish to examine food as a part of the domain of the geosciences, especially human geoscience.

In doing so, as described in the section above on *fudo*, this topic should not be approached from separate geoscience disciplines such as climate science, topology, or remote sensing. Instead, attention should also be paid to agriculture, the intermediary between human spheres and foods, and to how foods are consumed, including their socioeconomic and cultural implications. The approaches of the humanities and social sciences and their research findings should provide effective perspectives. Both the humanities and sciences have the necessary accumulation of research data. Now is the time to transcend our longstanding academic disconnections.

The Composition of This Book

I have explained our intentions in considering *fudo* and "food". Now, how are *fudo* and "food" combined? This is shown in Fig. 4. The influence of the natural environment on people is expressed by downward arrows, and the influence of people on the natural environment is expressed by upward arrows. The conditions given by the natural environment and the actions, lifestyles, and activities adopted by humans in the context of their own ideas, sociocultural background, and traditions are not uniform. Because of differences in the way people face the same natural environment, the lifestyles developed by the people in Monsoon Asia are

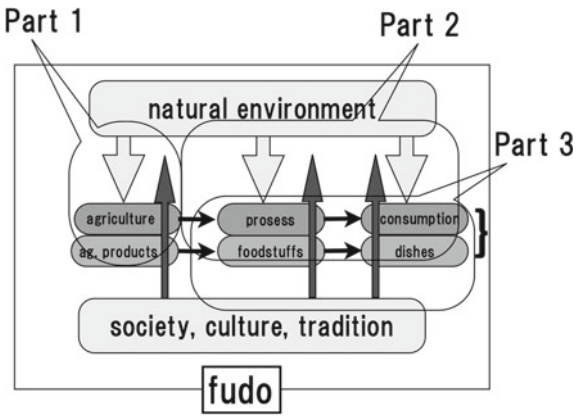

Fig. 4 *Fudo* and "food"

diverse, and their diversity widens further if the natural environment differs. The series of systems associated with food, from agricultural (ingredients) production to processing, cooking, and eating, are the concrete forms of the diversity examined in this book. The prevailing view is that the effects of the natural environment on agriculture are greater than the effects of the actions of cooking, processing food, or eating. Conversely, when it comes to the behavior of eating, it is easy to assume that the expression of sociocultural or traditional (historical) values makes up a greater component than the natural environment. However, even in agricultural production sites, the effects of society and culture cannot be ignored. It is also true that the actions of cooking, processing food, or eating are influenced by the natural environment.

The following chapters present what we experienced in the actual field of Monsoon Asia in this framework (Table 1 and Fig. 5). The book consists of three parts, Nature and Agriculture, Food and Regionality and Society and Culture. The chapters are composed of diverse perspectives from diverse authors: researchers who manipulate advanced measurement technologies, who have broad observation networks or human networks, who have local yet refined data, who gather their own data by living long term in the field, who converse repeatedly with local people; researchers who lived in the heart of the Himalayas for their fieldwork, in the severe

Table 1 Composition of this book

Monsoon Asia					
	South Asia		Southeast Asia		East Asia
Part: Nature and Agriculture	Chapter "Rainfall, Floods, and Rice Production in the Ganges-Brahmaputra-Meghna River Basin" Matsumoto and Asada	Chapter "Cultivation of Glutinous Rice in Northeast India, and Its Food Products" Asada	Chapter "Global Warming and Agricultural Production in Asia" Nishimori	Chapter "Fog and People in Xishuangbanna, Yunnan Province, China" Nomoto and Yokoyama	
Part: Food and Regionality			Chapter "*Natto* in Mainland Southeast Asia" Yokoyama		Chapter "Yamato-Shijimi and Environmental Changes in Lake Jusanko, Northern Japan, Over the Past Several Thousand Years" Koiwa

(continued)

Table 1 (continued)

Monsoon Asia					
					Chapter "Distribution of Traditional Seafood Dishes and Their Background in Miyazaki Prefecture, South Japan" Nakamura
Part: Society and Culture	Chapter "Nepalese Food and Its Sociocultural Climate: Changing *Dāl-bhāt* Inside and Beyond Nepal" Morimoto Chapter "Contesting Values of Brewing "*Chang*" in a National Park of Bhutan" Miyamoto		Chapter "Dietary Habits and Kitchens of the Sundanese in West Java Villages" Endo		Chapter "Satsuma *Shochu* and Geographic Indication" Motoki Chapter "Creating a New Relationship with the Environment Through Food: Learning from Community Development Initiatives in Kaneyama Township in Yamagata Prefecture, Northeast Japan" Sasaki

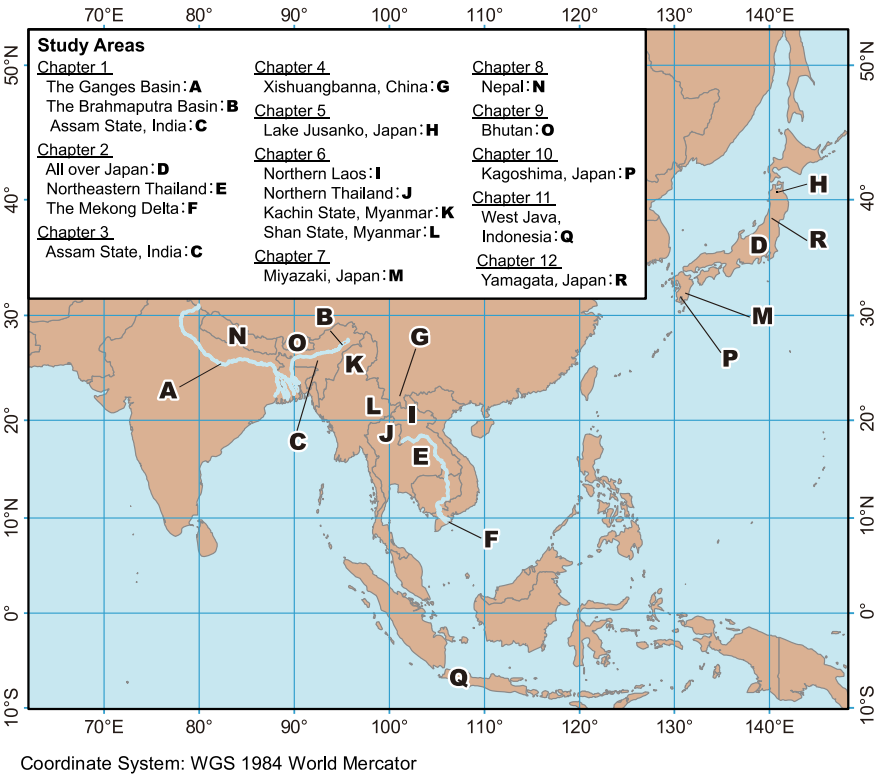

Fig. 5 Study areas

rainy and dry seasons of South Asia, on the banks of major rivers in Southeast Asia, on the islands in the western Pacific, and in East Asia with its four distinct seasons. While many things, such as our research areas, methods, and regions of focus, are not the same, there are many more things we have in common. Just as the Asian monsoon, which manifests itself in diverse ways in different areas, is one immense atmospheric phenomenon, our research is also connected by the winds and clouds of the Asian monsoon. I may be presenting a scheme that is too big (or too ambitious). However, Monsoon Asia has its full share of allure. I hope we can share the fascination of Monsoon Asia with you.

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Abbreviations

AJG	Association of Japanese Geographers
AMS	Accelerator Mass Spectrometry
GATT	General Agreement on Tariffs and Trade
GPCC	Global Precipitation Climatology Centre
HYV	High-Yield Variety
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied Petroleum Gas
NPO	Non-Profit Organization
WTO	World Trade Organization

Nature and Agriculture

Rainfall, Floods, and Rice Production in the Ganges-Brahmaputra-Meghna River Basin

Jun Matsumoto and Haruhisa Asada

Abstract The regional characteristics of the relationship between summer monsoon rainfall variability and rice production within the Ganges-Brahmaputra-Meghna River Basin, and those between flood-affected area variability and rice production in Bangladesh are examined for the period from 1961 to 2000 and 1947 to 2010, respectively. In the relatively dry upper Ganges River Basin, local rainfall and rice production were positively correlated. On the other hand, in the lower river basin the positive correlation was not clear and flood influences were dominant. In Bangladesh, a clear relationship has been observed between severe floods and rice production. The production of the dry season rice (*Boro*) gradually increased after the mid-1960s, in particular after years of severe flooding. After the severe flood of 1998, the production of *Boro* exceeded that in the rainy season for the first time, and the difference in production between these two varieties has increased since then. As such, rice production in Bangladesh has increased almost continuously in the late 20th century, even with recent frequent severe flood damage during rainy seasons, implying farmers' adaptation to the recent climate changes.

Keywords Rice cultivation · Climate change · Monsoon · Flood · High-yield variety

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1 Introduction

Rice is the most widely produced and consumed food in monsoon Asia. According to the statistics for 2014 released by the Food and Agriculture Organization (2017), nine of the top ten rice-producing countries shown in Table 1 are located in monsoon Asia. The only country not in this region is the ninth-ranked Brazil.

In addition to India and Bangladesh, which are among the top ten countries, South Asia also has producers such as Pakistan (13th), Nepal (17th), and Sri Lanka (20th). It accounts for approximately 30% of world rice production, and occupies an important position in the world rice market.

Within South Asia, the Ganges-Brahmaputra-Meghna River Basin is one of the major rice-producing regions. Here, the abundant rainfall due to the wet summer monsoon flow from the Bay of Bengal and fertile soil—over flat land—transported from the Himalayan Mountains provides an ideal environment for rice cultivation. Owing to the high agricultural productivity in such a well-endowed natural environment, a number of states have flourished in this area since ancient times, and have played a central role in the history of South Asia.

The summer monsoon not only supplies the indispensable water for rice cultivation but also causes serious damage to rice production in monsoon Asia because of its large inter-annual variability. When rainfall is too high, it causes floods,

Table 1 Country rank of annual rice production in 2014 (FAO 2017)

Rank	Country	Production (t)
1	China	208,239,610
2	India	157,200,000
3	Indonesia	70,846,465
4	Bangladesh	52,325,620
5	Vietnam	44,974,206
6	Thailand	32,620,160
7	Myanmar	26,423,300
8	Philippines	18,967,826
9	Brazil	12,175,602
10	Japan	10,549,000
11	United States	10,079,500
12	Cambodia	9,324,000
13	Pakistan	7,002,832
14	Nigeria	6,734,000
15	Republic of Korea	5,637,682
16	Egypt	5,467,392
17	Nepal	5,047,047
18	Lao People's Democratic Republic	4,002,425
19	Madagascar	3,977,863
20	Sri Lanka	3,381,000

whereas severe droughts occur when it is scanty. In India especially, the impact of less monsoon rainfall on rice production is more apparent than in other monsoon Asian countries (Gadgil and Rupa Kumar 2006). The stabilization of rice production that is vulnerable to fluctuations in summer monsoon rainfall is a big challenge for Indian agriculture. According to Yoshino (1999), this region is affected more prominently by the El Niño and La Niña than is East and/or Southeast Asia. In addition, changes in rice production in the future due to the ongoing global warming are a matter of great concern to society as a whole.

A number of previous studies have revealed a clear relationship with positive correlation between the summer monsoon rainfall and rice production in South Asia as shown by Gadgil and Rupa Kumar (2006). By using statistical analysis or numerical simulation, these studies have not only provided a deeper understanding of the past relationship between summer monsoon rainfall and rice production (e.g., Selvaraju 2003; Krishna Kumar et al. 2004) but have also predicted rice production due to future climate changes (e.g., Mall et al. 2006).

The state-of-the-art knowledge obtained by climatological studies on, for example, the impact of El Niño and La Niña, and the effect of intra-seasonal variability has been applied; however, most of the past studies have taken a macroscopic view and dealt with phenomena either at the scale of the county ($\sim$1000 km) and/or at the scale of the state ($\sim$100 km). Few studies have revealed detailed regional characteristics using a local scale. Asada et al. (2005) and Matsumoto and Asada (2011) analyzed the detailed regional effect of the summer monsoon rainfall and floods on rice production in Bangladesh. Asada and Matsumoto (2009) further expanded the study region into the whole Ganges-Brahmaputra River basin in India and Bangladesh. As not only the climatic characteristics but also the rice cultivation system or cultivation technology differ across regions, it is necessary to properly evaluate the impact of climate changes and provide adequate counteractions based on these regional characteristics.

Therefore, we present in this chapter the regional characteristics of the relationship between summer monsoon rainfall variability and rice production within the Ganges-Brahmaputra-Meghna River Basin in Indian and Bangladesh (Fig. 1).

2 Rainfall Variability and Rice Production

The relationship between the summer monsoon rainfall variability and rice production in a certain region can be presented by studying the correlation between these variables. A positive correlation indicates that, when rainfall is less, the rice production in that region will drop. It also indicates that the region is prone to drought damages. A negative correlation indicates that the region is flood-prone.

When we investigate the relationship between the summer monsoon rainfall and wet-season rice (*kharif* rice) production in the Ganges-Brahmaputra-Meghna River Basin from 1961 to 2000 at a district level, the correlation coefficient values are seen to vary, and large regional differences are found (Fig. 2a). A pronounced

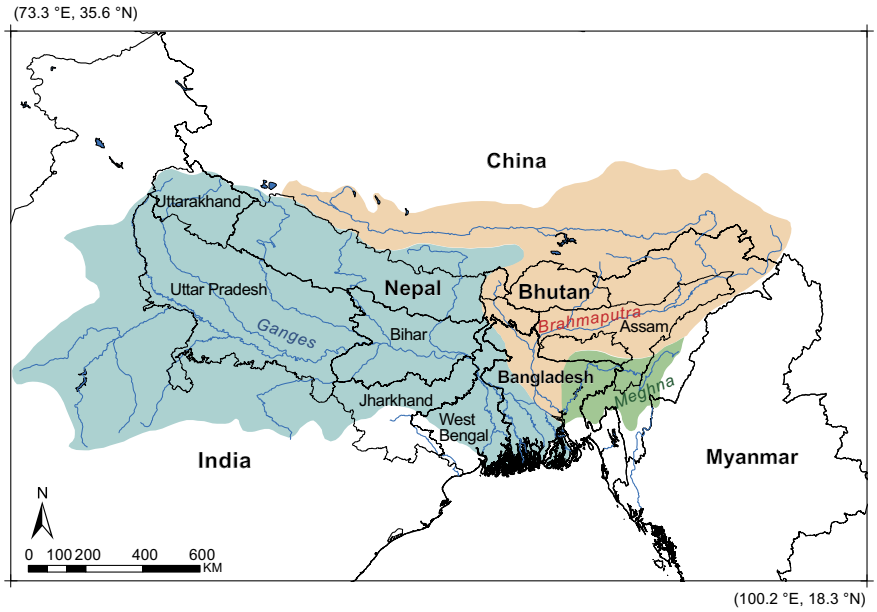

Fig. 1 A map of the Ganges-Brahmaputra-Meghna River Basin. *Note* River basin boundaries are based on Fig. 1 in Mirza (2002)

difference is found from the state of Uttar Pradesh to the state of Bihar in the upper Ganges River, where a positive correlation is predominant, indicating that these regions are highly drought-prone. On the other hand, correlation coefficient values are very low for the state of West Bengal in India, Bangladesh, and over the Indian state of Assam in the lower Ganges and Brahmaputra river basin, showing that drought impacts are not pronounced, although flood influences are high over there. Furthermore, when calculating the correlation coefficient between the summer monsoon rainfall variations and rice acreage, a statistically significant negative correlation is found in the northwestern part of Bangladesh around the lower Ganges River, implying the possibility of flood impacts on rice cultivation (Fig. 2b).

In previous country-scale studies, it has been confirmed that rice production in South Asia is strongly affected by the inter-annual variations of summer monsoon rainfall. A simple relationship is emphasized. Thus, when the rainfall increases, the rice production also increases and a fall in rainfall leads to a decline in production (e.g., Parthasarathy et al. 1992). In fact, given that a semi-arid climate is prevalent in South Asia and rain-fed rice cultivation is still dominant, this simple relationship may hold true at a macro level. However, this relationship may not hold when the investigation is carried out at the district level; in fact, even the opposite relationship may be observed, such as in the lower Ganges River (Asada and Matsumoto 2009).

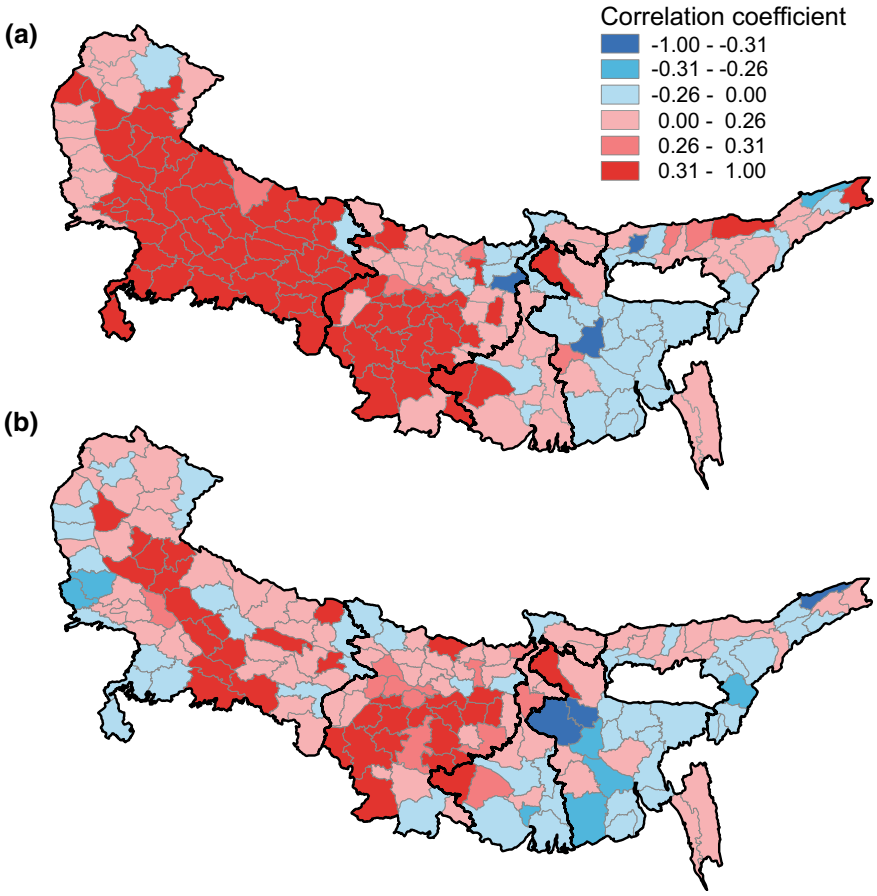

Fig. 2 Correlation coefficient between summer monsoon rainfall and rice production **a** and rice cultivation area **b** in the Ganges-Brahmaputra River Basin for the period 1961–2000 (Adapted from Asada and Matsumoto 2009) *Note* Rainfall data are based on a 0.5 × 0.5° gridded dataset from the Variability Analysis of Surface Climate Observations (VASClimO) in the Global Precipitation Climatology Centre (GPCC) (Beck et al. 2005; Schneider et al. 2014). Rice production and cultivated area data at state and district level were obtained from the yearly agricultural bulletins "Agricultural Situation in India," Department of Agriculture, Government of India, and the "Yearbook of Agricultural Statistics of Bangladesh."

As for the factors related to such regional diversity we should consider not only regional climate differences but also regional variety of the rice cultivation system. From the climatic point of view, the Brahmaputra River Basin in the east is located within a wetter climate, whereas the Ganges River Basin has a relatively dry savanna climate; as one moves westward, the climate becomes drier and the drought risk also increases. Similarly, the rice cultivation system also varies. Rice is cultivated only once in the rainy summer season and wheat is produced in the dry

winter season in the upper Ganges River Basin. As the duration of the summer monsoon season is also short here, the scanty monsoon rainfall directly influences the annual one-time rice production. On the other hand, because rice cultivation is possible twice in the rainy season—as will be described later—in the Brahmaputra River Basin, the drought risk can be weakened because of the longer cultivation period available. Further, the availability of river water is also higher, as it is located in the lower part of large river basins. However, rice cultivation in the low-deltaic flood plains in the lower river basin may add the risk of floods.

To discuss the future climate change impacts and consider countermeasures, not only the regional differences in the relationship between past rainfall variability and rice production need to be examined, but also the historical changes in such relationships. Therefore, we investigated how the correlation between rainfall variability and rice production has changed during the 40 years since 1961 at the district level and found the following regional differences in the historical changes in the relationship with rainfall variability (Fig. 3).

First, the positive correlation becomes weaker in the drought-prone upper Ganges region. Here, rice production has become more stable and the drought effect has gradually decreased. On the other hand, flood influence has become larger in the lower Ganges region, and the drought effect has been increasing in the upper Brahmaputra region. In these regions, rice production has become more unstable because of climate changes. Such regional differences may partly be due to the

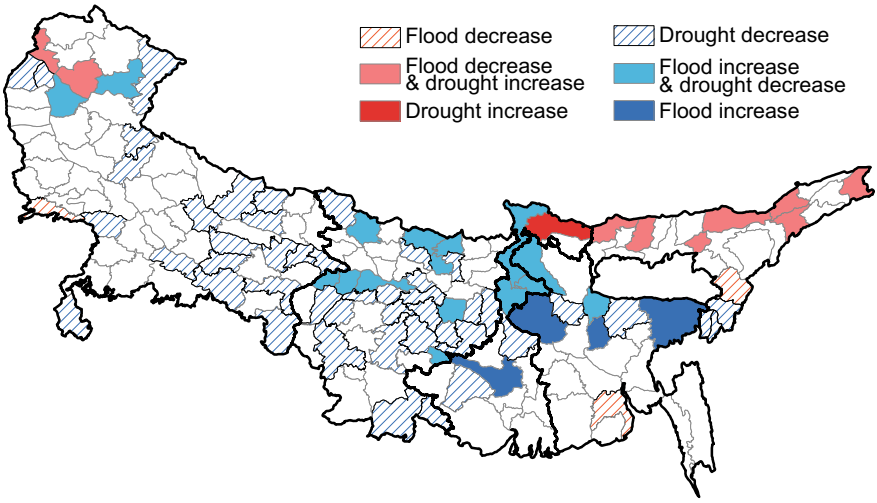

Fig. 3 Trend patterns of the correlation between the summer monsoon rainfall and wet-season rice production by district-based data in the Ganges-Brahmaputra River Basin from 1961 to 2000 (Reproduced from Asada and Matsumoto 2009) *Note* The temporal correlation between rice production and summer monsoon rainfall was examined by using seven-year moving correlation. The districts with significant temporal trends in the correlation coefficient at the 5% level, examined by Mann-Kendall rank statistics (Kendall 1938), are plotted

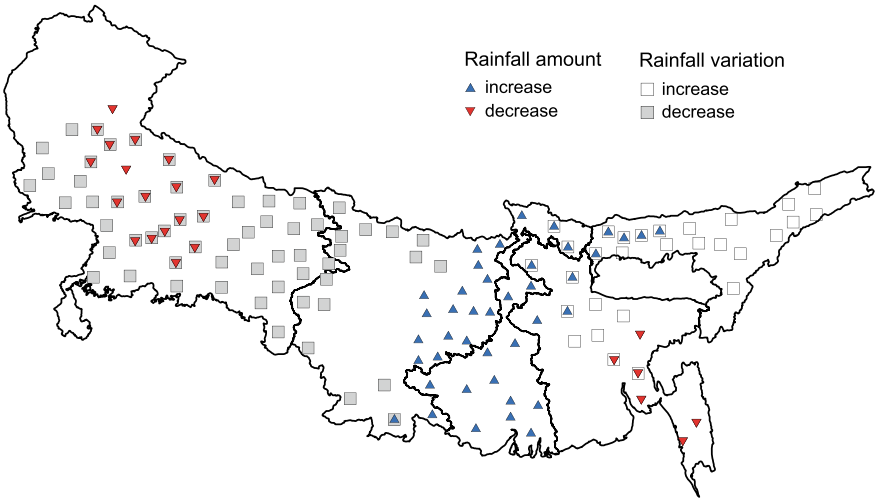

Fig. 4 Trends of rainfall amount and rainfall variation during the summer monsoon in Bangladesh and four Indian states for the period 1961–2000 (Reproduced from Asada and Matsumoto 2009)

change in rainfall patterns (Fig. 4). For example, in the upper Ganges region, the coefficient of rainfall variance has become smaller, indicating a more stable rainfall pattern. On the other hand, in the lower Ganges region, rainfall has increased and may partly be responsible for the more frequent floods. In the next section, more detailed year-to-year changes in Bangladesh will be examined.

3 Floods and Rice Cultivation System in Bangladesh

Bangladesh is located at the confluence of the Ganges, flowing in from the west, the Brahmaputra, from the northeast, and the Meghna, also flowing in from beyond its national border in the east (Fig. 1). Most of its territory is located in the low-lying floodplains that are less than 30 m above sea level. All the rainfall that falls in the upper catchments of these river basins converges in this county before flowing into the Bay of Bengal and inundating wide stretches of the country (Matsumoto et al. 2009).

The traditional rice cultivation pattern in such flood-prone regions in Bangladesh is different from that in the upper Ganges region, which cultivates rice only once a year. They have three major rice seasons: *Aus* rice from April to July, *Aman* rice from August to December, and *Boro* rice (*Rabi* rice) from December to May. In the preceding section, it was inferred that flood damage has increased in the rice-producing areas in Bangladesh. Further evidence is the recent increasing trend of flood damaged areas there (Fig. 5); in particular, severe floods have occurred in

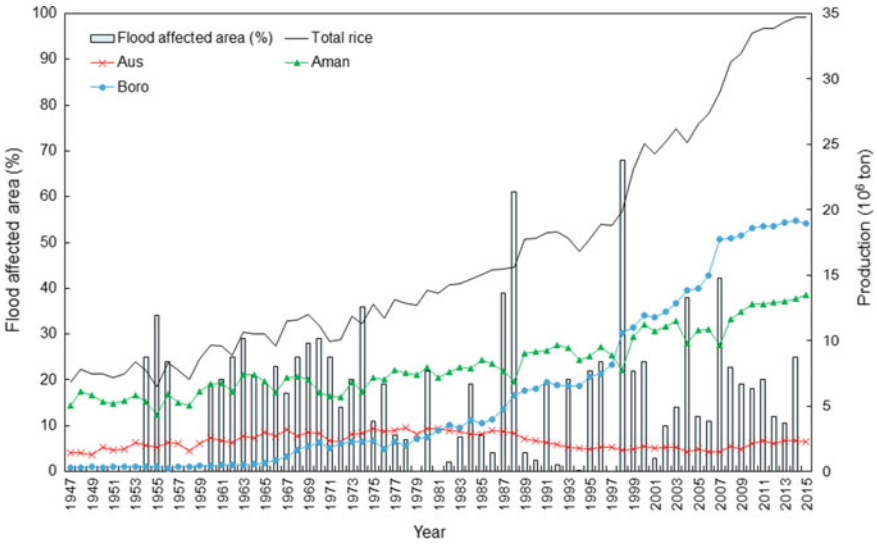

Fig. 5 The inter-annual variations in rice production for the annual total (solid line), each seasonal rice variety (solid line with symbols), and flood-affected area (bar) in Bangladesh from 1947 to 2015

this country in 1987 (39% of the country was affected), 1988 (61% affected), 1998 (68% affected), and 2007 (42% affected). The trend of severe flood occurrences seems to be more pronounced after the 1980s. Since the 1980s, the occurrence frequency of medium-scale floods has decreased, whereas both large- and small-scale floods have increased. Thus, the year-to-year variability in flooding has become larger. This tendency is partly due to the increase in rainfall, and also due to the rapid development of river embankments on a large scale; these factors may be able to provide protection during medium-scale floods, but once severe floods occur, their depletion or break may cause more severe damage, and/or sometimes even prevent drainage (Uchida and Ando 2003).

It is widely believed that, when a severe flood occurs, rice production falls because of heavy damages. However, it is surprising that annual rice production in Bangladesh during years of severe floods—especially in 1988, 1998, and 2007—did not decrease, and even increased dramatically in the following year (Fig. 5). The reason for this peculiar phenomenon may be the traditional rice cultivation system practiced in Bangladesh. In years of severe flood, the wet-season *Aman* rice cannot be planted, and both its acreage and production decrease. However, in the dry season that follows, *Boro* rice production increases greatly and compensates for the damage during the wet season. Furthermore, in the year after the severe flood, *Boro* rice production continues to remain high, and *Aman* rice production returns to the level seen in normal years; thus, the overall annual production is higher.

Although the frequency of severe floods has recently increased in Bangladesh, its annual rice production has not decreased, and has even rapidly increased in the

year after a severe flood. To understand the underlying processes, we will further investigate the inter-annual variations in the wet- and dry-season rice acreage.

The rice varieties planted include a sub-variety of the wet-season *Aman* rice, a transplanted local variety, a direct-seeding local variety, and a high-yield variety (HYV) developed after the so-called Green Revolution. Each sub-variety has a suitable elevation of paddy, and gives a different yield. As a long-term trend, the acreage of the two local varieties that attain lower yield is decreasing, while that of the HYV has been increasing (Fig. 6). When we studied the severe flood years in detail, a dramatic decrease and increase in the acreage of local varieties was observed. By the severe flood year of 1988, the direct-seeding local variety (broadcast *Aman*) had the higher acreage. However, after 1998, the HYV, which is planted on higher land, had become the dominant variety.

The dry-season *Boro* rice also has local and HYV sub-varieties. Traditionally, remnant water in the lowlands has been utilized for dry-season rice cultivation, while the acreage of HYV has gradually increased with the use of irrigation pumps and tube wells. Rapid increases in HYV *Boro* rice acreage are clearly seen after the very severe floods of 1988 and 1998. Furthermore, while the increase in the acreage of HYV *Boro* rice is almost proportional to that in irrigated areas, it has increased more in these flood years (Fig. 7). This may be due to the increase in remnant water areas after the severe flood and the fact that HYV *Boro* rice can be planted even without irrigation.

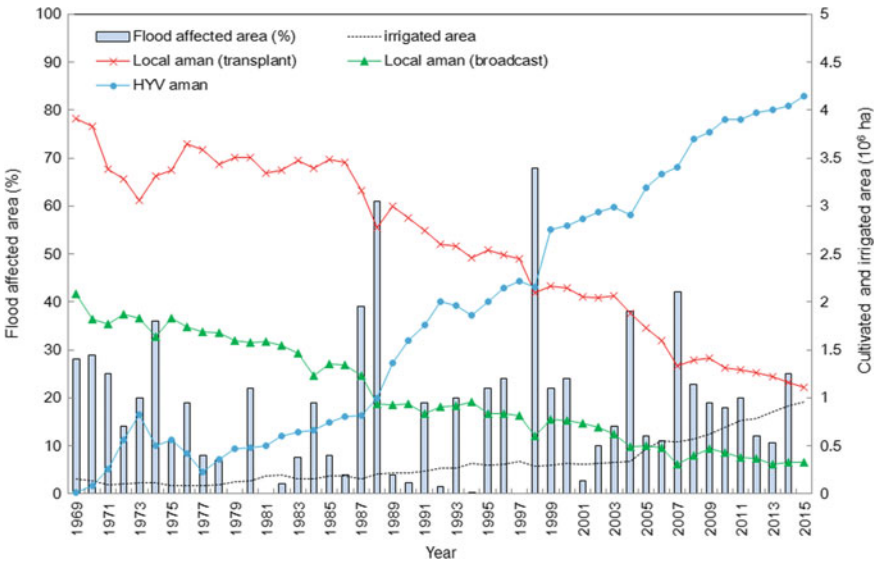

Fig. 6 The inter-annual variations of the cultivated area for each *Aman* rice sub-variety (solid line with symbols) and flood-affected area (bar) from 1969 to 2015. *Note* The black broken line shown is the irrigation area for all *Amon* rice

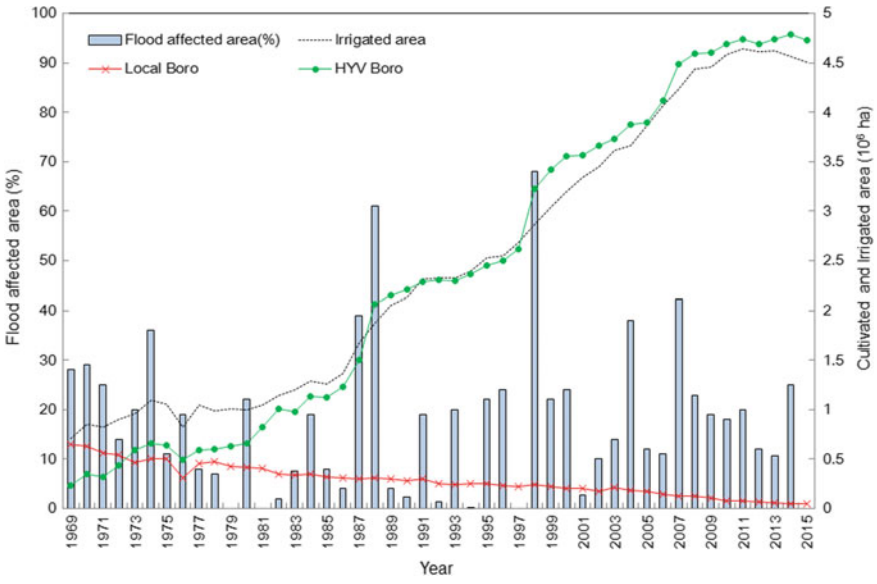

Fig. 7 This is the same as in Fig. 6, but for *Boro* rice. The cultivated area of Hybrid *Boro* is included in that of HYV *Boro*

Of course, in addition to natural environmental factors, economic factors may also be responsible for the increase in dry-season rice acreage. According to the report by del Ninno et al. (2003), farmers are motivated to plant more dry-season rice after the floods because of the higher rice price. The government has also supported farmers in their efforts to plant more rice (Khuda and Nizamuddin 2000). In any case, both natural and social factors are favorable for the increase in rice production in Bangladesh during severe flood years. The recent increase of planting more dry season *Boro* rice can be regarded as a manifestation of farmers' adaptation strategy after the recent increase in flood occurrences in Bangladesh. The combination of modern agricultural technology and the traditional cultivation system may be effective in the lower Ganges and Brahmaputra rivers in constantly increasing annual rice production despite the recent spurt in damage caused by severe floods.

4 Conclusions

In this chapter, the regional relationship between rainfall variations and rice production in the Ganges-Brahmaputra-Meghna River Basin in Indian and Bangladesh has been analyzed. The result shows clear regional differences between these two variables in the upper Ganges, lower Ganges-Brahmaputra, and upper Brahmaputra River Basins. These clear differences are recognized by analyzing the detailed, district-level data.

In addition to climatic impacts, the rice cultivation system is also different across the regions. In general, climatologically, it is wetter eastward while drier westward in the Ganges-Brahmaputra-Meghna River Basin located in the floodplains to the south of the Himalayas. In the drier upper Ganges Valley, droughts are more common, but of late their damage has been decreasing because of less rainfall variability. On the other hand, in the lower Ganges-Brahmaputra-Meghna River, floods occur more frequently; however, the increase in dry-season rice cultivation compensates for the flood damages in the wet season, and flood events even provide the opportunity to increase the annual rice yield.

The rice cultivation system has been developed at a local level to adapt to the climatic and hydrological environment. The farmers cultivate different rice varieties using different cultivation technology. To investigate the possible impact of future climate changes on local agriculture, we need to understand the regional characteristics of rice cultivation systems and conduct precise social field surveys on farmers' adaptation strategies and their social environment.

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Global Warming and Agricultural Production in Asia

Motoki Nishimori

Abstract In Japan, a rise in temperature of up to 3 °C will reduce the risk of cold-weather damage and increase biomass due to the CO_2 fertilization effect, especially in the northern part of the country, which is the main rice production region. As a result, rice production in Japan would be increased. However, there is concern about the quality of rice if the rise in temperature is extremely high. Also, research in Southeast Asia has raised worries about the negative effects of climate change on rice cultivation in regions such as northeastern Thailand and the Mekong Delta of Vietnam, which strongly depend on the hydrological environment. In general, agriculture around the world depends on the amount of rainfall, and water is essential for agriculture. This resource is itself on the verge of crisis due to climate change, and numerous political and economic issues. It is said that "the twenty-first century is the century of water." The same can be said about agricultural and food issues around the world, especially in the Monsoon Asia region. In short, the twenty-first century is "the century of agriculture."

Keywords Global warming · Monsoon Asia · Paddy rice · Crop model · Water resource

1 Introduction

The regional effects of global warming, such as frequent occurrences of climate extremes and the resulting unstable food production and supplies, are becoming of increasingly greater concern. The IPCC (Intergovernmental Panel on Climate Change) Fifth Assessment Report (IPCC 2013) states that "warming of the climate system is unequivocal," based on their estimations that the global average surface temperature rose 0.85 °C over the period 1880–2012, and that an increase of

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0.3–4.8 °C from now until the end of this century is "likely." The 2014 report of the IPCC Working Group II (IPCC 2014), assessing the impact, adaptation, and vulnerability to climate change, also states that in addition to the risk of mortality and morbidity during periods of climate-change-wrought extreme heat, it believes with high confidence that food insecurity, and lack of reliable and safe drinking water due to drought, will also increase.

In addition to irrigated rice cultivation as practiced in a country like Japan, rice production in Asia also includes many regions that depend on rainfed paddy fields. In these areas, rice cultivation depends entirely on rainfall. Consequently, in contrast to Japan, China, and both Koreas—where the primary concern is on the effects of temperature on rice production—other parts of Monsoon Asia are focused on whether it is possible to ensure the crop water demand is met. While the increase in the concentration of CO_2, a major greenhouse gas, is the cause of the rise in global temperature, it also has the fertilization effect of stimulating photosynthesis, which increases crop production levels. Furthermore, to evaluate the effects of global warming on agriculture and food production, it is necessary to consider the meaning of "regionality" in its broadest sense, including not only the natural conditions of a region, but also local people's motives for production and changes in consumption preferences (consumer trends) based on economic circumstances.

When examining the relationships between global warming and regional food production in Asia, we must consider a variety of perspectives, not just the impact of changes in nature. While not meant to be exhaustive, here we introduce the findings of research in Japan and Southeast Asia, and discuss points that should also be considered besides natural conditions.

2 Effects of Global Warming on Rice Production in Japan

Three broad categories of techniques are used to estimate future rice production under global warming conditions.

(a) Use of statistical equations to estimate rice production developed from data on past production amounts and natural environmental conditions, such as temperature, to calculate the estimated rice production under future temperature change conditions.
(b) Cultivation of paddy rice under conditions of high temperature and concentrations of CO_2, and measuring production amounts experimentally.
(c) Development of a numerical model that can simulate rice growth from planting to harvest to project changes due to high temperatures and concentrations of CO_2.

These methods have their advantages and drawbacks. As an example of (a), Nishimori and Yokozawa (2001) sought to determine the difference between the maximum yield temperature and the current temperature. In northern and inland

Honshu regions of Japan, the difference is positive: rice yield is expected to further increase even if the temperature rises from the present value. However, in southern Kanto and northwest Kyushu regions, a future rise in temperature is expected to reduce rice yield. This research, however, used statistical estimation, and did not consider the fertilizer effect and state policies such as reduction in crop size.

Rice growth experiments in category (b) include growing rice outdoors in a FACE (free atmosphere CO_2 enrichment) environment in which carbon dioxide is increased (Kobayashi 2001) to reproduce global warming conditions, in addition to growing rice in greenhouses with higher temperatures and CO_2 concentrations. However, it is not possible to carry out experiments for all combinations of rice breeds and soil conditions, and sufficient information about the complex effects of temperature and CO_2 concentration cannot be obtained. Therefore, changes in crop production as a result of climate change are basically estimated using method (c), developing models of crop production from research data on crop physiology and ecology obtained from experimental cultivated fields (or lab settings) as carried out in (b), together with the statistical calculations of (a); expected climate change scenarios are input into the models to estimate future yield.

Models in category (c) can be broadly divided into those that place weight on empirical statistical formulas like those developed by Yokozawa and Iizumi (e.g., Iizumi et al. 2009) and models that seek to faithfully reflect a crop's physiological and growth processes, as presented in Sect. 1. Yokozawa et al. (2009) estimated the annual rice yield in each region of Japan for current, near future, and century-end periods by inputting climate change scenarios into a model of the former category. According to the model, a rise in temperature of up to 3 ºC will result in a rice yield nationwide that is similar to or slightly above current yields. A large increase in yield in northern Japan would be due to a reduction in the probability of cold-weather damage. Also, the coefficient expressing the magnitude of yearly variation in rice yield in each region increases in all regions as the temperature rises (Fig. 1). The reason is that empirical knowledge about the sharp decrease in the conversion factor (harvest coefficient) from the crop biomass to yield, which occurs because of high-temperature stress effects during the rice crop's flowering season, is incorporated into the model. However, there are still great uncertainties about the response of rice yield to high temperatures, and research from the perspective of crop physiology is needed, as described in Sect. 4.1 below.

3 Effects of Global Warming on Rice Production in Southeast Asia

3.1 Water Resources and Rice Cultivation in Monsoon Asia

In this section, we present the effects of global warning on water resources based on the results of a continental-scale water circulation model developed by Ishigooka

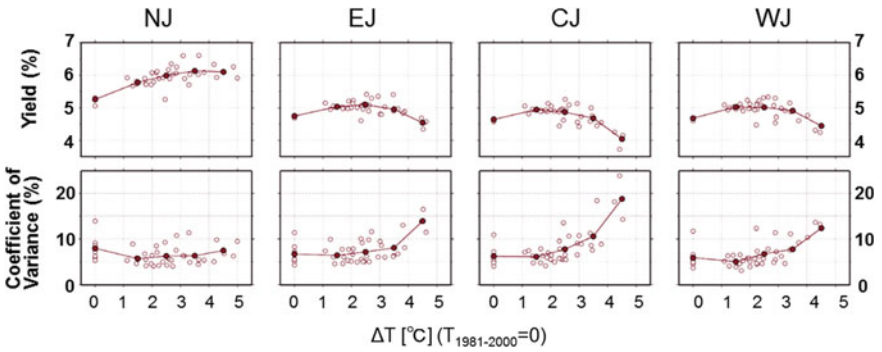

Fig. 1 Regional effects of climate change on rice yield in Japan (Reproduced from Yokozawa et al. 2009) *Note* The horizontal axis shows the degree of warm season averaged surface air temperature increasing from 1981 to 2000. The vertical axis shows the average yield (top) and the coefficient of variation (bottom). The regions considered here are composed of Japan's traditional regional divisions (from left): NJ (northern Japan); EJ (eastern Japan); CJ (central Japan); WJ (western Japan)

et al. (2005), which takes land use into account. This model calculates the amount of water demand for irrigation (the amount needed to grow crops without stress brought about by insufficient water) and the amount of water resources that can feed arable land.

Figure 2 shows the difference between the averages of the amount of water needed for irrigation and suppliable water resources over a 30-year period (1961–1990) obtained from long-term wide-region weather data. Regions with high values require considerable water to grow crops without water-related stress, but we have to note non-arable areas that are not colored. The greater the difference, the more the agricultural water supply was in danger. Regions with great disparities included Central Asia, Pakistan, and Northern China, with the amount of water that is insufficient to needs reaching more than 500 mm per year in the Indus River region. Thus, we see that water is the limiting factor of rice production in Monsoon Asia.

3.2 Effects on Northeastern Thailand

The northeast region of Thailand is one of the major rice production areas in Southeast Asia. Even now, 70 percent of rice paddies in that region are rainfed (Shimizu et al. 2004). It is therefore essential to consider water use when estimating rice production.

To evaluate the climate change effects on the surface water circulation process and its relation to rice production in rainfed regions, Ishigooka et al. (2010) first estimate the surface area of rice planting as the saturation surface area, an indicator that the ground surface is sufficiently moist. Fig. 3 shows a comparison between a

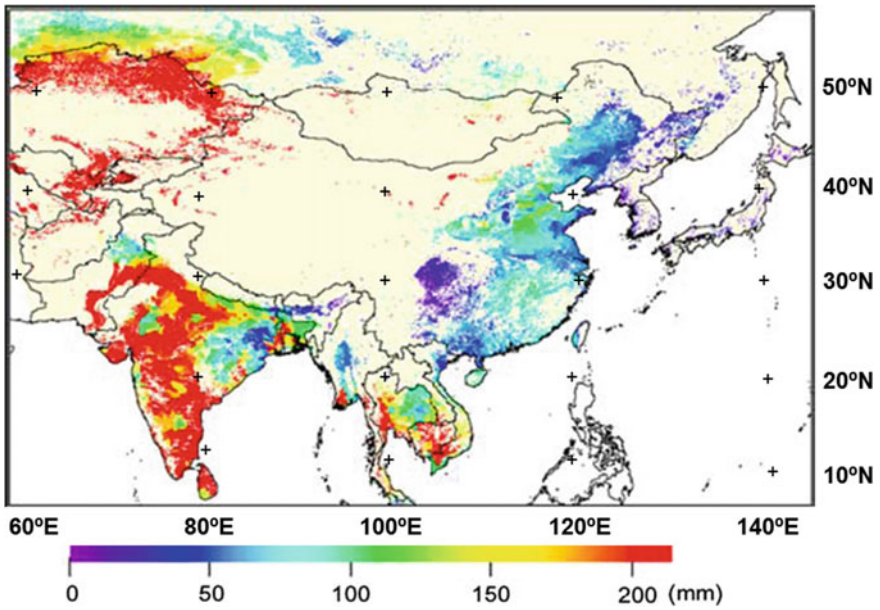

Fig. 2 Theoretical distribution of insufficient amounts of crop water (difference between amount needed for irrigation and suppliable water sources) during a 30-year period (averages from 1961 to 1990) in eastern Eurasia (Reproduced from Ishigooka et al. 2005)

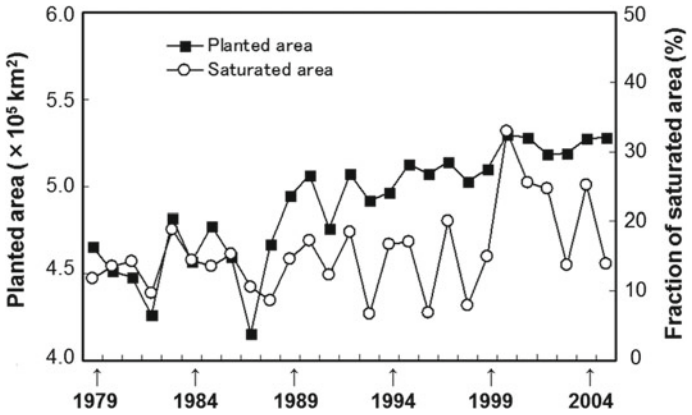

Fig. 3 Interannual variability of observed planted area obtained from statistics and simulated saturated area in mid-August. *Note* Saturated area is expressed as an area fraction to the maximum paddy area within Northeast Thailand (Ishigooka et al. 2010)

simulation of yearly variation in the rice-planting area in mid-August and values estimated from statistical data of the FAO Statistical Yearbook 2007–2008. While the model values in the latter half of the period are underestimations, the trend of yearly variations itself comparatively matches the statistically estimated values. Thus, it is possible to estimate the rice-planting area based on the projected supply and demand of agricultural water.

3.3 Effects on the Mekong Delta in Vietnam

The Mekong Delta in the southern region of Vietnam (Fig. 4) produces about half of the rice crop in Vietnam, one of the top rice-exporting countries after India and Thailand (Inoue et al. 2015). Nevertheless, much of this region is less than two meters above sea level, and saltwater intrusion is a problem.

To evaluate the change in rice production in this area, Khang et al. (2010) modeled a rice-planting style that seeks to maintain yield by focusing on intensive rice-planting periods when the saline concentration is low. The model was developed to estimate the periods in which rice planting and growth are possible from water resources in the paddy fields. The results reveal that the low salinity period

Fig. 4 Geographical location of the Mekong Delta region in Vietnam indicated by dark area surrounded by a rectangular box (Reproduced from Khang et al. 2010)

suitable for planting becomes shorter as saltwater intrusion expands because of global warming. It is expected that the number of possible plantings will decrease because of saltwater intrusion's seasonal cycles on the cultivation calendar. Furthermore, Kotera et al. (2014) sought to estimate changes in the rice-planting calendar, the surface area of harvest, and the yield for each small water area in the Mekong Delta by combining hydrological processes and a rice crop growth and yield prediction model that takes climate change scenarios as its input. The results showed a mutually opposing relationship whereby the harvestable surface areas in the upstream region during flood years and in coastal areas during low rainfall years experience large decreases, while at the same time the plantable and harvestable surface area in other regions experience increases. Meanwhile, ill effects on the rice yield as the temperature rises will be observed immediately; it is possible that the amount of rice produced in the Mekong Delta in the latter half of the 2020s will drop by 11 percent from current yields.

4 Prediction of Rice Production in Monsoon Asia and Various Issues

4.1 Necessity of Perspective from Crop Physiology

Determinants of the development, growth, and yield of rice, the major agricultural product in Monsoon Asia, are the rice's genotype (variety), environment, and the interaction between the two. As a result, models derived by incorporating various genetic traits obtained from theoretical equations expressing the development process of rice in accordance with physiological, ecological, and physical laws, which are tested empirically, are effective for understanding the interactions between the genetic characteristics of growth and yield formation, and the environment; they are also effective for identifying high-yield dominant traits under different environmental conditions.

Figure 5 shows the simulation results by Horie et al. (2005) that developed a crop model for Indica rice IR72 and Japonica rice Nipponbare at a CO_2 concentration of 700 ppm in Iwate (the northeastern part) and Kyoto (the central part) of Japan, Nanjing (the central part) and Yunnan (the southwestern part) of China, and Ubon, the northeastern part of Thailand. The figure also shows the relative additional yield (as a percent) at 360 ppm of CO_2 for each of the locales and rice varieties. Compared with Japonica rice varieties like Nipponbare, the yield of Indica rice varieties like IR72 responds well to CO_2. The yields in all surveyed regions increase in doubled CO_2 concentration and present temperatures. However, under global warming conditions with an increase in temperature of +2 °C, the beneficial effects of a high CO_2 concentration disappear in all stations, except for Iwate. At temperatures of +4 °C, the harvest is reduced excluding Iwate. In short, the effects

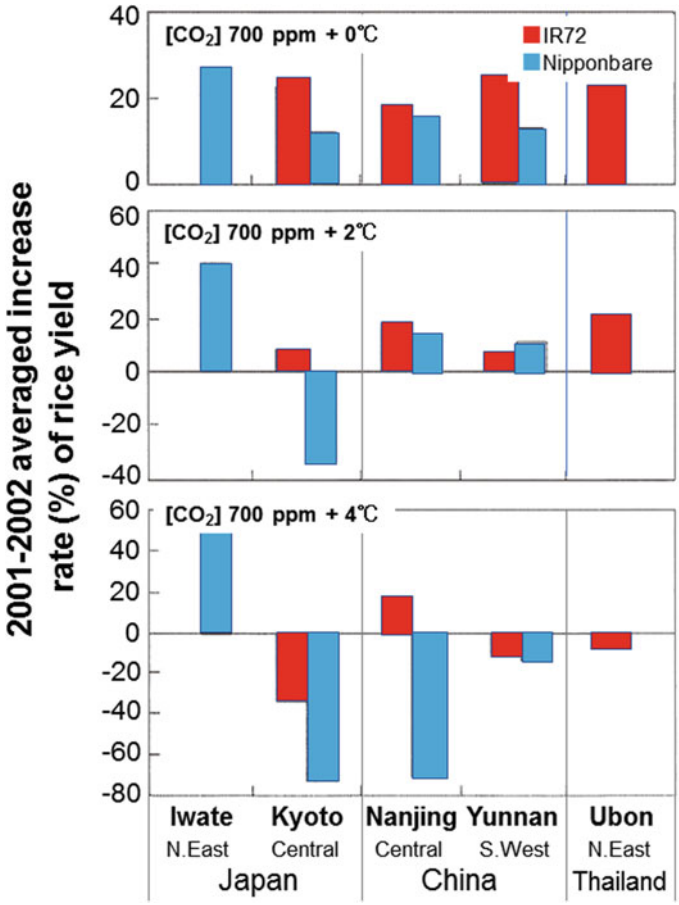

Fig. 5 Rate of increase in rice yield under increased CO_2 and temperature conditions in Iwate and Kyoto, Japan; Nanking and Yunnan, China; and Ubon, Thailand, for two rice varieties (IR72 and Nipponbare) (Reproduced from Horie et al. 2005) *Note* Three conditions (increase of 0 °C, +2 °C, +4 °C from present temperatures) are applied with CO_2 concentration of 700 ppm. The average increase rate is obtained by using the standard temperature and rice yield data at each location in 2001 and 2002

of high temperatures and high CO_2 concentrations are significant in the tropics during dry-season rice cultivation and in the temperate zone (which includes Kyoto and Nanjing), which is subject to high temperatures during the summer season. Even if adaptive measures are considered on the basis of the rice variety and cropping season, the predicted global warming will have major effects on rice cultivation in each part of Asia.

4.2 Necessity of Perspective Besides Agronomics and Climatology/Meteorology for Research

To project agricultural ecologies and food production in these Asian regions, it is necessary to consider not just hydro-meteorological conditions but also causes inhibiting the growth of crops. For example, rice production declines because of insect pests even if the natural (atmospheric) environment is sufficient. Rice blast, which occurs in Japan, is a representative example. Also, small brown planthoppers (*Laodelphax striatellus*) are known to carry a virus that causes rice plant sheath blight disease. Furthermore, much of the carbon-containing organic matter in soil in which rice is planted is decomposed by the activities of soil microorganisms, and a great portion of nitrogen found in soil is in ammonia form, which renders it inorganic through the removal of carbon. As a result, the amount of nitrogen in arable land has a critical effect on the yield and quality of rice crops. The rate of nitrogen's mineralizing activity is determined by temperature, pH, moisture, and the type of soil. It will be greatly affected by global warming (Nishimori 2007).

5 Conclusion

To summarize the discussion above, in Japan a rise in temperature of up to 3 °C will reduce the risk of cold-weather damage and increase biomass due to the CO_2 fertilization effect, especially in northern parts of the country, the main cultivated areas for rice. Thus, it is expected that the rice production of Japan would continuously increase. However, there is concern about the quality of rice and crop yield if the rise in temperature is extremely high. Also, research in Southeast Asia has raised worries about the negative effects of climate change on rice cultivation in regions such as northeastern Thailand and the Mekong Delta of Vietnam, which strongly depend on the water environment.

In general, agriculture around the world depends on the amount of rainfall, and water is essential for agriculture. Of course, water is necessary not just for agriculture but also for drinking and other wide-ranging aspects of human society, including industry. This resource is itself on the verge of crisis due to climate change and numerous political and economic issues. It is said that "the twenty-first century is the century of water." From our discussion above, the same can be said about agricultural and food issues around the world, especially in the Monsoon Asia region. In short, the twenty-first century is "the century of agriculture."

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Cultivation of Glutinous Rice in Northeast India, and Its Food Products

Haruhisa Asada

Abstract The glutinous rice cultural sphere is the region spanning East Asia to Southeast Asia where the cultivation of glutinous rice variety and consumption of its food products is prominent. This area has long had a preference for sticky food products, and is known for the diverse ways glutinous rice grains are processed. However, a preference for glutinous rice products is not observed west of the glutinous rice cultural sphere, the region of South Asia from the Himalayas to the Indo-Gangetic Plain. Thus, it can be said that there is a discontinuity in food culture between these two regions. Northeast India is located in the nexus of this discontinuity. The region is the only part of South Asia to which the Southeast Asia-centric glutinous rice cultural sphere has extended. Thus, the case of Northeast India holds special significance in studying the characteristics of the glutinous rice cultural sphere in Monsoon Asia. In this chapter, diverse food products made from glutinous rice in Assam, a major state in Northeast India, are introduced to compare the characteristics of glutinous rice used in this region with those of other regions.

Keywords Glutinous rice · Northeast India · Assam · Southeast Asia

1 Introduction

Glutinous rice is one of the important cultural items grown and consumed in many countries in Monsoon Asia. In Japan, for example, *mochi* (glutinous rice cakes) is considered an essential food item during the New Year's holiday. Glutinous rice is widely consumed in the country as *kagami mochi* (a New Year's decoration consisting of a small round rice cake on top of a bigger one, along with other adornments), *kashiwa mochi* (rice cake filled with red beans and wrapped with Japanese oak leaf), *sekihan* (glutinous rice steamed with red beans), and *okowa* (a steamed mixture of glutinous rice, vegetables, and meat). Food products made from

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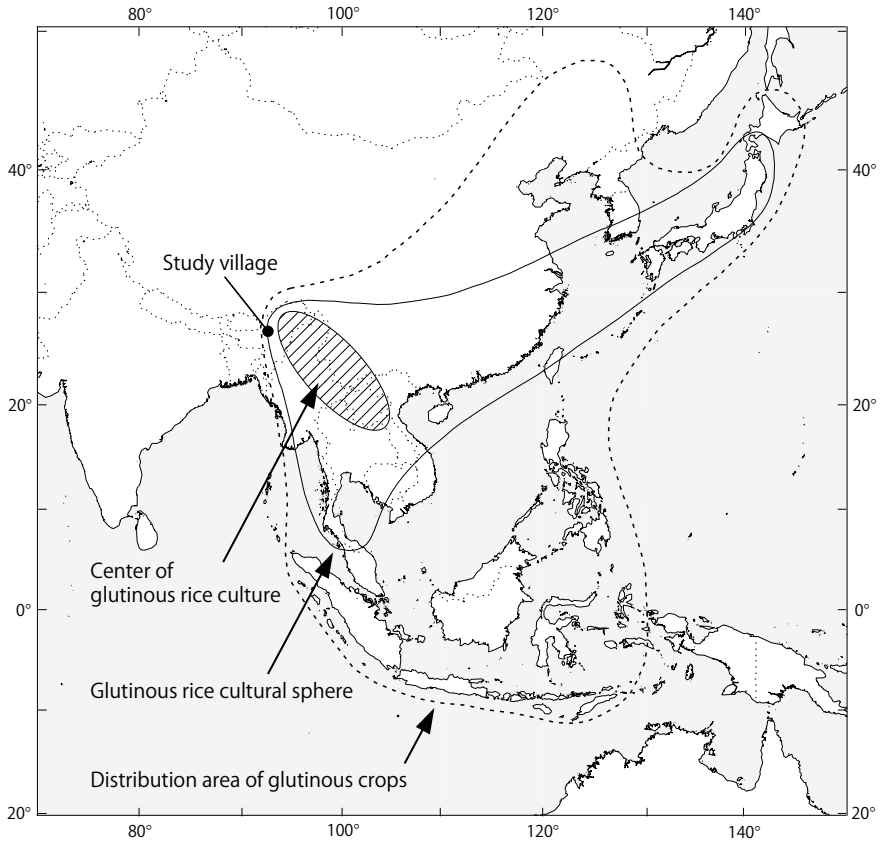

Fig. 1 Map of the glutinous rice cultural sphere in Asia (Reproduced from Sakamoto 1989)

glutinous rice are considered representatives of Japanese culture. The locations of Japan and other countries constitute a "glutinous rice cultural sphere" that extends across Monsoon Asia. The region is shaped like an upside-down triangle, with Japan at the eastern edge and Northeast India at the western edge (Fig. 1).

The glutinous rice cultural sphere is the region spanning East Asia to Southeast Asia where cultivation of glutinous rice crop and consumption of its food products is prominent (Sakamoto 1989). This area has long had a preference for sticky food products, and is known for the diverse ways glutinous rice grains are used. In particular, because people in mainland Southeast Asian countries and regions, primarily Laos, northern Thailand, northern Myanmar, and southwest China, eat glutinous rice as their daily staple, this area is given the appellation "the center of glutinous rice culture." Meanwhile, a preference for glutinous rice products is not observed west of the glutinous rice cultural sphere, the region of South Asia from the Himalayas to the Indo-Gangetic Plain. Thus it can be said that there is a discontinuity in food culture between these two regions.

Northeast India is located in the nexus of this discontinuity. This region is surrounded by Bangladesh, Myanmar, Bhutan, and the Tibet Autonomous Region of China. From ancient times it has been a strategic region that connects India with Tibet and Southeast Asia. Ethnic groups from different directions have settled in the region, not only peoples belonging to the Indo-European group but also those belonging to the Tibeto-Burman, Tai (Tai-Kadai), and Austro-Asiatic language families, resulting in the spread of unique cultures in India. Northeast India is the only part of South Asia to which the Southeast Asia-centric glutinous rice cultural sphere has extended. Thus, the case of Northeast India holds special significance in studying its characteristics. However, for a long time surveys by foreigners have been restricted in the region, and information that has reached abroad is limited. There have been cases of field surveys conducted by Japanese researchers (Ishige et al. 1998; Watabe and Fukazawa 1998), but their study periods have been short and they gleaned only fragmentary information about the features and production methods of glutinous rice products.

In this chapter, I introduce diverse food products made from glutinous rice in Assam, a major state in Northeast India, and compare the characteristics of glutinous rice used in this region with those of other regions.

2 Environment and Rice Cultivation in Assam

The topography of Assam is formed by the Brahmaputra River, one of the major rivers in Asia. The river originates from the Tibetan Plateau north of Assam and traverses east to west across Assam, resulting in the formation of a vast floodplain. Myriad rivers flow in this floodplain, and backswamps form in the lowlands behind natural highland levees along the rivers. As a result of these micro-topographic features, gradual undulations almost invisible to the human eye are produced. Because water is supplied to paddy fields in the floodplain by rivers and rainwater, inhabitants practice rainwater-harvesting agriculture, which does not require irrigation. On the other hand, the agriculture is also characterized by a variable hydrological environment due to fluctuations in the volume of river discharge and rainwater. Furthermore, because the soil of the lowlands in Assam contains a great deal of coarse sand carried from the Himalayas, it is difficult for paddy fields to retain rainwater for a long period of time. If there is no rainwater for a while even during the rainy season, the flooded rice paddies dry up immediately.

Rice cultivation in Assam has traditionally developed in response to the unstable hydrological environment of the floodplain. The great number of local varieties of rice is another method of environmental adaptation. To plant different types of rice in paddies with different water depths, from high-elevation fields to low-elevation fields, a wide variety of local varieties are used in Assam (Asada 2011). Because local varieties differ in characteristics such as height and the length of time until maturation, it is possible to respond to differences in the hydrological environment on a micro level by planting different varieties on the basis of water depth.

Of the local varieties, a glutinous rice variety called *baradhan* in Assamese language is especially important. Glutinous rice and non-glutinous rice differ in the chemical composition of the starch stored in the rice (Watabe and Fukazawa 1998). In short, the amount of starch in non-glutinous rice contains about 20 percent amylose and 80 percent amylopectin. In contrast, the starch in glutinous rice is composed almost entirely of amylopectin. The relative proportions of the two components determine whether or not the rice is sticky. All glutinous rice varieties belong to the group of local varieties; none are found in high-yielding varieties. Five different glutinous rice varieties were found in the study village in Assam, and interview surveys revealed that almost all households planted one or more varieties of glutinous rice (Asada 2011).

3 Types of Glutinous Rice Products and Methods of Use

In the following sections I introduce glutinous rice products seen in the study village in eastern Assam, based on interviews with villagers and my own observations. While here I present a village inhabited by a Tai group called the Ahom (for details see Asada 2009); as far as I have observed, almost the same glutinous rice products are prepared and consumed in the villages of other ethnicities and Hindu castes in Assam.

As in other regions, in Assam the products made from glutinous rice are diverse. The occasions and preparation methods for their production and consumption are also wide ranging. In the study village, glutinous rice products can be broadly divided into three kinds: *pitha*, made from glutinous rice flour; *jolpan*, which are eaten as light snacks; and *xaj*, wine made from glutinous rice.

3.1 Types of Pitha and Preparation Methods

Pitha is the name of food products prepared by binding together rice flour and generally cooking on a hot griddle (Fig. 2). First, glutinous rice is soaked in water for about three hours and then dried for just a short time. The soaking time differs depending on the type of *pitha* to be made. The rice is then pounded using a wooden mortar operated by foot, called a *dheki*. Rice flour produced from the *dheki* is placed on a griddle, to which black sesame is added. As it is heated, rice flour is shaped into a stick form. The finished product is called *til pitha* (*pitha* with sesame), and it has a crunchy mouthfeel (Fig. 3). If after being soaked in water the batter is shaped into small balls and fried in oil, the product is called *ghila pitha* (*pitha* in the shape of *ghila*, a round tree seed). *Ghila pitha* is sometimes also called *tel pitha* (*pitha* fried in oil).

These two types of *pitha* are the most often prepared and consumed in the study village. There is a variety of other *pitha* as well, with different preparation methods

Fig. 2 Making *pitha*: **a** rice flour produced from *dheki*, **b** heating rice flour on a metal plate with sesame, **c** shaping the batter into small balls

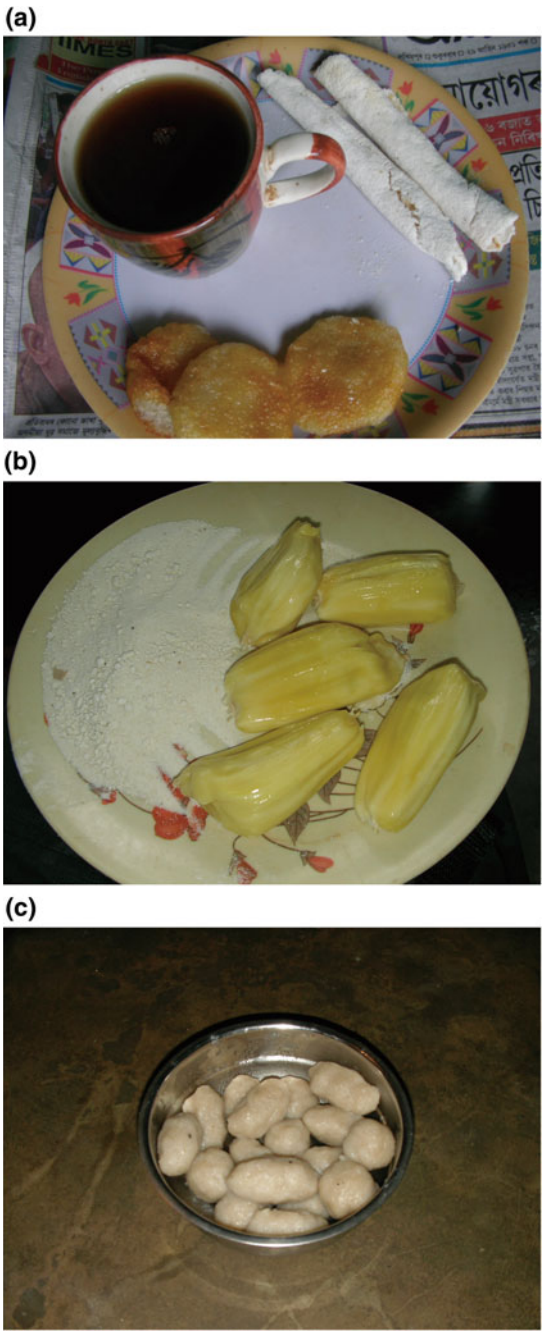

Fig. 3 Kinds of *pitha*: **a** *til pitha* and *gila pitha*, **b** *bhouja pitha* with jack fruit, **c** *muthiya pitha*

and shapes. They include *muthiya pitha* (hand-formed *pitha*), made by gripping water-soaked rice flour in one's palm; *bhaat pitha* (rice-like *pitha*), rice flour batter turned into grain form by pushing it through a sieve; *hesa pitha* (pushed *pitha*, also called *narikol pitha*), which includes coconut meat instead of black sesame; *kol pitha* (banana *pitha*), in which banana is mixed; *tekeli pitha* (kettle *pitha*), cooked using steam from a kettle; and *burpuriya pitha* (soft *pitha*), which has the shape of a pancake.

Instead of being steamed and then pounded in a mortar, the Assamese make *pitha* by using uncooked glutinous rice that is soaked in water and then pounded into flour. In this regard, it is similar to *shitogi*, a type of Japanese rice cake. It has been reported that in the past, in Japan, *shitogi*, formed by shaping rice flour into a round shape, had been widely produced and consumed (Nakao 1972).

Besides *pitha* that is made by soaking rice flour in water, there are also *kesa pitha* (uncooked *pitha*), which is prepared by mixing rice flour with bananas or jackfruit, and *bhouja pitha* (sautéed *pitha*). Because the fruit is already sticky, non-glutinous rice is used as the rice flour instead of glutinous rice.

While there are cases of *pitha* eaten daily with tea, it is largely a special food consumed on festive holidays. Of these occasions, *pitha* is considered indispensable for the *Bihu* festivals held three times a year in Assam. In Assam, New Year is celebrated in mid-April. The festival of *Bohag Bihu* is observed during this period ("*Bohag*" means the month from mid-April to mid-May in the Assamese calendar). Beginning several weeks before *Bohag Bihu*, the pounding of *dheki* reverberates as each household prepares to make *pitha*. *Pitha* is eaten not only by people. A special *pitha* is also served to cows used for agricultural labor and for milk.

Pitha is prepared by each family and served to family members and guests not only during *Bohag Bihu* in April but also during *Kati Bihu* in October and *Magh Bihu* in January. ("*Kati*" and "*Magh*" mean the month from mid-October to mid-November, and mid-January to mid-February, respectively, in the Assamese calendar.) It is also made on special days besides the Bihu festivals. For example, *bhaat pitha* is prepared on the day that all rice planting is completed to thank neighboring villagers who helped. This *pitha* is also called *nangal dhowa pitha* (plow-washing *pitha*), which means the end of field preparation season.

3.2 Types of Jolpan and Preparation Methods

Jolpan is the name of snacks made from rice (Fig. 4). It is usually eaten with milk or sugar. In Assamese, *jol* means water and *pan* means to drink. The main types of *jolpan* include various kinds of puffed rice such as *muri*, *akhoi*, and *hurum*; roasted rice called *chira*; roasted rice powder called *xandoh guri*; and rice steamed in bamboo tubes called *chunga chawal*. These snacks are made not only from glutinous rice but also from non-glutinous rice.

Puffed rice *jolpan* uses rice that has been parboiled (Fig. 5). Parboiling rice involves soaking unhulled rice in water, boiling it, and then drying it under the sun.

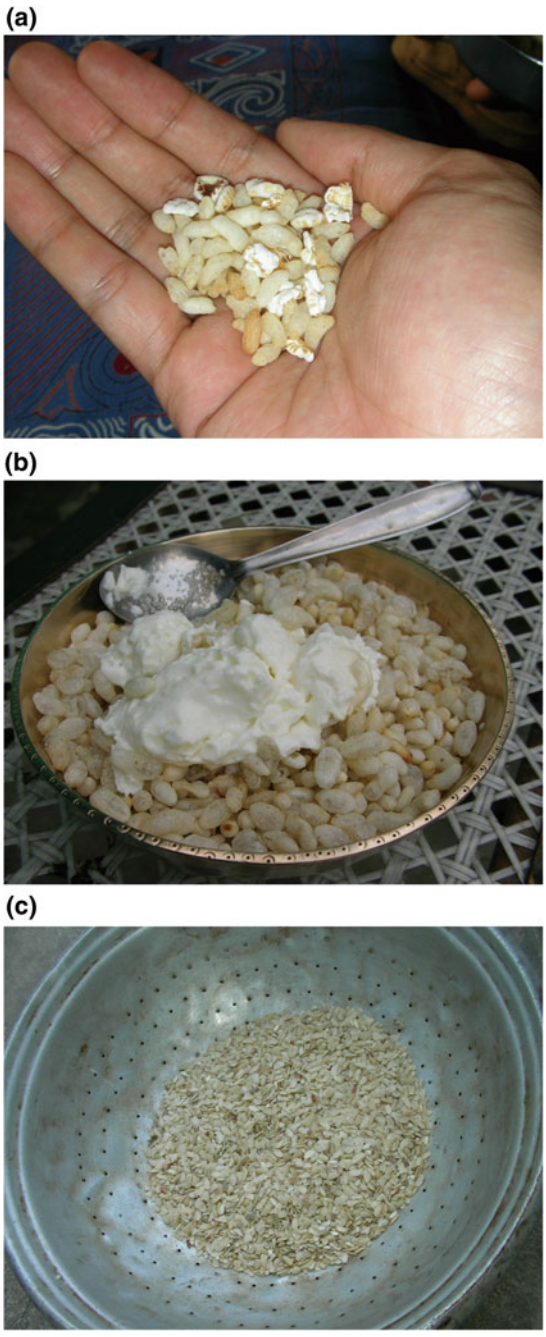

Fig. 4 Kinds of *joplan*: **a** *muri* and *akhoi*, **b** *hurum* with *doi*, **c** *chira*

Fig. 5 Making *okhuwa chawal*: **a** unhulled rice in water, **b** drying the boiled unhulled rice

After this process the rice is hulled (Nakao 1972). Parboiled rice called *okhuwa chawal* in Assamese has a slightly bland taste, but after boiling it loses the ability to attract insects and can be stored for a long period of time. Because the rice expands in volume, it gives the sense of satiety, and there are villagers who declare that it is beneficial for diabetic patients. Few households in the village eat parboiled rice as their main staple instead of hulled rice.

To make puffed rice, unhulled rice is soaked in water for three days and then boiled in a pot for two hours. It is then transferred to a sieve and dried under the sun for two days. This completes the process for preparing *okhuwa chawal*. This rice is then pounded with a *dheki* to remove the hull, soaked in brine, and then dried (Fig. 6). Sand is heated in a hot pot, into which the rice is added and stirred with a bamboo spatula, resulting in a puffed rice product called *muri*. (The mixture is then passed through a sieve to remove the sand.) If the rice is stirred with hot sand without first being hulled, the product is called *akhoi*. *Hurum* is created by heating

Fig. 6 Making *jolpan*: **a** *okhuwa chawal* pounded with *dekhi*, **b** roasting in an iron pan

okhuwa chawal in a metal pot and letting it cool, then pounding it with a *dheki* to remove the hull, and then stirring it with hot sand. Of these types of puffed rice, the process of making *hurum* requires the most time. As in the case of the study village, *hurum* is prepared only in villages inhabited by the Ahom. It is not found in villages belonging to other ethnic groups and castes.

To make *chira*, or roasted rice, unhulled rice is soaked in water for three days and then roasted in a hot pot. It is then pounded by a *dheki* to remove the hull and flattened. In India, *chira* is generally known as *chura*, and in Japan the identical food product is called *yakigome* (Nakao 1972). *Chira* can be made from all types of rice, regardless of whether they are glutinous or non-glutinous. However, *chira* made from a breed of rice called *chakuwa* (Watabe and Fukazawa 1998), which has a quality in between glutinous and non-glutinous rice, is considered the best by villagers.

Xandoh guri, a type of roasted rice powder, is made from puffed rice *muri*. *Muri* is roasted in a hot pot, and then pulverized into powder with a *dheki*.

Although *chunga chawal*, rice cooked in a bamboo tube, is classified as a *jolpan* because it is a snack made from rice, its method of preparation differs greatly from those described above. Glutinous rice and water are placed in a bamboo tube (*chunga*), which is then placed in direct fire (Fig. 7). After heating for about an hour, the glutinous rice in the tube is completely cooked using steam. The tube is then split and the rice is scooped out to be served. *Chunga chawal* is considered to be identical to glutinous rice steamed in bamboo tubes widely found in Southeast Asia (Nakao 1972).

These *jolpan* are not prepared every time they are eaten. With the exception of *chunga chawal*, they can be stored after being made, and are brought out when one needs a snack. A *jolpan* is transferred to a brass bowl, milk is poured or sugar is sprinkled on top, and the snack is then immediately consumed. It is an instant food product often eaten in the morning before villagers head out for agricultural work and in the evening before dinner.

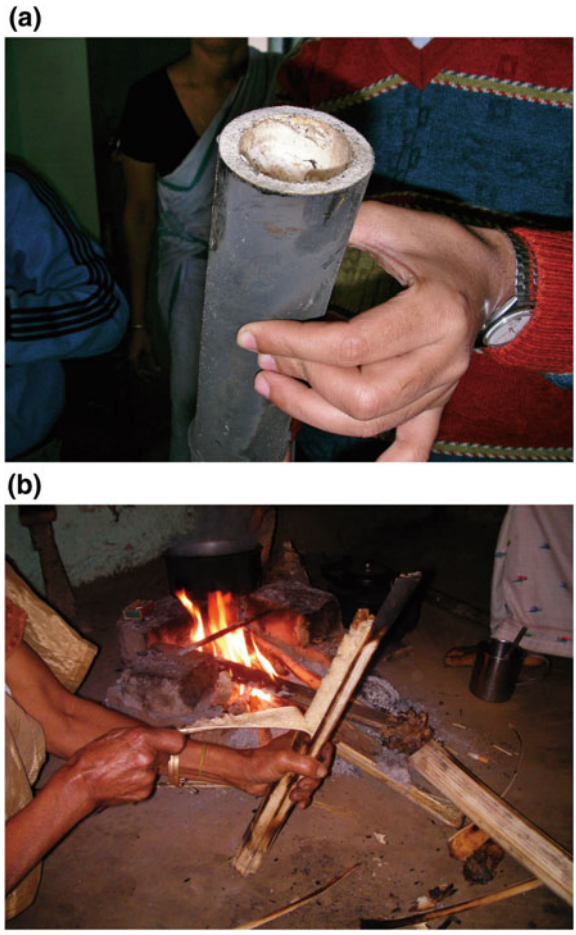

Fig. 7 Making *chunga chawal*: **a** glutinous rice in bamboo, **b** bamboo tube burned

Like *pitha*, *jolpan* is also consumed during festivals. Roasted rice *chira* is invariably served to guests at functions such as weddings and funerals. Because there is not enough time for each family to make portions of *chira* for all the guests from inside and outside the village, in many cases *chira* is now purchased from merchants in the nearest town. For these special occasions, *chira* is hand-mixed with *doi* (homemade yogurt) and a topping of *gur* (brown sugar jaggery) made from sugarcane molasses in a vessel created by splitting the trunk of a banana plant grown in one's yard. Besides *chira*, there are also other *jolpan* eaten on festival days. Puffed rice *hurum* is made most often just before the *Bohag Bihu* festival in April, and *chunga chawal* (glutinous rice steamed in bamboo tubes) is an essential dish during *Magh Bihu* in January.

3.3 Types of Rice Wines and Production Methods

The main rice wine drunk in the study village was *xaj*, a fermented rice wine. While it can also be made from non-glutinous rice, *xaj* is considered to be most delicious and fragrant when glutinous rice is used as the main ingredient.

The process of making *xaj* begins with steaming glutinous rice (Fig. 8). According to the explanations of villagers, a specialized steaming vessel is not required. Instead, water is boiled in a metal pot over fire. Glutinous rice is placed in a colander, which is placed over the pot and steamed for about an hour.

To ferment the glutinous rice, the villagers use malt, a lump of fermentation culture called drop. The main ingredients of drop are several dozen types of wildgrasses and flowers of fruits that naturally grow around the village. The gathered plants are dried, and then mixed and pounded with a *dheki*. The mixture is formed into large lumps using the palms of one's hands and then dried under the sun for about a week. At present, drop can be purchased from merchants cheaply without the need to make it at home.

Drop is crumbled on top of steamed rice while it is stirred. The mixture is then transferred to an unglazed pot and left to ferment in a dark spot inside one's home. After about four days, water is added to the pot, and the mixture is left for three more days. The fermented liquid can then be drunk. When poured into a glass, *xaj* is turbid, and its taste is slightly tangy. It looks and tastes like unrefined Japanese *sake*. The color and flavor of *xaj* vary depending on the type of rice used as the main ingredient, as well as whether the rice was hulled by a *dheki* or by a machine.

A spirit called *sulai*, made by distilling *xaj*, is also drunk (Fig. 9). A simple distillation apparatus is created by stacking three aluminum containers on top of one another. A hole opens at the bottom of the middle container. As the bottom container is heated, steam from *xaj* rises and settles at the bottom of the middle pot. The top vessel contains water so that the steam from the *xaj* is cooled and condenses. This liquid is extracted from the vessel in the middle.

Unlike *pitha* and *jolpan*, rice wine is not produced by all households, but only by a small number in the study village. Of the 96 households in the village, only five

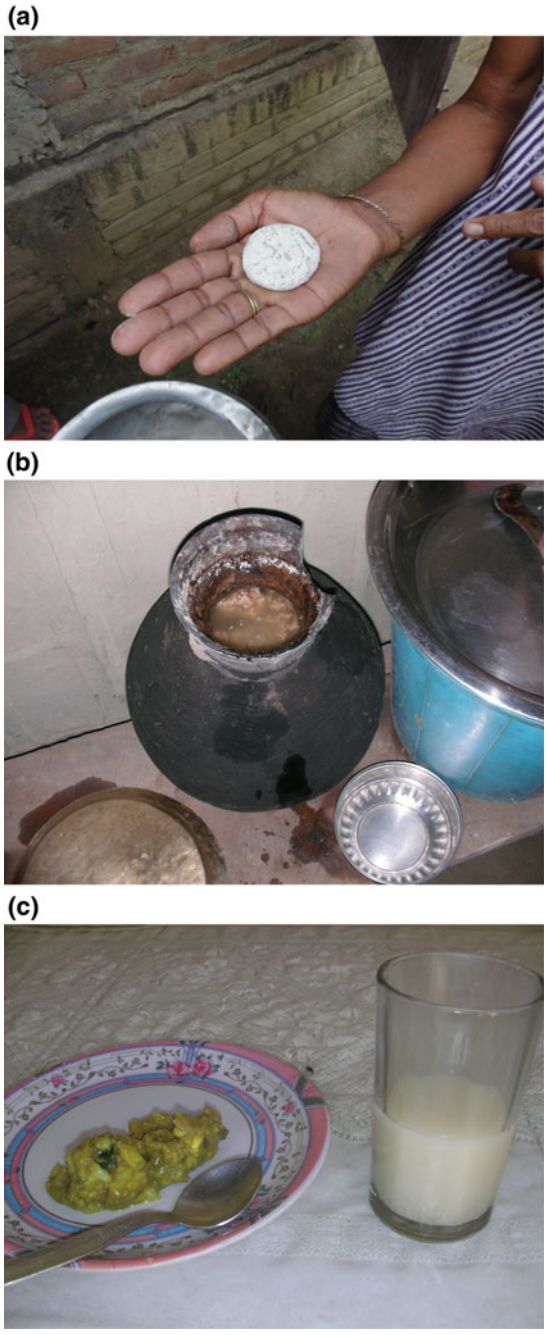

Fig. 8 Making *xaj*: **a** drop, **b** fermentation in an earthen pot, **c** *xaj*

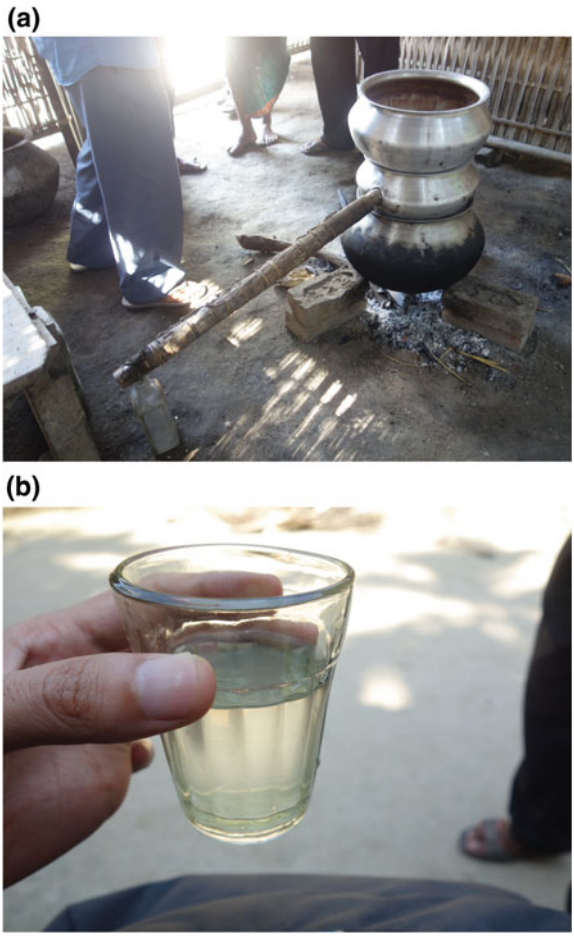

Fig. 9 Making *sulai*, **a** distillation apparatus, **b** *sulai*

made their own rice wine. Whether or not a household made their own liquor was related to Hindu denominations. In Hinduism, strict rules on alcohol are prescribed by each denomination. In the study village it seemed that many households belonged to the denomination that prohibited the production of rice wine. The people who made rice wine were classified as "*pakka*" ("ripened") and those who did not were considered "*keccha*" ("unripened") among villagers. For the "*pakka*" group, rice wine is essential for events such as weddings and funerals. However, in the study village, because the majority were "*keccha*" people, there were few opportunities to produce and serve glutinous rice wine.

The custom of drinking alcohol differs between ethnic groups. Many of the Assamese Hindus who belong to the Aryan group do not drink alcohol at all. On the other hand, indigenous tribal groups, such as Bodo and Mishing, like to drink alcohol more than the Ahom. When one is invited to their homes, rice wine is served instead of tea.

4 Glutinous Rice Cultural Sphere in South Asia

Assam in Northeast India is included in the westernmost edge of the glutinous rice cultural sphere, in which the custom of using glutinous rice is prominent. However, to what extent can one see similarities in glutinous rice products in this area? Glutinous rice is eaten as the main staple in several countries in mainland Southeast Asia: Thailand, Laos, and Myanmar. These countries share the common culture of eating glutinous rice products such as steamed rice with vegetables and meat, rice cakes, steamed dumplings wrapped in leaves, rice steamed in bamboo tubes, rice sweets, and rice wine (Watabe and Fukazawa 1998). In Myanmar, which directly neighbors Northeast India, glutinous rice is cultivated, especially in Kachin State in the north and the Shan Plateau in the east, and glutinous rice products are sold in markets. Like these regions, in the study village in Assam the production and consumption of the same glutinous rice products, with the exception of glutinous rice dumplings wrapped in leaves, are observed. Thus, the term "glutinous rice cultural sphere" is appropriate to apply to Assam. However, because glutinous rice is not consumed daily as the main staple in Assam, the region cannot be considered to be a part of the "center of glutinous rice culture." The use of glutinous rice products either spread from this "center" to Northeast India, or the custom of eating glutinous rice as the main staple was lost there.

Considering the other side of the glutinous rice cultural sphere, how much of a discontinuity is there in South Asia? Bangladesh, neighboring Assam to the west, is completely removed from the cultural sphere; instances of cultivation of glutinous rice plant are almost completely unknown (Watabe and Fukazawa 1998). However, surveys of villages in eastern Bangladesh have revealed many similarities with the study village in Assam in the rich usage of preparation methods. These include similar rice products, locally called *chira*, *pitha* made from a variety of glutinous rice (*binni dhan* in Bengali); steamed rice in bamboo tubes; steamed glutinous rice mixed with meat and vegetables; and puffed rice locally called *muri* and *akhoi* (Ando 1987). These names of rice products in Bangladesh are identical to those in Assam. The method of parboiling glutinous rice, used in the production of these rice products, is also the same as in Assam. Parboiling is a rice processing method widely observed not just in eastern Bangladesh but also in western Bangladesh and the Indian subcontinent (Kobayashi and Tani 2005).

These findings suggest that the geographic boundaries of the glutinous rice cultural sphere, with Northeast India considered until now as the western edge, need to be reconsidered. It is possible that a wide geographic range of the use of glutinous rice extending not just to Assam but also to the eastern part of the Indian subcontinent, including Bangladesh, can be confirmed. While the traditional view holds that there is a discontinuity in Northeast India, it is not certain whether this is definitively true. It is assumed that South Asia did not originally have a glutinous rice culture. How it entered the region remains to be investigated.

The question of where glutinous rice in Assam came from is also related to the problem of identity of the state's present inhabitants. Northeast India was annexed

into British territory in the 19th century, which is later than other parts of India, and the cultural influences from India are relatively less in the region. Also, the region is not fully integrated into the Indian political and social system (Barua 1999). The international border drawn in the year of the India-Pakistan partition (1947) geographically separates the region from mainland India. Therefore, inhabitants of Assam tend to feel more affinity to cultures in Southeast Asia than to those in India. Glutinous rice and its products are regarded as symbolic items that suggest their cultural bonds with the eastern region. The assertion of local historians who insist that glutinous rice was brought from the east by the Tai-Ahom king in the thirteenth century is also widely accepted in the region (Guha 1991). Thus, in Northeast India located at the edge of the glutinous rice cultural sphere, glutinous rice and food products are not just ordinary foods but ones that have social and even political significance to the local people.

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Fog and People in Xishuangbanna, Yunnan Province, China

Seiki Nomoto and Satoshi Yokoyama

Abstract The Xishuangbanna Dai Autonomous Prefecture, located in the extreme south of Yunnan Province (China), comprises 49 basins and is known as a region that experiences frequent foggy days. Different ethnic groups have long coexisted in this region, separated from one another by this fog. The Dai people inhabit the basin floors, where they have traditionally maintained trees, which are the water source for the fog, in order to use the latent heat of the fog droplets to protect their crops from cold nighttime temperatures. Meanwhile, the mountain ethnic minorities inhabit the nighttime thermal belt that exists on the slopes above the fog layer and also receives early morning sunlight, where they have traditionally practiced a form of swidden agriculture that promotes forest regeneration. The peoples in this region have thus been able to maintain stable geoecosystems over entire basin areas. Since the 1960s, however, large-scale development driven by national policy has started to erode the geoecosystems of this region.

Keywords Xishuangbanna · Land of fog · Dai people · Mountain ethnic minorities · Swidden agriculture

1 Introduction: The Road to Xishuangbanna

The Xishuangbanna Dai Autonomous Prefecture, located in the extreme south of Yunnan Province (China), comprises a mountainous region consisting of 49 basins. Flat basin and valley floors account for a mere 5% of the region's 17,000 km^2 area. According to 2017 data, the population of Xishuangbanna was about 1,180,000, with Dai, Hani, and others, including Han, accounting for 33.3, 20.7, and 46.0% of

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the population, respectively (Xishuangbanna Prefecture Government 2018). Even today, the ethnic groups are clearly segregated, with Dai and Han peoples occupying basin floors and mountain ethnic minorities inhabiting the mountain slopes. The Dai cultivate wetland rice, while the mountain ethnic minorities practice swidden agriculture. However, China's ethnic minority policies and rapid economic development have forced a shift in land use from swidden agriculture to more intensive agriculture and other types of land use such as para-rubber plantation (Huijun et al. 2002; Van Vliet et al. 2012). Trial cultivation of para-rubber in Yunnan Province began in 1948, followed by full-scale production of para-rubber on government farms starting in 1956 and subsequent rapid expansion of afforestation with para-rubber in Xishuangbanna supported by the Chinese government (Jianchu et al. 2005).

Although subject to loose control by the Han government, Xishuangbanna remained an independent country until 1949. The region's formidable terrain and endemic diseases, such as malaria and dengue, may have played a significant role in hindering the advance of Han people and maintaining the region's independence. Another factor was the physical distance of Xishuangbanna, located at the southernmost tip of China, from Beijing. It can well be imagined how difficult it would have been to travel a distance of over 3000 km from Beijing to Jinghong City, the seat of Xishuangbanna, at a time when infrastructure was not developed. According to an interview with Mr. Wang Ke, who has been working at the Yunnan Institute of Tropical Crops since its establishment in 1952 and served its former director, it took one month to travel from Beijing to Jinghong at that time. The last leg of the journey from Kunming, the capital of Yunnan Province, was on horseback, which was the only means of transportation (Nomoto 1993). The road from Kunming to Jinghong involves crossing the undulating Yunnan plateau in a southerly direction before descending into the Yuan River. Kunming is located 2000 m above sea level, while the floor of the Yuan River is 400 m above sea level. After passing through the Yuan River, the road passes over the Ailao and Wuliang mountain ranges before finally arriving at Simao (the old name for Pu'er), the gateway to Xishuangbanna. From there, the road traverses four more basins. Some distance after crossing the final peak, the Lancang River, called the Mekong River across the border, and Jinghong come into view below. Although the distance from Kunming to Jinghong is only 730 km, the journey takes three days and two nights by car because of the mountainous terrain (Fig. 1).

The rivers that flow from Yunnan into Vietnam, Laos, and Myanmar have carved deep ravines in southern Yunnan Province. As a result, the valley floors and surrounding highlands experience vastly different temperatures. The temperature of the Yuan River basin remains high even in January. Furthermore, because tropical plants and animals have infiltrated the region via valleys, low-lying areas in Xishuangbanna and parts of south Yunnan Province form a landscape similar in appearance to a tropical rainforest, which has resulted in the development of a unique dietary culture. Pangolins, which are similar to armadillos, can be seen hanging in dry goods stores along the Yuan River. Pangolins are found in Africa and Southeast Asia. Incidentally, a hot pot with pangolin meat is extremely

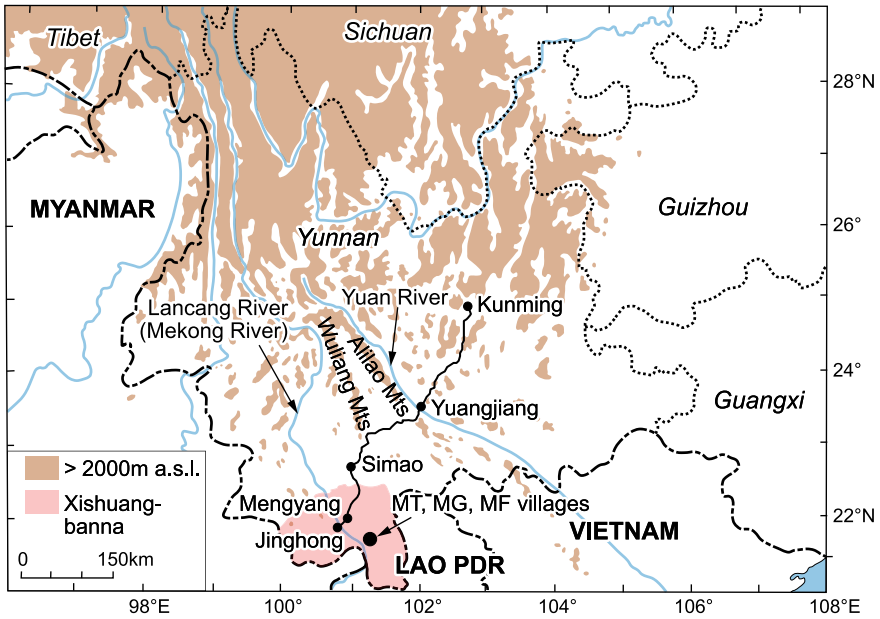

Fig. 1 Map of Yunnan Province

delicious. Elephants live in Xishuangbanna. Although it is no longer permitted, traditional Xishuangbanna cuisine included dishes featuring elephant meat.

At the same time, the warm, tropical forests and swamps of the valley floors are home to numerous endemic diseases, including malaria and dengue, as mentioned above. In the past, the region west of the Yuang River was feared by the Han to be a hotbed of tropical diseases. The writings of Hesheng Yao, which describe in detail the circumstances in Xishuangbanna in the 1930s, include frequent references to the threat of endemic diseases, wild animals, and bandits (Yao 2004). The Han, who moved to Xishuangbanna in the 1960s and later as a part of the government's effort to develop the region, also faced daily threats from endemic diseases and wild forest animals (Fukao 2004). Today, there is an airport in Jinghong, which has shortened travel time from Kunming to one hour. That said, until recently, the road to Xishuangbanna was long and perilous.

The objective of this chapter, after explaining the unique climatic characteristics of the region focused around fog, is to clarify livelihood changes of mountain- and basin-dwelling ethnic groups living above and below the fog in Xishuangbanna, where the influence of Chinese government policies has been increasing over the past 20–30 years. The climatic descriptions in this chapter are based on observations made by Nomoto from 1986 to 1993, while the descriptions of livelihood are based on a survey by Yokoyama conducted in 2011.

2 The Land of Fog, Xishuangbanna

The seasons in Xishuangbanna are interesting. Broadly speaking, the year can be divided into a rainy season and a dry season. The dry season can be further divided into a cool foggy season from late October to late November, cold foggy season from early December to mid-February, cool dry season from late February to late March, and warm dry season from early April to mid-May. As is also evident from the names of the seasons, except for the mountain meteorological observatories in China, Xishuangbanna experiences the highest frequency of foggy days of any region in China. During the foggy seasons between late October and mid-February, fog forms almost every day (Fig. 2). During the winter, the weather in Sichuan and Guizhou Provinces located to the north and east of Yunnan Province, respectively, is extremely bad. There is even a saying that "Shu dogs bark at the sun," meaning that the sun is so infrequently seen that Sichuan dogs become alarmed and bark whenever they see it. In contrast, the weather in Yunnan Province during the winter is good. In Yunnan Province, the number of daylight hours per month in January is 260 h, compared to 40 to 80 h in most areas of Sichuan and Guizhou Provinces. Looking southward from Sichuan Province, on the other side of the clouds, there is a temperate land with abundant light. The place name Yunnan (*Yun* = "clouds," *nan* = "south") is indeed a reflection of the climate. That said, owing to the fog,

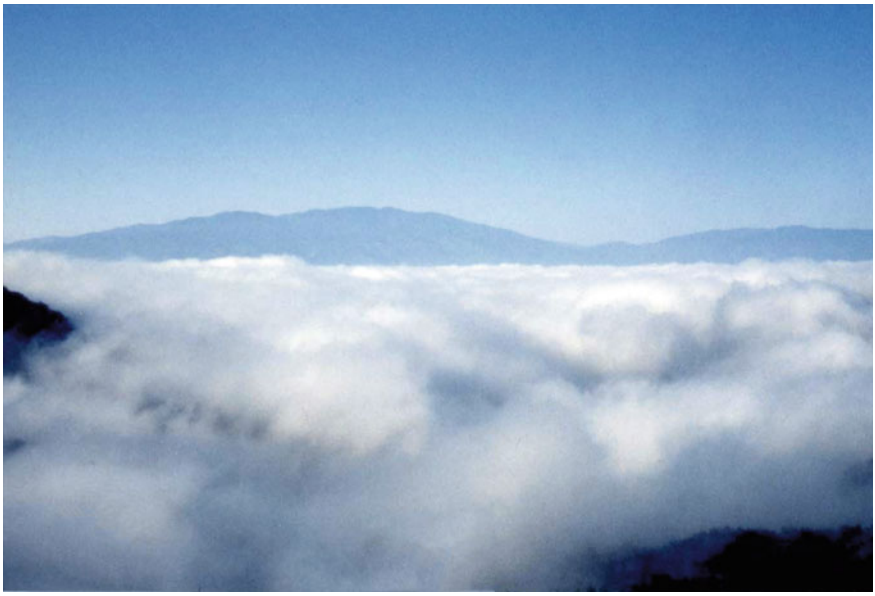

Fig. 2 The sea of clouds over the Jinghong basin viewed from swidden fields of the mountain people (1987)

Xishuangbanna does not receive sunlight in the morning, greatly reducing the number of daylight hours per month to approximately 200 h in January (Nomoto 1997).

2.1 Fog and the Dai People that Inhabit the Basin Floors

Traveling by car from Kunming to Xishuangbanna, after crossing the Yunnan plateau, one encounters a continuous series of mountain passes. Although the road crosses numerous small basins along the way, on the other side of each basin lies yet another mountain road to usher travelers to the next peak. After traveling in this manner, one finally arrives in Jinghong basin the breadth of which is nothing short of impressive. On this basin floor that seems to spread forever, Dai villages consisting of raised-floor houses are scattered among the paddy fields (Fig. 3). In the Era of Kingdoms (first half of the 13th century to the mid-20th century), each basin in Xishuangbanna was controlled by a different ruler (Kato 2000, pp. 25–65). It is likely that the ruler of the most productive basin became the king of all the basins. Given the sheer size of the Jinghong basin, it seems only natural that this basin became the imperial capital.

Fig. 3 Traditional raised-floor house of Dai people in Jinghong (2004)

Nomoto conducted meteorological observations in the Jinghong basin and Mengyang basin in collaboration with the Yunnan Institute of Tropical Crops and the Yunnan Institute of Meteorological Science over a four-week period from December 1986 to January 1987. The most striking result yielded by these observations was the change in nighttime temperature at the basin floor. The temperatures reached a minimum between 2 and 3 a.m. in the Jinghong basin and at around midnight in the much smaller Mengyang basin. Standard time in China is Beijing time, which is approximately two hours ahead of Xishuangbanna. Accordingly, sunrise in the Jinghong area occurs at around 8 a.m. Although temperature minima are almost always observed around sunrise in most locations, in this region, the lowest temperatures occur 6–8 h earlier. This is because latent heat is generated when fog forms. This heat, plus the radiation emitted by fog droplets, causes the air temperature to rise. The unusual nighttime temperature change that occurs at the basin floor is thus caused by the formation of fog.

This phenomenon is extremely important for the Dai people who inhabit the basin floor. The crops cultivated at the basin floor are able to avoid 6–8 h' worth of temperature drop thanks to the insulating/heating effect of the fog. Knowing from experience that the fog protected their plants from the cold and that the fog would occur reliably if the mountain slopes were left forested, the Dai people left much of the mountain surrounding the Jinghong basin forested.

2.2 The History of Two Realms Divided by Fog

Historically, it was in the 13th century, around the time of the Yunnan invasion by the Yuan Dynasty, that the Dai people in Xishuangbanna first attracted attention. Originally, the small countries in each basin formed a federation for the purpose of resisting the Yuan (Kato 2000). Although no historical records exist, the Dai people are believed to have lived peacefully, cultivating rice in the basins of Xishuangbanna even before this time.

When did people begin living on the mountains of Xishuangbanna? According to Nagatsuka (1993), the oldest carbonized wood fragments found in the soils of swidden fields are approximately 2000 years old. Although there is no definitive proof that these fragments are from swidden agriculture, the discovery of carbonized wood fragments of different ages suggests that swidden agriculture has been practiced continuously in the area. When we visited a mountain-top village to inquire about borrowing some land for setting up a weather monitoring station, we were told several interesting things. Among the most intriguing of these was that "The Xishuangbanna government is encouraging us to leave the mountain and move to a lower elevation, but we will not do so because this location receives a lot of sunlight" and "We borrow land from the forest and give it back." The result of weather monitoring revealed that because cold air accumulates in low-lying areas, the upper mountain slopes experience relatively warm nighttime temperatures, and that because the village and swidden fields are located above the fog, they receive

light and experience rapid warming as soon as the sun rises. The mountain peoples inhabit an area with favorable sunlight and temperature conditions. Examination of the swidden fields revealed that numerous tree stumps are left in place. New shoots are said to emerge from these stumps in as short a time as one year. The mountain peoples practice non-rotation swidden agriculture, which involves cultivating a parcel of land for one year and then leaving it fallow for 13–14 years before it is cultivated again. This swidden system is the same as that practiced by the Jinuo people in Xishuangbanna (Yin 2001, pp. 216–266).

The Dai people, who live on the basin floors, retain forests to enable the fog on which their agriculture relies, while the mountain people, who live above the fog layer, practice a lifestyle based on forest regeneration. The maintenance of these peoples' traditional lifestyles ensured maintenance of a stable geoecosystem until the 1990s. In recent years, however, the region has experienced a striking decline in the number of foggy days and changes in the amount of rainfall (Nomoto 2003; Arai and Nomoto 2006). According to Zhang (1986), the frequency of low temperatures in the dry season and the frequency of strong rains in the rainy season are both increasing. These changes began with the massive influx of new settlers into Xishuangbanna, who use the land in completely different ways than before.

3 Livelihood Changes

For many centuries, the Dai people living below the fog maintained prosperous kingdoms, fully reaping the benefits of nature's bounty by practicing traditional irrigated paddy farming and growing different types of vegetables in the lowlands. At the same time, the Hani and Jinuo ethnic minorities living above the fog lived in secrecy so as to avoid control by the government, making use of abundant forest resources and practicing a subsistence lifestyle based on swidden agriculture. In this section, we clarify recent livelihood changes experienced by the Hani and Dai in Xishuangbanna based on field research that we conducted in 2011.

3.1 Hani People Living in the Mountain

First, let us examine the case of MT, a Hani village located in Mengla County approximately 60 km southeast of Jinghong City. The Hani people, who are known as the Akha in Southeast Asia, live in Xishuangbanna as well as in mountainous regions of the neighboring countries of Thai and Laos. According to the villagers that we interviewed, MT village, comprising a collection of approximately 50 households, was formed in 1968. At the time of the 2011 field survey, the number of households had increased to 83.

When the village was established, there were no paddy fields, and the villagers practiced a subsistence lifestyle based on swidden agriculture with upland rice

being the staple crop. The villagers practiced a mixed planting system, cultivating maize, job's tears, and peanuts along with upland rice. Swidden fields were cultivated for two consecutive years and then left fallow for approximately seven years.

In 1983, a quarter century after the village was established, the Chinese government implemented a land and forest classification program. As a result, a nature protection area was established within the village. Given that the residential area was inside the protection area, the possibility of relocation was discussed. However, no suitable destination site was identified, and the residents continue to live in the same area today. At the same time, swidden agriculture was outlawed. Because the residents would be unable to support themselves without swidden agriculture, the government created 1 mu/person (0.067 ha/person) paddy fields, which they allocated to the villagers. In MT village, 1 mu yields approximately 400 kg rice. Although the area of the allocated fields is sufficient for subsistence production, the villagers also need to earn cash income. Accordingly, in addition to the paddy fields, the government allocated upland farmlands with an approximate area of 4 mu/person (0.27 ha/person). These farmlands consisted of fallow fields previously used in the swidden agriculture.

Furthermore, in 1984, the government established community forestland and granted each household the right to utilize approximately 10 mu (0.67 ha/household) of land. The community forestland was land to be used for the para-rubber afforestation being promoted by the government. However, because the community forestland in MT village is situated at an elevation greater than 1000 m, the rubber yield was less than half that in the basin. Consequently, the para-rubber afforestation did not advance much. In 2008, the government distributed the community forestland to the households, making the land completely private property. As such, the land became capable of being used for purposes other than para-rubber afforestation. In recent years, some residents have started to plant macadamia nut trees (*Macadamia integrifolia*) introduced from Australia. Seeds of macadamia nuts for consumption, which garner high prices in markets, began to be introduced in 2010. There is even a macadamia tree nursey near MT village (Fig. 4).

Despite the ban on swidden farming, because paddy fields were not available for new households that emerged after 1983 either through the splitting of households or the arrival of new settlers, those households continued to practice swidden farming outside the nature protection area. Swidden agriculture was only completely abandoned in 2005. Thus, swidden agriculture continued to be practiced for more than two decades after being banned. Today, even if the residents would want to practice swidden farming, there is no land left where they could do so. This is because there are no trees left on the mountain (Fig. 5). Every inch of the mountain slope is covered with para-rubber and banana trees. The traditional subsistence lifestyle practiced by the people living above the fog came to an end in the 1980s as a result of the government's land use policy. The livelihood structure had shifted to one embedded in the market economy wherein the residents cultivate cash crops, which they sell and use the cash earned to purchase food items.

Fig. 4 Macadamia tree nursery in Mengla County (2011)

Fig. 5 Banana and para-rubber planted on the mountain slope in Mengla County (2011)

3.2 Dai People Living in the Basin Floors

What was the state of livelihoods among the Dai people living below the fog on the basin floors? Let us examine the case of MG village, located in a basin lying approximately 20 km west of the Hani MT village. MG is a Dai village that has existed in this location for many centuries. Ancient documents contain records of a temple being built in 1061. As of 2011, the village comprised approximately 700 residents in 168 households.

For several centuries, the residents practiced subsistence rice farming in irrigated paddies. However, since 2000, the residents are also engaged in contract production with Han-owned companies of chili, watermelon, tomato, and maize in the paddy fields during the dry season. Some households grow three crops a year (rice-chili-maize) in the same paddy field. Land use in Dai villages located in basins is moving toward intensive farming entailing sequential cropping and use of chemical fertilizers.

In addition, para-rubber trees were planted around the village (Fig. 6). Para-rubber afforestation began in 1975. At the time of the survey, nearly every household owned approximately 2 mu (0.134 ha) of land for afforestation. Rubber production-related work is carried out from April to November and completely overlaps with the rice cultivation period. During this time, the residents fall into a daily routine that involves getting up at 3 a.m. and starting to harvest resin at 4 a.m. The residents finish harvesting by 9 a.m. at the latest. After that, they have breakfast and head for the paddy fields at 10 a.m.

Fig. 6 Para-rubber plantations in the basin floors (2011)

Up to that point, the residents had practiced a livelihood that entailed cultivating rice during the rainy season and cultivating vegetables for subsistence during the dry season. Today, however, the residents not only cultivate rice but also harvest rubber during the rainy season and grow cash crops during the dry season. Not only has the land productivity increased; so, too, has labor productivity. The residents were thankful for these changes, which caused residents' cash income and richness in everyday life to both increase.

Although we did not observe this at MT village, the residents of MF village, another Dai village in the same county, completely abandoned paddy production and began planting banana trees instead of rice (Fig. 7). In Xishuangbanna, banana production in paddy fields began in 2000 and thereafter spread rapidly (Zhang et al. 2014). For many centuries, rice cultivation in paddy fields was the most important livelihood activity for the Dai people. It is surprising that the important staple food, rice, had been replaced by the cash crop, banana, in only a few years. Moreover, the banana seedlings used are grown from tissue culture and need to be purchased from a seed company at a cost of 1 CNY per seedling. Cultivation of bananas grown from tissue culture requires the use of vast amounts of chemical fertilizers and insecticides, leading to concerns regarding the potential detrimental health effects on farmers.

It is not clear whether the Dai people desired this livelihood change. It is becoming rarer to see the lives of the Dai people coexisting with nature while cultivating crops and receiving the blessings of the fog.

Fig. 7 Banana cultivation in the paddy field of Dai village in Mengla County (2011)

4 Conclusion

Since the 1960s, forces have entered Xishuangbanna that are overpowering long-held views of nature and values. Unfortunately, along with the changes, these two nature-friendly realms are facing an inevitable demise. Furthermore, seeing the paddy fields that have been planted to banana since 2000, the dramatic change in the Dai's agriculture, which had previously emphasized rice cultivation, is nothing short of shocking.

Despite being banned by the government in the 1980s, the swidden farming practiced by ethnic groups above the fog continued to be practiced after 2000. However, swidden agriculture was completely abandoned in the mid-2000s. This period coincides with the period in which cash crop trees, such as banana and macadamia, started to be introduced. If we also consider para-rubber, which was introduced in the 1960s, it could be said that land use in Xishuangbanna has been changed as a result of government policies and the advance of globalization through the introduction of non-native trees and crops suited to Xishuangbanna's tropical/sub-tropical climate.

The mountain ethnic minorities inhabiting the highlands of Xishuangbanna reside in a region that is part of the area comprising Yunnan Province in China, Northern Vietnam, and Northeast India, referred to as "Zomia" by James C. Scott (2009, pp. 1–39). Starting in the 19th century, the territory occupied by each ethnic group has been assimilated into the domain of one of those countries, where it was subject to dramatic political and economic influence by the central government. Xishuangbanna has also historically experienced complicated political negotiations between the nation state and ethnic groups. The mountain ethnic minorities also engaged in political bargaining with the Dai who ruled the basins in Xishuangbanna. In other words, Xishuangbanna is a region in which the powers of the mountain ethnic minorities, the Dai people, and the Chinese government are complexly nested.

However, with the advance of globalization, the growing importance of cash income, and the increasing impact of the Chinese government's agricultural and forest policy, the differences in livelihood strategies of the Dai living below the fog and that of the ethnic minorities living above the fog are becoming less and less distinct. Furthermore, para-rubber and banana are being planted in both regions. That said, we do not believe that the ethnic identities of the different groups have been absorbed into the identity of the Han, who are the majority in China. Both the Dai and the mountain ethnic minorities continue to wear traditional dress and to celebrate New Year, the most important holiday of the year, based on their respective calendars and not on the Chinese calendar. Each ethnic group is looking to establish its own position within the nation-state framework that is China by accepting, negotiating with, or rejecting new developments. In Xishuangbanna, we see different ethnic groups inhabiting different physical environments. Politically, it is subsumed within the nation state of China and has followed a unique development path while being entangled in this framework. As such, it is a region that is also garnering attention as a model region for the blending of multiple cultures.

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Food and Regionality

Yamato-Shijimi and Environmental Changes in Lake Jusanko, Northern Japan, Over the Past Several Thousand Years

Naoto Koiwa and Mio Takahashi

Abstract This work involves the reconstruction of environmental changes regarding Yamato-shijimi (*Corbicula japonica*) over the past several thousand years based on a geomorphological study. Although a large amount of *Corbicula japonica* is currently available in Lake Jusanko located in northern Japan, a brackish lake, the environment has been observed to have experienced significant changes over the past several thousand years. In the study area, the effects of seawater became strong about 6,000 years ago because of the Holocene transgression. However, a period from 4,000 to 2,500 years ago, a stratified lake was formed in which has the halocline between epilimnion strongly affected by freshwater and predominant hypolimnion of seawater. During this period, an unsuitable environment for the growth of *Corbicula Japonica* spread. Subsequently, rivers transported large amounts of sediments through heavy rains generated in monsoon Asia, and the lake became shallow. Seasonal winds that are characteristic of East Asia frequently agitated the lake water, leading to the development of a brackish water environment that supported the conditions for *Corbicula japonica* to thrive.

Keywords Lagoon · Brackish water · Diatom analysis · Holocene

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1 Introduction

In Aomori Prefecture, there are television commercials in the early morning showing catches of Yamato-shijimi (*Corbicula Japonica*, commonly known as Japanese basket clam[1]) and powder products extracted from basket clams simmered in large pots. The authors of this chapter, residents of this prefecture, frequently experience hangovers, and the images of these commercials have the amazing effect of restoring upset stomachs. Several years ago, we drank an ample amount of alcohol, but also consumed a cup of basket clam soup, dried basket clams, and basket clams braised in soy sauce as side dishes. The next morning, we felt invigorated, which appeared to be an effect of *Corbicula japonica*. The amino acids alanine and glutamine found in the body of *Corbicula japonica* activate alcohol dehydrogenase enzymes in the human body,[2] giving the clams restorative properties.

Lake Jusanko in Aomori Prefecture holds top records for catches of *Corbicula japonica* in Japan. The Tsugaru Plain, located next to the lake, is home to numerous archaeological sites from the Jomon period and onward, such as the Kamegaoka Ruins. A large amount of *Corbicula japonica* shells have been discovered at these sites. Having a palliative effect on the stomach, the shellfish must have played an unmistakable role in the health of people since the Jomon period. Furthermore, *Corbicula japonica* diggers appeared to have been able to earn high incomes. In a section of a settlement near Lake Jusanko, large houses called "basket clam palaces" can be seen. Therefore, *Corbicula japonica* brought not only health benefits to people but also economic benefits to the region.

Our research interest is geomorphology, which seeks to understand how the terrain of a region is formed. Unlike the other chapters, here we describe the historical formation of Lake Jusanko and its environmental changes impacting *Corbicula japonica* over a long time scale of several thousand years.

2 Locality of *Corbicula Japonica* in Lake Jusanko

Lake Jusanko is a brackish lake located in the northernmost part of Honshu (Fig. 1). Although it has a surface area of 18.6 km^2, its depth is only 2 m at most, yielding a volume of just 16 million m^3. Considering its wide surface area, the lake has a small volume.

Lake Jusanko has a long barrier separating it from the Sea of Japan. Many brackish lakes have mouths where lake water flows out and seawater flows in. In the

[1]For purposes of general descriptions and cases, this paper will use the term basket clams. For purposes of the paper's scientific theme, this paper will use *Corbicula japonica.*

[2]Fisheries Cooperative Association of Lake Jusanko
http://www.trace-info.jp/jusanko/大和シジミとは/. Accessed 28 Jan 2018.

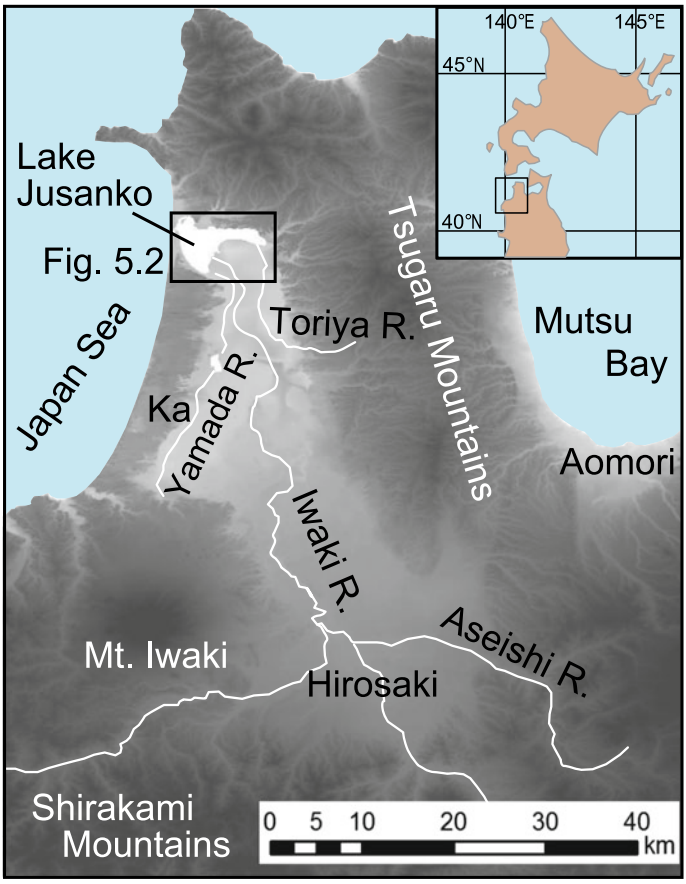

Fig. 1 Location map of the study area. Ka: Kamegaoka Ruins

case of Lake Jusanko, a large amount of sand is deposited at its mouth by strong winter winds and turbulent waves, blocking the exit of lake water to the sea. This blockage has induced frequent flooding upstream of the river flowing into the lake. To address these issues, a breakwater and training dike structure has been constructed. Currently, a moderate amount of seawater enters from this structure, creating a brackish water environment (Sasaki et al. 2011).

Corbicula japonica live in shallow water regions (depth of 4–5 m or less) (Ishikawa 2001). From the standpoint of depth, Lake Jusanko is perfectly suited as a habitat for *Corbicula japonica*. In brackish lakes, seawater from the open seas flows in and settles at the bottom of the lake because it is relatively heavier than fresh water, forming a halocline. This induces a dysoxic environment in the hypolimnion. If this dysoxic state continues for a long period of time, the lake would no longer be a suitable habitat for brackish water clams such as *Corbicula japonica* (Ishikawa 2001). In the Lake Jusanko region, cold winds called the

Yamase blow in from the Pacific Ocean (eastern) side several times from spring to summer. During winter, strong seasonal winds also blow in from the Sea of Japan side. These winds cause the mixing of seawater flowing in from the Sea of Japan and freshwater supplied by the Iwaki River, preventing the formation of a halocline in Lake Jusanko.

A delta has been formed in the lowest downstream region of the Iwaki River, where sediments transported by the river to water regions, such as the lake and the sea, accumulate. The gradient of the delta is finely divided into the foreset bed, where coarse sand from the large amount of dirt and sand flowing into the lake during flooding is deposited near the river mouth, and the bottomset bed, where fine sediment particles such as dirt in the inflow are suspended and slowly settle near the center of the lake. *Corbicula japonica* prefer sandy soil composed of less than 10% dirt (Nakamura 2000). Combining the topographical map of Lake Jusanko presented by Hirai (1994) and the density distribution of *Corbicula japonica* habitation from the Inland Water Fisheries Research Institute (2010), the habitat density of *Corbicula japonica* was found to be the highest at the delta plain and delta front (foreset bed), composed of sand, and on shelves near lakeshore areas (Fig. 2). Meanwhile, the distribution density of *Corbicula japonica* is low in areas corresponding to the bottomset bed, where dirt accumulates.

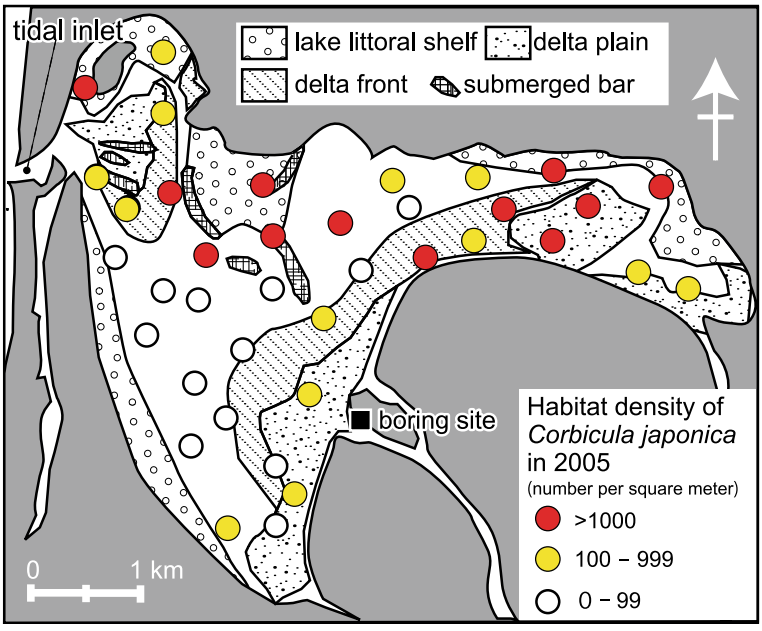

Fig. 2 Topography of Lake Jusanko and habitat density of *Corbicula japonica*. Modified from Hirai (1994) and Aomori Prefectural Industrial Technology Center's Inland Water Fisheries Research Institute (2010)

3 Changes in the Topographical Environment of Lake Jusanko Over Long Time Scale

3.1 Borehole Core Dating

To study the formation of Lake Jusanko, boring was carried out at the mouth of the Iwaki River (where the river flows into Lake Jusanko) to a depth of 58 m (Fig. 3). Sediments exhibited wide differences above and below a depth of 27 m. At depths below 27 m, layers of pebbles and relatively coarse sand intercalated between muddy layers were observed. A large amount of organic substances, such as wood fragments, could also be found in these layers. Considering these characteristics, it is surmised that these layers accumulated on land. Meanwhile, sediments at depths above 27 m were assumed to have been accumulated in water, such as the sea and the lake, because they contain many layers of sandy and muddy layers mixed with clam shells.

These clam shells and wood fragments were dated using accelerator mass spectrometry (AMS). Because AMS can measure ages with a small amount of samples, *Corbicula japonica* shells can be dated using only one sample for each layer. The wood fragments in the silt layers considered to be land sediments gave estimated ages of 12,250 ± 50 years BP (depth of 57.1 m) and 9,410 ± 50 years BP (38.6 m), and *Corbicula japonica* shells found between sandy layers at depths of 24–26 m, directly on top of the land sediments, gave ages of about 8,190 ± 50 years BP (Fig. 3). The age of the *Corbicula japonica* shell indicates the period of the Holocene glacial retreat, when the sea rapidly encroached on land after the Ice Age as the climate warmed. In addition, muddy layers containing *Corbicula japonica* shells and other clam shells were found at depths of 6–24 m. These fine-grained sediments can be inferred to be lake or sea bottom deposits accumulated when water regions formed after the Holocene glacial retreat. AMS results gave estimated dates of 5,760 ± 40 years BP at 18.6 m, 2,450 ± 30 years BP at 9.5 m, and 610 ± 30 years BP at 6.8 m, showing that the higher the layer of sediment, the younger its age. The layers of silt and clay demonstrate the progress of sedimentation in the water region.

The top portion of the borehole core shows a sandy layer of about 5 m thick. This layer is considered to be the layer that comprises the foreset bed of the lake delta. In this sandy layer, particles become larger with decreasing depth of the level, showing the gradual approach of the once-distant river mouth to the bore site. Overall, the results show the development of the delta. The bottom portion of this sandy layer contains *Corbicula japonica* clams dated to be about 220 ± 30 years BP (Fig. 3). These results show that the development of the delta at the mouth of the Iwaki River is extremely recent.

As mentioned above, many different types of clam shells, including those of *Corbicula japonica*, were found in the borehole core (Fig. 4). *Corbicula japonica* shells occurred frequently in multiple horizons at depths of 6–12 m and in the sandy layer at depths of 24–25 m. However, the clam shells did not occur

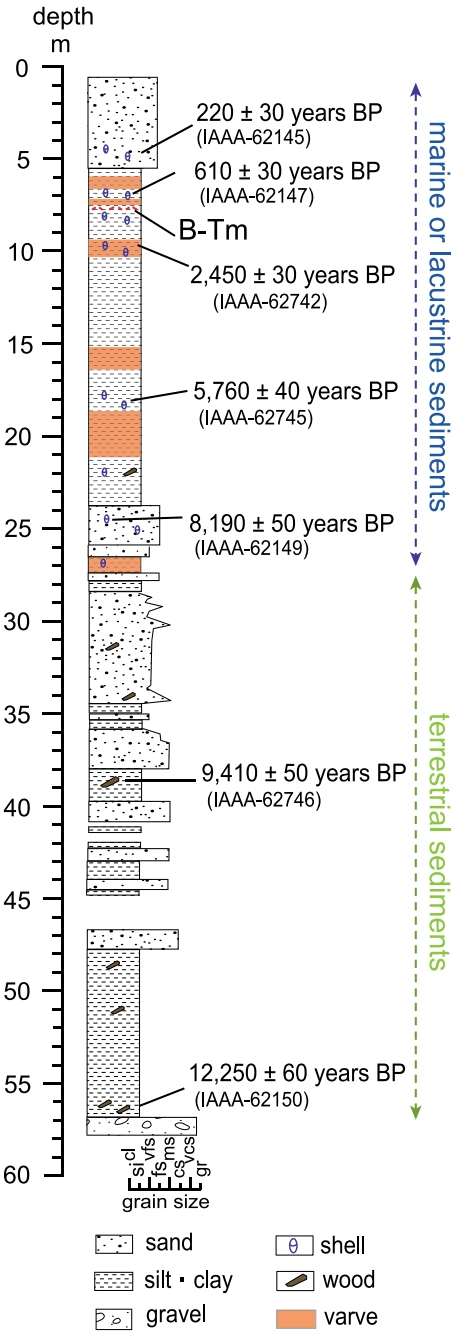

Fig. 3 Columnar section of boring core collected from the mouth of the Iwaki River. The boring site is shown in Fig. 2

Fig. 4 *Corbicula japonica* shell collected from borehole core

continuously throughout the core; none could be found at depths of 12–18 m. In addition, at the depth of 18.6 m, the observed bivalves were clearly different from *Corbicula japonica*. There is a possibility that these shellfish were transferred by streams from the area they actually inhabited and redeposited here. While the habitat cannot be precisely identified, there is no doubt about the time period of their habitation from the age of their shells.

3.2 *Lake Jusanko's Water Environment as Reconstructed from Fossils*

To understand changes in the water environment of Lake Jusanko, we conducted an analysis of diatoms in about 20 horizons of fine sediments at depths of 6–24 m. Diatoms are single-celled algae with siliceous skeleton, and they are adapted to living in saline, acidic, streaming, and other types of environments. The water environment of a past time period can be reconstructed from fossilized diatoms in sediments. For analysis, about 1 cm^3 of sample was taken from sediments. After treatment, the sample was magnified by about 1,000 times using a microscope to identify and quantify the genus or species of the diatoms.

Here, we omit detailed entries of the diatom genera or species. Instead we group the identified diatoms by their habitat environment and describe the changes in the time period of each environment (Fig. 5). The following five findings can be deduced:

(a) From 8,000 to 6,000 years ago, marine/brackish water diatoms gradually increased, and the percentage of freshwater diatoms, which had been predominant previously, dropped suddenly.

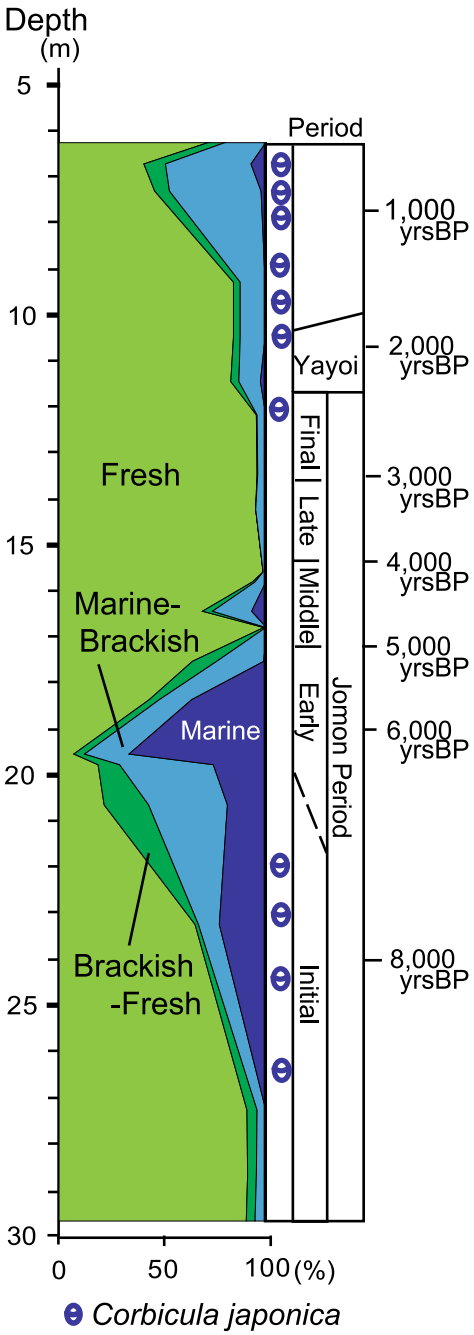

Fig. 5 Changes in the lake environment since the early Holocene based on diatom analysis of borehole core. The boring site is shown in Fig. 2. The Jomon period that indicates a prehistoric culture in Japan began approximately 15,000 years BP after the end of the Last Glacial age. The Jomon period is subdivided into five stages. This figure shows these stages except for the first stage called Incipient Jomon

(b) About 6,000 years ago, seawater diatoms became predominant, and freshwater diatoms decreased to an extremely small amount.
(c) From 4,000 to 2,500 years ago, freshwater diatoms became predominant.
(d) From 2,500 to 1,100 years ago, freshwater diatoms continued to be predominant. However, brackish water diatoms increased slightly.
(e) Since 1,100 years ago, brackish water diatoms have been increasing.

Although large amounts of *Corbicula japonica* are currently found in Lake Jusanko, over the past several thousand years the environment experienced significant changes, as summarized in (a)–(e) above. Based on these results, we recreated the geomorphic environment of Lake Jusanko and its surroundings over the course of time (Fig. 6).

As shown in Fig. 6, an area that had been land (near the mouth of the Iwaki River today) became part of the sea about 8,000 years ago. At that time, there was brackish water, and the environment supported the inhabitation of *Corbicula japonica*. Subsequently, the advance of the sea reached its peak (about 6,000 years), and the salinity of the environment was as high as that of the open sea or the inner harbor. This period was unfavorable for the growth of *Corbicula japonica*.

During the time period of (d), the effects of freshwater continued to be extremely strong (Figs. 5 and 6). The predominance of freshwater diatoms suggests that the epilimnion must have been completely freshwater (Kashima 2001). In agreement with this conclusion, *Corbicula japonica* shells were not found at all in the borehole core corresponding to this time period.

What about the bottom of the lake? Was it also freshwater? To further study the lake water environment, we conducted a sulfur analysis of its sediments. In sulfur analysis, the amount of pyritic sulfur produced from the effects of the sulfur ion concentration in sediments is measured. Sediments deposited in seawater or brackish water would contain a greater amount of pyritic sulfur that those deposited in fresh water. The results of the analysis revealed that not only sediments predominated by marine and brackish water diatoms but also sediments of time period (d) predominated by freshwater diatoms were marine sediments. The finding indicates that even though the diatom analysis indicates a freshwater epilimnion, sedimentation at the lake bottom was strongly affected by seawater.

Overall, the following scenario can be deduced. Shortly after the Holocene transgression, the water region of Lake Jusanko was partially filled by sediments. Subsequently, a tidal inlet formed in the sandbar, separating Lake Jusanko from the Sea of Japan and allowing lake water to flow out and seawater to flow in. During that time, the depth of Lake Jusanko was than the present depth. Seawater that flowed in gathered near the lake bottom, while freshwater supplied from rivers and streams predominated at the epilimnion. The layers could not mix, forming a halocline formed. Afterwards, sediments from rivers and streams accumulated, and the lake became shallower. As a result, winds could agitate the lake water down to the lake bottom, creating a brackish water environment favorable for the growth of *Corbicula japonica*.

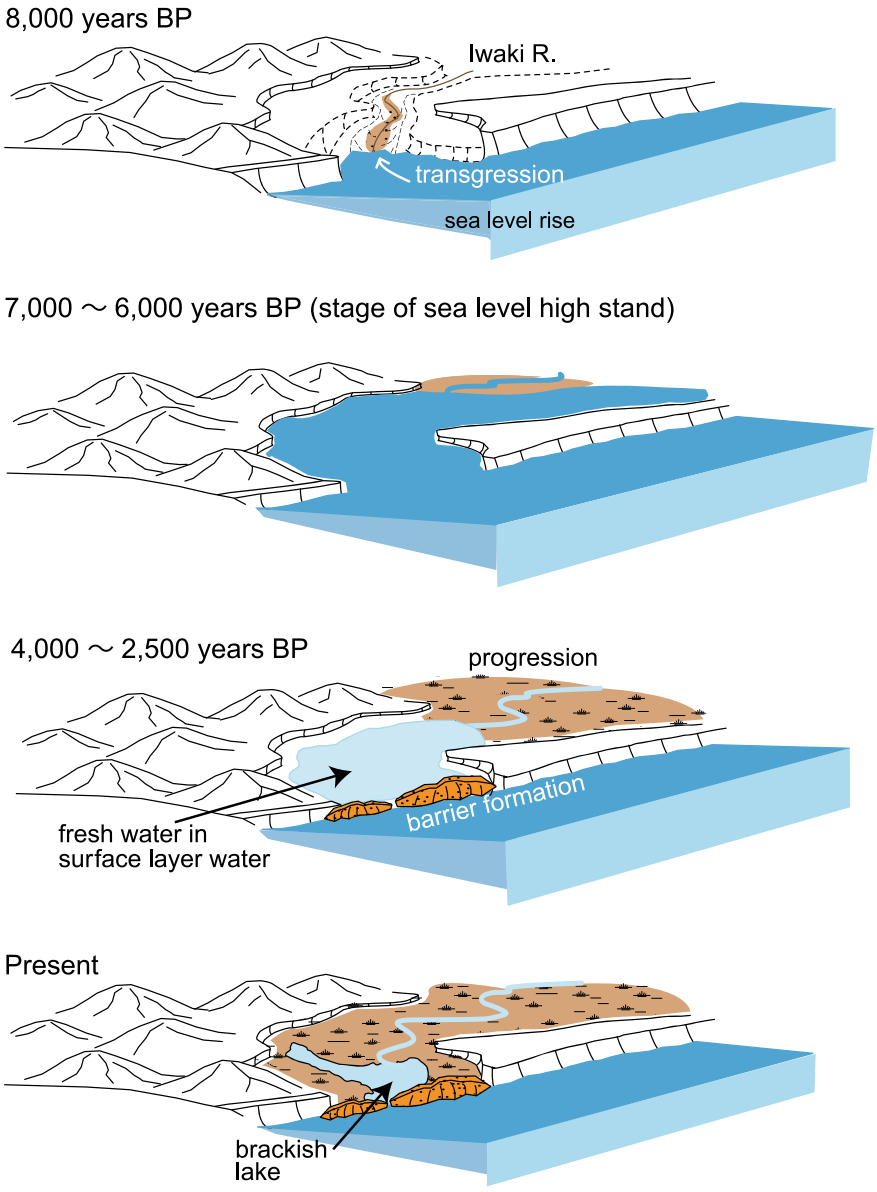

Fig. 6 Schematic diagram of the geomorphic changes in the lake environment. This figure shows a bird's-eye view from the northwest direction, indicating landform development since the past 8,000 years in the lower part of the Iwaki River

4 Conclusion

As described above, a brackish water environment formed in Lake Jusanko during the Holocene glacial retreat. Afterwards, the effects of seawater became strong about 6,000 years ago. The water environment then became brackish for a while. However, for a period from about 4,000 to 2,500 years ago, fresh water strongly affected the epilimnion, and a deep lake was formed, in which a halocline of seawater distributed in the hypolimnion was evident. An environment unfavorable for the growth of *Corbicula japonica* spread. Afterwards, rivers and streams such as the Iwaki River transported and deposited dirt and sand, and the lake became shallow. Seasonal winds frequently agitated the lake water, leading to the development of a brackish water environment that supported the conditions for *Corbicula japonica* to thrive.

Japan, located in monsoon Asia, also lies on a mobile belt. It is a region with dynamic tectonic changes and volcanic activities. Furthermore, the frequency of intensive torrential rain is high because of typhoons and the seasonal rain front. With torrential rains, large amounts of sediments from protruding mountains formed by active tectonic movements are transported by rivers and streams. These sediments are deposited at river mouths and basins and form plains. Lake water in shallow lagoons not fully filled with sediments through such a process is agitated by seasonal winds, creating brackish water environments. This can be said to be a particular product of monsoon Asia's mobile belts.

Nevertheless, the influence of human actions in sustaining the habitat environment of *Corbicula japonica* in Lake Jusanko should not be ignored. Currently, sand produced in mountains is trapped by dams constructed upstream and cannot be transported downstream by rivers and streams. As a result, Lake Jusanko is not completely filled by sediments. Furthermore, the closure of tidal inlets is artificially prevented, promoting the moderate inflow of seawater. If human beings are "involved in the natural environment as they assert themselves" (Preface), humans have asserted themselves in the Lake Jusanko region by preventing flooding to increase agricultural production. As a by-product, *Corbicula japonica*'s environment is sustained, and the economy of the region also reaps benefits.

From the perspective of a long time scale, Lake Jusanko has repeatedly been an environment inhospitable to *Corbicula japonica*. While it is undoubtedly true that the environment surrounding *Corbicula japonica* will change greatly in the future, we quietly hope that *Corbicula japonica*, which has satisfied the appetite of people since the Jomon period, will continue to comfort the stomachs of those who enjoy alcohol.

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Natto in Mainland Southeast Asia

Satoshi Yokoyama

Abstract In the mid-1960s, the "lucidophyllous forest culture" theory was proposed. This proposal notes that lucidophyllous forests range from Japan to mainland Southeast Asia to the Himalayas, and that commonalities could be observed in the use of vegetation in these regions, suggesting the existence of similar cultures. Non-salted fermented soyfoods (*natto*) are also widely found in the lucidophyllous forest range, and is considered an element of lucidophyllous forest culture. There have been many theories proposed and debated concerning the origin of non-salted fermented soyfoods and how they were propagated, but no clear proof has yet been established. In this paper, we compare between regions and peoples the forms, production methods, and uses of *natto* made for countless generations in mainland Southeast Asia to shed light on the characteristics and universality of the soyfood in each region. We then discuss the approach, based on our field surveys, to elucidate the origin and propagation of *natto* within mainland Southeast Asia.

Keywords *Natto* · Non-salted fermented soyfoods · Lucidophyllous forest culture theory · Mainland Southeast Asia

1 Introduction

Natto is a traditional Japanese soyfood by fermenting with *Bacillus subtilis* var. *natto*. In addition to being high in protein, soybeans also include isoflavone, which has the effect of lowering blood pressure. Other active ingredients include "nattokinase," a thrombolytic enzyme produced by *B. subtilis* var. *natto* (Kiuchi et al. eds. 2008, pp. 53–57). In January 2007, a health program on TV promoted *natto* has having weight-loss benefits, resulting in its selling out in supermarkets all across Japan. It was revealed, however, that the program used fabricated data in its

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presentation of *natto*, and the *natto* boom lasted only a week (Asahi Shimbun, Tokyo, Jan. 21, 2007, morning edition).

However, *Natto* can be still obtained anywhere in Japan, so that it is considered by the Japanese people to be representative of the country's traditional food. Surprisingly, despite *natto's* revered status, its birthplace remains obscure. Furthermore, like *natto* in Japan, fermented soybean foods without the addition of salt (non-salted fermented soyfoods) are also found in Korea, China, and mainland Southeast Asia (Laos, Thailand, and Myanmar). In this paper, we explore theories on the birthplace of *natto*, and introduce characteristics of *natto* in mainland Southeast Asia.

2 Theories on the Birthplace of *Natto*

A stone monument in Kanazawa Park, located in Yokote City, Akita Prefecture, bears the inscription "The Birthplace of *Natto*." It is written that the *natto* has its origin in an episode during the *Gosannen-no-eki* (Later Three-Year War) from 1083. Cooked soybeans stuffed into straw bags were delivered by farmers. After a few days, the bags released a scent. Surprised, the farmers opened them, tasted the beans (which had become sticky), and found them to be delicious. Thus *natto* was passed down to succeeding generations. This is the story told in Yokote. Similar folktales are also found in areas such as the vicinity of Hiraizumi town, Iwate Prefecture, which is associated with the samurai *Minamoto no Yoshiie*, the key player in the *Zenkunen-no-eki* (Former Nine Years War) from 1051 and the Later Three-Year War; Iwadeyama, Miyagi Prefecture; Ibaragi Prefecture; Otawara, Tochigi Prefecture; and Kyoto (Foods Pioneer ed. 1975). However, just as rice and soybeans are crops introduced from mainland Asia, there is no special reason to believe that the conditions for producing *natto* arose only in Japan. Accordingly, we should be able to find the birthplace of *natto* outside Japan as well.

The argument for seeking the origin of *natto* outside Japan stems from the "lucidophyllous forest culture theory," debated from the 1960s to 1970s (Ueyama et al. 1976). Lucidophyllous forests range from Japan to mainland Southeast Asia to the Himalayas. Similar plant uses can be found in these regions. It was suggested that as a result, similar cultures also exist in these regions. The use of non-salted fermented soyfoods similar to Japanese *natto* was considered an element of lucidophyllous forest cultures. (Hereinafter, to distinguish between *natto* found in Japan and in the rest of Asia, the respective terms "Japanese *natto*" and "*natto*" will be used.)

Sasuke Nakao, an advocate of the lucidophyllous forest culture theory, proposed the "Great *Natto* Triangle", a triangular region in which *natto* is distributed, bound by the fermented soybean products *tempe* in Java, *kinema* in the Himalayas, and Japanese *natto* (Nakao 1972). According to this theory, *natto* originated in China's Yunnan Province, and propagated from there to the Himalayas and Java, and then from Java to Japan. However, it was later learned that the fermenting agent of *kinema* and Japanese *natto*, *B. subtilis*, differs from that of *tempe*, *Rhizopus* spp.,

a fungus. Even though they are all non-salted fermented soyfoods, *tempe's* fermenting agent differs from that of *kinema* and *natto*. It is therefore believed that the distribution of *natto*, which uses *B. subtilis*, is an ellipse-shaped region joining the Himalayas and Japan.

This Chinese-origin-of-*natto* theory is also supported by Yoshida (1993) because of its relationship with the region where soybean cultivation originated. Yoshida believes that *natto* was produced as a result of failures in the process of making the Chinese condiment *douchi*. (For *douchi*, boiled soybeans are subjected to mold, and then dampened for fermentation). *Natto* became more widespread because it could be produced more easily than *douchi*. The cultivation of soybeans is believed to have originated in the Jiangnan region of China, and it is hypothesized that there is correlation between soybean cultivation and the birthplace of fermented soybeans. According to Yoshida, fermented soybeans then spread to India and Nepal, and in other directions to southern China, Korea, and Japan.

Meanwhile, since the 1980s, elucidation of Japanese *natto*-producing bacteria has proceeded as microorganism-analysis technologies developed (e.g. Hara et al. 1982; Inatsu et al. 2006; Nishito et al. 2010). However, even if the physical properties of the bacteria are revealed, researchers cannot elucidate from where and to where the methods of *natto* production propagated. What's more, it is not even known where Japanese *natto* originated in Japan, even as it is a traditional food of the people. It may be never known if Japanese *natto* has independent roots in Japan, or if it came from the mainland Asia. The only thing known at this time is the different varieties of *B. subtilis* used for fermentation in the different regions of Asia (Inatsu 2008). It is not clear if *natto* arose by accident in Japan on the backs of horses, as passed down by folklore, or propagated from the mainland Asia. There is no way of knowing for certain.

In Japan, it is known that horses were used from the middle of the 3rd century at the least by archeological research. Cooked soybeans and rice straw used as fodder were often placed next to the horses. It cannot be denied that Japanese *natto* might have come about fortuitously in such an environment. An interesting experiment was carried out to test this theory. Matsumoto (2008) sought to determine if Japanese *natto* could be produced by placing soybeans and rice straw on the human body. The human body's temperature is only one degree lower than that of horses, not a great difference. Although Japanese *natto* having sticky strings like the commercial version was not produced, the flavor of the soybeans was indeed that of Japanese *natto*. Whether Japanese *natto* has sticky strings is not simply a matter of the fermentation temperature. For example, in the Tohoku region, "*yuki* (snow) *natto*" is produced by wrapping cooked soybeans in straw and fermenting them in snow for a long period of time. And, as noted above, sticky strings are not produced simply by using rice straw, but are largely determined by the supply of *Bacillus subtilis* var. *natto*. For example, in Kumamoto, it is traditional knowledge that straw from paddy fields that have been continually cultivated and used provides greater concentration of *B. subtilis* var. *natto* than rice straw from new paddy fields (Foods Pioneer 1975). Therefore, although *natto* production failed at the temperature of the

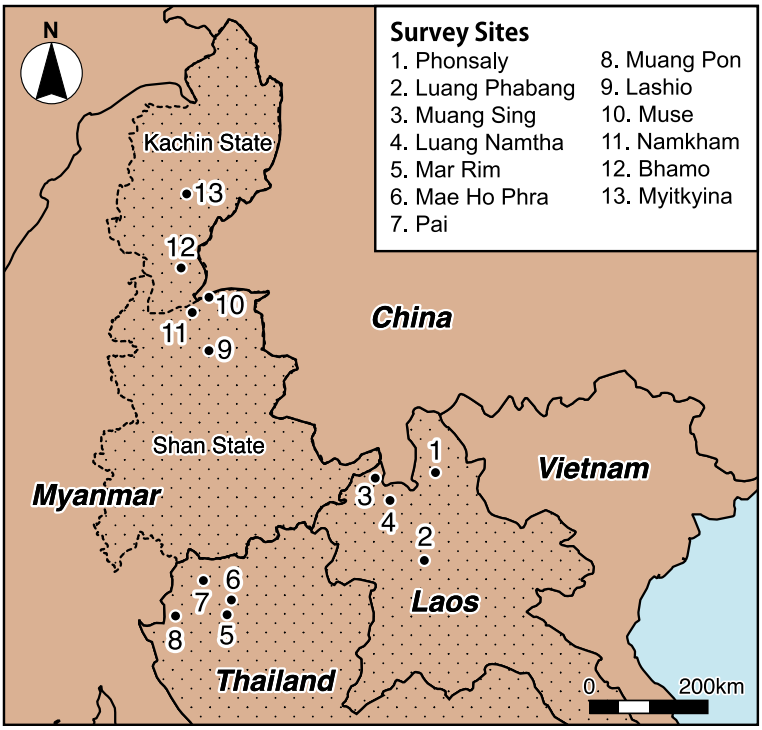

Fig. 1 Survey sites

human body, Japanese *natto* might have been produced on the backs of horses, depending on conditions.

Although many people may be interested in the birthplace of *natto*, a traditional food of Japan, exploring its origin is extremely difficult. However, if we diligently investigate *natto* in the different regions of Asia, we may find the key to identifying its birthplace. Thus, in this chapter, we introduce *natto* that we surveyed in Laos, Thailand, and Myanmar (Fig. 1). These countries in mainland Southeast Asia, part of the lucidophyllous forest range, are not well known for their production of *natto* compared with other Asian regions where *natto* is currently produced.

3 Types of *Natto* in Laos, Thailand, and Myanmar

In the local languages of these countries, what is *natto* called? In Laos and Thailand, it is called *thua nao*. In Lao and Thai, *thua* means "beans" and *nao* means "fermented." Thus, *thua nao* means fermented beans. In Myanmar, *natto* is called *pebouk*. In Burmese, *pebouk* has diverse meanings. In general, it means "soybeans," but it can also mean fermented soybeans. In the sections below, we explain the

types and production methods of *thua nao* in Laos and Thailand and *pebouk* in Myanmar.

3.1 Types and Uses of Natto *in Laos*

Laotian *natto* can be divided roughly into three shapes: granular form (*thua nao pen met*), the original form of the soybeans in their fermented state (Fig. 2); ground form (*thua nao mu*) (Fig. 3); and dried flat "cracker" form (*thua nao paeng*) (Fig. 4). The production of *natto* is limited to northern Laos, heavily centered in Muang Sing (Fig. 1, Site 3). From our field survey in Muang Sing, we learned that *natto* was brought into the region by ethnic Tai who immigrated from Yunnan Province in China three generations ago. Therefore, the *natto* of Muang Sing was propagated from China.

This *natto's* method of production is extremely simple. First, soybeans are sun-dried. The drying period may be long or short depending on the weather. The dried soybeans are placed in into large pots and boiled for about half a day. Next, they are placed in highly breathable plastic bags, commonly used for the transportation of rice. The process of fermentation is completed as-is in about two days.

Ground *natto* (*thua nao mu*) is produced by pounding granular *natto* with mallet and mortar as salt and chili powder are added (Fig. 5). Dried "cracker" *natto* is produced by forming ground *natto* into disks about 10 cm in diameter; the disks are then dried lying flat. Their thickness varies depending on the producer.

Dried "cracker" *natto* is roasted over fire or fried in oil and eaten. As for granular and ground *natto*, their uses include being mixed in *cheo* (mixed paste consisting of

Fig. 2 Laotian *natto*, *thua nao*: granular form. (Photo by author in 2007)

Fig. 3 Laotian *natto*, *thua nao*: ground form. (Photo by author in 2007)

Fig. 4 Laotian *natto*, *thua nao*: dried flat "cracker" form. (Photo by author in 2007)

Fig. 5 *Natto* producer in Sing district, Laos. (Photo by author in 2007)

fish sauce, chili, herbs, etc.), as a condiment added to glutinous rice, and in meat paste placed on rice noodles called *khao soi* (Fig. 6). *Khao soi* is the form of rice noodle generally found in northern Laos. When we consider the amount of *khao soi* consumed, we can see that *thua nao* is used to a great extent in the region.

3.2 Types and Uses of Natto *in Thailand*

Thai *natto* is found only in the northern part of the country. It can be divided roughly into three forms, all of which are exactly identical to the Laotian versions: granular (*thua nao sa*), ground (thua *nao mu*); and dried "cracker" (*thua nao paeng*). Granular form similar to Japanese *natto*, however, is found almost nowhere in local markets. Also, because ground *natto* is added to glutinous rice for consumption, it is often divided into small pieces and wrapped in banana leaves for sale in markets.

As a case study, we explain the Tai Yai people's method of producing *thua nao*. Identical to the Shan people of Myanmar, this ethnic group resides in Mueang Pon in Khun Yuam District, Mae Hong Son Province, in northern Thailand (Fig. 1, Site 8). First, dried soybeans are washed, and then soaked in water overnight. The beans

Fig. 6 Rice noodles called *khao soi* with *thua nao.* (Photo by author in 2007)

are then placed in large pots and boiled for about five hours until soft. Unlike the method used in Laos, the interior of bamboo basket is lined with leaves of *Dipterocarpus tuberculatus*. Boiled soybeans are placed into the basket to be fermented (Fig. 7). Furthermore, pine branches are stuck into the baskets to add aroma. After being left undisturbed for three days, granular *natto* is produced. Like Japanese *natto*, this village's granular *natto* has sticky strings. However, in Thailand, granular *natto* is seldom eaten as-is, but instead processed into ground *natto*. There are areas that use pestle and mortar to ground the granules. Recently, however, the use of meat-mincing mixers has become prevalent. After the *natto* is ground, it is mixed with salt and spices such as garlic, chili, and lemongrass. To the Japanese palate, this ground *natto* is quite salty. Furthermore, to process ground *natto* into dried "cracker" form, ground *natto* is formed into balls the size of ping pong balls, and then pound flat. The pieces are then air-dried on bamboo-woven webbing. If the *natto* crackers are dried well, it is said that they can be stored for one year.

Thai *thua nao* has many culinary uses. It is added to soup, broiled in wraps, used in vegetable dressings, and as seasoning for grilling and stir-frying, among other uses, making it more functionally diverse than Japanese *natto*. In northern Thailand, fermented rice noodles called *khanom chin* are served in a soup called *nam ngiao*,

Fig. 7 Bamboo basket and leaves of *Dipterocarpus tuberculatus* which are used for producing Thai *natto*, *thua nao*. (Photo by author in 2009)

to which *thua nao* is added. The use of *natto* in rice noodle soup is fascinating in the similar use in Lao's *khao soi*, a soup.

3.3 Types and Uses of Natto *in Myanmar*

Myanmar *natto*, called *pebouk* in Burmese, can be divided into roughly two forms: dried and wet. Dried *natto* is called *pebouk chauk*, and is equivalent to the dried "cracker" *natto* of Laos and Thailand. Wet *natto* is called *pebouk so* and is similar to the granular and ground forms of *natto* in Laos and Thailand. However, compared with the two countries, there is an overwhelming variety of *natto* in Myanmar.

Dried "cracker" *natto* sold in a variety goods store in Lashio, Shan State (Fig. 1, Site 9), is available not only in thin, round form, but also in rectangular form. Furthermore, there are also *natto* "crackers" thicker than one centimeter. As for *pebouk* so, there are many types of processed *natto* in granular form. In a market in Muse, Shan State (Fig. 1, Site 10), *natto* fried in oil and sweetly flavored and *natto* mixed with sauces like chili can be found. Dried *natto* in granular form are sold in a market in Namhkam, Shan State (Fig. 1, Site 11), which appears just like air-dried

Fig. 8 Steamed *natto* with cylindrical shape in Shan State. (Photo by author in 2009)

Japanese *natto*, a specialty of Ibaraki Prefecture. Furthermore, ground *natto* is used in an unusual manner, where it is dried once and then steamed and shaped into a cylindrical shape (Fig. 8). *Natto* in this cylindrical form is soft like clay, and bits are broken off to be used as seasoning for soup and stir-fried dishes.

We interviewed people about granular string *natto* found in the markets in Shan State, and learned that while it was not sold, it was being produced. However, in markets in Bhamo, Kachin State (Fig. 1, Site 12), located further north, more granular *natto* than processed *natto* could be found. Further north in Myitkyina (Map 2 Location 13), the capitol of Kachin State, granular *natto* with strong sticky strings (Fig. 9) made up the majority of *natto* sold. In Myanmar, the further north one travels, the prevalence of *natto* similar to Japan's string *natto* increases.

When we conducted a field survey in a small village in Namkham, Shan State (Fig. 1, Site 11), about the method of *natto* production in Myanmar, we found that the process until the granular form is basically the same as the process used in northern Thailand. No plants are used as the source of bacteria for fermentation. However, until the 1990s, producers stated that teak leaves or fern leaves were used to line hemp sacks. In Shan State, fern leaves still seem to be widely used today to supply bacteria during fermentation (Yoshida 2000, p. 70).

In Myanmar, the types of bags and baskets used to ferment boiled soybeans differ for each region, as do the methods used to supply bacteria believed to be

Fig. 9 Granular *natto* with strong sticky strings in Kachin State. (Photo by author in 2009)

active in fermentation. For example, in a village on the outskirt of Lashio in Shan State, where we stopped by in the middle of our survey, plastic bags were used to ferment soybeans. Leaves from trees of *Dipterocarpus tuberculatus* were used to line the packs. These were the exactly the same plants used to supply bacteria as the plants in Thailand. Also, in Kachin State, where string *natto* in granular form is produced, the fermentation method differs from the other areas. Boiled soybeans are not placed in large vessels like bamboo baskets or plastic bags. Instead, small amounts of boiled soybeans are wrapped in leaves and fermented. The *natto* is then sold still wrapped in its leaves. In Myitkyina (Fig. 1, Site 13), we encountered a Kachin household (Zaiwa people) that was producing string *natto* called *pebouk chauk*. The leaves used for fermentation were leaves from *Ficus* spp. planted by the producer in the garden.

In this section, we examined the types of *natto* found in the markets of Laos, northern Thailand, and Myanmar, and their production methods and uses. In terms of the quantity of varieties, we can say that Myanmar is the region with the greatest diversity of *natto*.

4 Regional Features of *Natto* Production in Mainland Southeast Asia

4.1 Changes in Method of Production

In mainland Southeast Asia, households that mass-produce commercially do not use bamboo baskets (shown in Fig. 7) as fermentation vessels. Instead, boiled soybeans are simply left in plastic bags (Fig. 10) for two to three days; plants that serve as the source of bacteria are also not used. Commercially mass-produced *natto* come in ground form and dried "cracker" form, which are sold in mass quantity wholesale to markets, or supplied to intermediaries, also in mass quantity.

In Laos, there are almost no households that produce *natto* for personal consumption. Almost all producers sell *natto* in the markets. Consequently, all the *natto* in our studies were soybeans fermented using plastic bags, and we did not encounter any households that used bamboo baskets or plants as the source of bacteria. In northern Thailand, households producing small amounts of *natto* for self or village consumption place boiled soybeans in bamboo baskets lined with plant leaves. Households that use teak leaves to ferment soybeans claim that their *natto* is tastier than *natto* produced by plastic bags. On the other hand, households

Fig. 10 Plastic bags which used for fermenting soybeans in Shan State, Myanmar. (Photo by author in 2009)

that commercially produce *natto* wholesaled to local markets use plastic bags. In Shan State, Myanmar, *natto* is produced using plastic bags, but there are also villages that place plant leaves in the packs.

When mass-producing *natto*, it is extremely troublesome to gather leaves for lining bamboo baskets. Therefore, a fermentation process using plastic bags without placing bacterial sources is most likely inevitable. Plastic bag-based fermentation produces *natto* without strong strings. *Natto* is also mass-produced in Japan, but instead of supplying bacteria from rice straw, *B. subtilis* var. *natto* is sprinkled over soybeans in factories. Similar simplification is also found in mainland Southeast Asia. The traditional fermentation method of using bamboo baskets and lining them with plant leaves is disappearing.

4.2 *Features and Comparison of Mainland Southeast Asian* Natto

In contrast with Japanese *natto*, which is placed on rice and eaten as-is, many of the *natto* in mainland Southeast Asia are used as seasoning. The Japanese tend to consider their *natto's* sticky strings as an essential feature of *natto*. However, because *natto* in mainland Southeast Asia are fried, grilled, or mixed with other ingredients, stickiness in *natto* so as to produce "pulling strings" is unnecessary. Because of this, producers in Southeast Asia are not very concerned with *natto's* stickiness, and it is not necessary to supply the viscous substance producing stickiness (*B. subtilis* plasmids). This is probably the reason that the fermentation process became simplified and did not require ingredients like plants during fermentation.

Although Kachin State in Myanmar produces string *natto* like Japanese *natto*, this *natto* differs from those of Laos and Thailand, and as well as from the *natto* of Shan State in the same country. It is believed this *natto* instead shares greater commonality with Himalayan *natto* (*kinema*). Professor Tamang of Sikkim University in India reported that *Ficus* spp. used during fermentation in Kachin State is also used in the production of *kinema* with a sticky texture in Nepal and Sikkim (Tamang 2010).

We interviewed households producing *natto* in Myitkyina, Kachin State. They stated that because string *natto* sold well, sticky strings in *natto* was important. Granular *natto* produced here is added to vegetables or rice and eaten. Stickiness is important for this purpose. The characteristics desired in this *natto* are clearly different from the *natto* of other regions, and similarities with Himalayan *natto* can be observed.

5 Conclusion

In this chapter, we reviewed theories of the birthplace of *natto*, and introduced *natto* found in mainland Southeast Asia, where diverse forms and uses can be seen. Laotian *natto* was brought into the country by the ethnic Tai people who immigrated from Yunnan Province in China. However, it is strong influenced by Thai *natto*, *thua nao*, and its method of production resembles Thailand's, which uses simple-to-manufacture plastic bags. Accordingly, it has great similarity today with Thai *natto*. The *natto* of Thailand and Shan State, Myanmar, share commonality in the method of production and the plants used to source the bacteria. Because the Tai Yai and Shan peoples share the same place of origin, it is expected that their *natto* also share the same birthplace. The *natto* of Kachin State, Myanmar, differs in form and production method from the other *natto* of mainland Southeast Asia. It is more meaningful to compare it with the *natto* of the Himalayas rather than mainland Southeast Asia. Typical of Japanese *natto* is its "string-pulling" character; however, the *natto* of mainland Southeast Asia do not share this trait or its method of production. *Natto* is produced in such a way as to meet the needs of each area, which accounts for its great diversity.

Ultimately, we are as yet unable to clarify the birthplace of *natto* in this chapter. However, we have in our sights future topics for study that can determine the approach for elucidating its origin and method of propagation. One topic is the method of fermentation, particularly differences in plant use to supply the bacterial agent. Also, because there are clear regional differences in the form of *natto* and the strength of their strings, we should be able to determine groupings of *natto* by investigating the ranges of the distribution of these characteristics. It is also clear that besides examining only the production methods of *natto*, using a variety of indicators to deduce its origin, such as the peoples consuming *natto*, their food culture, and natural vegetation associated with *natto*, is needed. There are still many forms of *natto* in Asia and Himalayas that are not yet studied. The research of *natto* is extremely profound, and will not be exhausted any time soon.

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Distribution of Traditional Seafood Dishes and Their Background in Miyazaki Prefecture, South Japan

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Abstract In this article we clarify the spread of traditional seafood dishes in Miyazaki Prefecture, South Japan. We then discuss local factors that support these traditional dishes. The results of the research can be summarized as follows: for analysis of data obtained from an interview survey conducted throughout the entire prefecture, nine types of distribution patterns of seafood dishes can be discerned: (A) prefecture-wide consumption, (B) coast-wide consumption, (C) wide consumption in coastal and mountainous areas, (D) wide consumption in mountainous areas, (E) other prefecture-wide consumption, (F) consumption in specific coastal areas, (G) consumption in specific coastal and mountainous areas, (H) consumption in specific mountainous areas, and (I) other specific area consumption. Looking at the background of the distribution patterns, we find that traditional dishes consumed prefecture-wide are dishes familiar in the prefecture in terms of both ingredients and methods of preparation. Many dishes consumed in coastal areas use locally produced ingredients. Dishes consumed in mountainous areas use ingredients that come from over-mountain routes from neighboring prefectures. These distribution routes are connected on a countrywide scale, resulting in dishes like *bodara*, which originated in Hokkaido and were brought to Miyazaki Prefecture.

Keywords Traditional seafood dish · Distribution pattern · Miyazaki prefecture

1 Introduction

1.1 Background and Research Aims

In Japan, seafood has traditionally been eaten in a variety of regions, from coastal areas to inland mountains. Supported by systems of producing and distributing ingredients established through a long passage of time, such seafood dishes have

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shaped diverse local food cultures. However, traditional seafood dishes of different regions are being lost today. Reasons include the abandonment of a fish diet, difficulty in procuring ingredients because of decline in the stock of local specialty fish as a result of depleting resources and changes in fishing methods, and the super-aging of local residents who preserved traditional food cultures.

Research on traditional food cultures has produced many findings. However, when confined to seafood cuisine, there has not been much investigation of local dishes, even in studies of the countrywide diffusion of seafood culture. In my view, in the area of local cuisines there have not been any studies on the spread of diverse traditional seafood dishes in a specific region or on the elucidation of the reasons behind their spread to different areas. Thus, using the region of Miyazaki Prefecture as a case study, we conducted research on the spread of traditional seafood dishes, which overlap in the prefecture in complex ways, and their contemporary use (Nakamura 2008, 2009).

In this article, I introduce the results of the aforementioned research conducted in Miyazaki Prefecture (Fig. 1) and then discuss reasons behind the spread of such seafood dishes.

1.2 Research Methods

First, we conducted a literature review to identify major traditional seafood dishes developed in Miyazaki Prefecture. In the editorial committee of Miyazaki the complete works of eating habits in Japan (1991), 46 local seafood dishes, drawn from six survey areas within Miyazaki Prefecture during the early Showa era, are introduced along with their ingredients, methods of preparation, and seasons of consumption. Miyazaki Prefecture federation of fisheries cooperative associations (ed) (1994) introduces 73 dishes collected in collaboration with the fishery cooperatives' women's division by the Miyazaki Prefectural Federation of Fisheries Cooperative Association. As there are only a few original creations included in the collection, we selected only traditional dishes confirmed by each fishery cooperative for our research. By referring to these and other sources, we identified 58 dishes as traditional seafood dishes of Miyazaki Prefecture.

Next, to understand where and how these 58 selected dishes were eaten, we conducted interview surveys of households within the prefecture. Specifically, we selected 853 households to interview, or about 2‰ of all households in the prefecture. The locations of these households were decided on the basis of local maps to avoid any geographic bias. We then conducted onsite interviews. The subjects of the surveys were women 50 years of age or older, whom we assumed had an understanding of traditional cuisines. However, because the sample was randomized, the subjects included men and comparatively young women. The survey asked the subjects to choose the frequency with which they consumed each of the 58 seafood dishes: "often (several times a week)," "sometimes (several times a month)," "seldom (several times a year)," and "never." To analyze the data

Fig. 1 Study area

obtained, the response "often" was given three points, "sometimes" two points, "seldom" one point, and "never" zero points. The score for each dish in a village or town was calculated by multiplying each survey's frequency consumption score for a dish by the number of surveys, summing the values, dividing the total by the number of surveys, and then multiplying the result by 100. A choropleth map was then created.

2 Regional Diffusion of Traditional Seafood Dishes in Miyazaki Prefecture: Results of Interview Surveys

In this section, we explain traditional seafood dishes of Miyazaki Prefecture using the classification of nine geographic distribution patterns. A total of 63 seafood species can be counted in the list of ingredients of the 58 traditional seafood dishes

Fig. 2 Frequency distribution of the consumption of traditional seafood dishes in Miyazaki Prefecture. **a** *Sakana-no-surimi-no-tempura* [minced fish tempura]. **b** Fish sushi, such as *mehikari* [bigeyed greeneye]. **c** *Mezashi-no-tempura* [dried sardine tempura]. **d** *Bodara-no-nitsuke* [dried codfish cooked in soy sauce]. **e** *Kujira-oba-no-su-miso-kake* [whale tail coated with vinegar and miso]. **f** *Magari* [dishes of boiled seaweed]. **g** *Katsuo-no-soboro* [minced bonito]. **h** *Shio-kujira-no-mugi-gayu/mugi-zousui* [wheat porridge of salted whale]. **i** *Ayumeshi* [sweetfish rice] ▶

selected for the study. Of these ingredients, 44 were fresh seawater seafood (69.8% of the total), 15 were salt-cured seafood (23.8%), and four were freshwater seafood (6.3%).

The results of the interview survey revealed that, broadly speaking, dishes ranked 1 (grilled salted *iwashi* [sardine] and grilled salted *saba* [mackerel]) to 17 (miso-grilled *sawara* [Spanish mackerel]) in frequency of consumption were eaten in almost the entire prefecture. Dishes ranked 18 (*katsuo* [bonito] miso) to 32 (*kani-no-tsubushi jiru* [soup of mashed crab]) were eaten in fairly broad areas. Dishes ranked 33 (*magari*) [boiled *Campylaephora hypnaeoides*, a species of red algae] and lower were limited to particular areas within the prefecture.

Furthermore, we were able to divide the regional pattern of consumption of the traditional seafood dishes in the prefecture into nine types based on the geographic characteristics of each dish.

2.1 Type A [Prefecture-Wide Consumption]

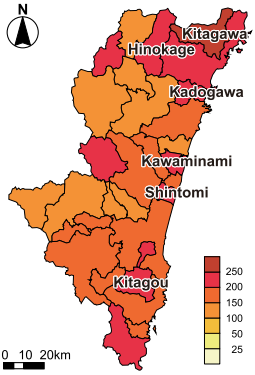
This type includes 17 dishes eaten often throughout the entire prefecture. These dishes all use dried products or seafood popular in the prefecture as ingredients.

Figure 2a shows the frequency distribution of the consumption of s*akana-no-surimi-no-tempura* [minced fish tempura] in Miyazaki Prefecture. It is widely eaten throughout the prefecture, and is noted as a local specialty in areas such as Nichinan (called *obiten*) and northern Miyazaki (*agemi*).

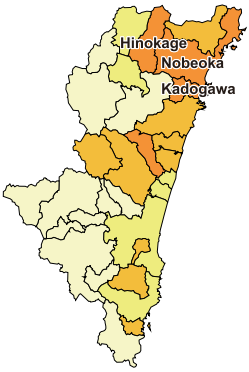
2.2 Type B [Coast-Wide Consumption]

Six dishes of this type are consumed widely along the coast. They use fish heavily caught in the prefecture, such as *iwashi*, *aji* [Japanese horse mackerel], *shiira* [common dolphinfish], and *katsuo*.

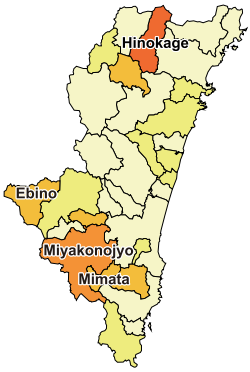
Figure 2b shows the frequency distribution of the consumption of fish sushi, such as *mehikari* [bigeyed greeneye]. Fish sushi is often made from *aji*, *saba*, *iwashi*, and other fish. Originally they were served on special occasions such as festivals. The survey results revealed that they are now eaten daily.



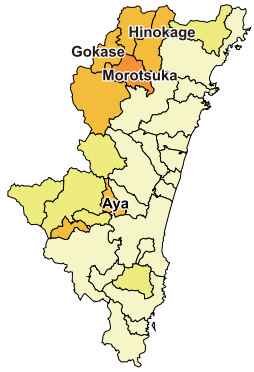
(a) *Sakana-no-surimi-no-tempura* [minced fish tempura]



(b) Fish sushi, such as *mehikari* [bigeyed greeneye]



(c) *Mezashi-no-tempura* [dried sardine tem-pura]



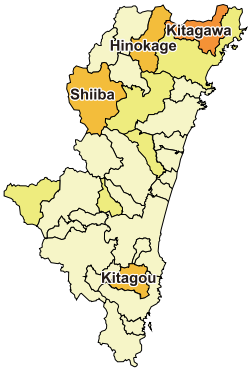
(d) *Sakana-no-surimi-no-tempura* [minced fish tempura]

(e) *Kujira-oba-no-su-miso-kake* [whale tail coat-ed with vinegar and miso]

(f) *Magari* [dishes of boiled seaweed]

(g) *Katsuo-no-soboro* [minced bonito]

(h) *Shio-kujira-no-mugi-gayu/mugi-zousui* [wheat porridge of salted whale]



(i) *Ayumeshi* [sweetfish rice]

2.3 Type C [Wide Consumption in Coastal and Mountainous Areas]

Four dishes are included in this type. Noticeably, they are consumed in a wide range of areas from the coast to the mountains. Ingredients in this type include dried foods and seasonal foods that are suitable for preservation and transported from different coastal areas.

Figure 2c shows the frequency distribution of the consumption of *mezashi-no-tempura* [dried sardine tempura]. For this example, the distribution can be observed inland from a coastal area in southern Miyazaki to a coastal area and mountainous areas in northern Miyazaki.

2.4 Type D [Wide Consumption in Mountainous Areas]

This type is noticeably and widely consumed in mountainous areas. The only dish belonging to this type is *bodara-no-nitsuke* [dried codfish cooked in soy sauce]. Its frequency of consumption in these areas is extremely low, with a score of 0.9. The reason is not that this dish is unimportant in this region, or that it is being forgotten. Although it is eaten infrequently, it is a special dish essential to observing the Bon summer-ritual season.

Figure 2d shows the frequency distribution of the consumption of this dish. It reveals that this dish tends to be eaten in areas that are particularly inland.

2.5 Type E [Other Prefecture-Wide Consumption]

Dishes of this type are widely eaten. No biases could be seen in the regions of consumption. This type includes six dishes with low frequency of consumption. Besides *unagi* [eel] and *kujiraoba* [whale tail], much eaten inland, the dishes use popular ingredients such as *aji* and *ika* [squid]. However, also included are dishes with uncommon methods of preparation.

Figure 2e shows the frequency distribution of consumption of *kujira-oba-no-su-miso-kake* [whale tail coated with vinegar and miso]. Widespread inland consumption could be observed, which extended to the coast. Whale tail is a special New Year's dish, as parents who wish their children to grow "as big as a whale" believe it has auspicious properties.

2.6 Type F [Consumption in Specific Coastal Areas]

Sixteen dishes included in this type are typical local dishes that use ingredients produced only in specific regions or use original cooking methods. Examples in the former category include *mukadenori* [food using *Eucheuma serra*, a species of red algae] and *magari*, dishes of boiled seaweed in southern Miyazaki, and dishes using *maguro* [tuna] and *tobiuo* [flying fish], also caught in southern Miyazaki. Dishes in the latter category include *konamasu* [grilled rice balls with *katsuo*], found in Hososhima District of Hyuga City, and *ika-no-kuromiae*, a dish found in Shimanoura District of Nobeoka City. This dish, prepared in the winter, dresses *ika* with miso and squid ink.

Figure 2f presents a map showing the distribution frequency of magari consumption, a representative local dish eaten in southern Miyazaki.

Dishes of this type represent the most typical local cuisine. For this reason we further conducted onsite participant observation of *konamasu* and *mukadenori* preparation. We report our findings here.

A cooking demonstration of *konamasu*, a local cuisine of Hososhima, Hyuga City, was provided for us in June 2006 by Sakae Koide, the executive director of the Hyuga City Fisheries Cooperative. The method of preparation involves first separating the head and tail of fresh bonito and carving the body into three pieces. After the outer surfaces of the pieces are grilled, the meat is finely sliced. The head and tail are also grilled, and their meat, including the dark meat, is scraped into a bowl with the previously sliced fish. The meat is seasoned with salt and then added to cooked rice. The mixture is then stirred and kneaded (*konemawasu*—it is said that the name of the dish, *konamasu*, is etymologically derived from this word). The rice and fish mixture is then shaped into *onigiri* [rice balls]. The preparation is completed by grilling the *onigiri* in the oven. Originally this dish was eaten on boats by Hososhima fishermen (Fig. 3). As far as I know, in the numerous harbors where *katsuo* catch is unloaded, there is no other place where a food item like *konamasu* is served. A slightly similar fare is *yaeko*, found in Tosashimizu City, Kochi Prefecture. It is grilled *onigiri* using minced *sodagatsuo* [frigate tuna].

We observed the preparation of *mukadenori*, a local cuisine of southern Miyazaki, in July 2006 at Nakano Shoten (a shop operated by Kazue Nakano), which sells the product in *Ibii*, Nichinan City. Dried *togekirinsai* [a type of seaweed] harvested in advance is soaked in water for about half a day and turned into a paste. Water is added little by little while the seaweed is boiled in a large pot for about 20 min. It is kneaded with a large spatula and any foreign articles are removed. Some salt is sprinkled into a container, into which the paste is poured. A small amount of salt is further sprinkled from above. The mixture is cooled in a refrigerator overnight to set. It is then sliced to the thickness one prefers and then pickled in miso for about two weeks. At present, because *togekirinsai* is not harvested much, the preparation of *mukadenori* has declined (Fig. 4).

Fig. 3 *Konamasu* [grilled onigiri of the rice and minced bonito mixture]

Fig. 4 *Mukadenori* [dishes of boiled seaweed]

2.7 Type G [Consumption in Specific Coastal and Mountainous Areas]

Dishes of this type show noticeable consumption in relatively specific mountainous and coastal areas. This type includes *soboro* [minced fish] and dried *fuka* [shark] dishes, which are suited for preservation.

Figure 2g shows the frequency distribution of *katsuo-no-soboro* [minced bonito] consumption. It reveals that the dish is eaten in southern and central Miyazaki, the main regions for catching *katsuo*, and in the mountainous Ebino City and Shiiba Village.

2.8 Type H [Consumption in Specific Mountainous Areas]

Dishes of this type are noticeably consumed in relatively limited and specific mountainous regions. In general, because these dishes developed in regions where there were few opportunities to eat seafood dishes, there are only two of them: *enoha* (*yamame*)*-no-hodarayaki* [fish stuffed with garlic chives and miso, then wrapped with a bamboo sheath and grilled over indirect heat in a traditional Japanese sunken hearth] and *shio-kujira-no-mugi-gayu/mugi-zousui* [wheat porridge of salted whale]. In Shiiba Village, the salted whale porridge dish is mainly eaten during the rice-planting period in June. It fortifies the body to provide strength for harsh physical labor. It is also consumed because it can be prepared in advance during a time when women's labor devoted to cooking is reduced (Fig. 5).

Fig. 5 *Shio-kujira-no-mugi-gayu* [wheat porridge of salted whale]

Figure 2h shows the distribution map of the frequency of *shio-kujira-no-mugi-gayu/mugi-zousui* consumption. Shiiba Village has the greatest frequency (80.0 points).

2.9 Type I [Other Specific Consumption Areas]

Dishes of this type are eaten in relatively limited and specific areas. However, in terms of distribution there is little bias. Three dishes are included in this category. Both saltwater and freshwater seafood are found as ingredients. The former are used in dishes primarily consumed in areas near the sea. The latter are used in dishes consumed primarily in inland areas. However, the frequency of consumption of these dishes is low.

Figure 2i shows the frequency distribution of *ayumeshi* [sweetfish rice] consumption. This map reveals that besides the northern region of Miyazaki Prefecture—mainly in the Gokase River basin famous for its *ayu* dishes—*ayumeshi* is also distributed from inland to coastal areas in central and southern Miyazaki.

3 Background of Regional Diffusion of Traditional Seafood Dishes

In this section, we discuss the reasons for the formation of the nine patterns of distribution of traditional seafood dishes in the entire Miyazaki Prefecture and the local background that has sustained these traditional dietary habits.

3.1 Type A [Prefecture-Wide Consumption]

Dishes included in Type A do not use special preparation techniques; they are salt-cured foods eaten daily and dishes of popular seafood such as *aji*, *saba*, *iwashi*, *ika*, and *katsuo*. The distribution of salt-cured foods includes those items produced along the coast and transported inland, and items brought into mountainous areas from across prefectural borders. Fresh seafood is caught all along Kyushu's coastline. Like salt-cured foods it is also distributed within Miyazaki Prefecture as well as transported from outside the prefecture. As a result of the distribution of such food items, they are eaten frequently and widely across the prefecture, regardless of whether the area is coastal, inland, or mountainous.

3.2 Type B [Coast-Wide Consumption]

The coastline of Miyazaki Prefecture is of the ria type in the northern and southern region of the prefecture, where it runs unevenly. However, in the rest of the prefecture it is almost entirely linear. The fish stock corresponds to this difference, consisting of warm-water migratory fish in the former areas and shellfish inhabiting rocky and sandy beaches in the latter area. Therefore, dishes using seafood found along the coast are spread throughout the entire coastal region.

3.3 Type C [Wide Consumption in Coastal and Mountainous Areas]

Geographically, Miyazaki Prefecture has a high elevation in the west and a low elevation in the east. As a result, the majority of rivers flow from west to east. Therefore, during the early modern period and the middle Meiji era, when rivers were major transportation routes, goods produced in mountainous regions were transported downriver from river ports and then carried to Osaka, a big port city in western Japan. In contrast, there is almost no evidence of coastal seawater products carried inland to mountainous regions. In other words, seafood caught along the coast and their salt-cured products were not transported inland. Instead, they were distributed locally along the coast, and after the development of rail, transported to urban markets. Consequently, especially in Miyazaki Prefecture's inland regions, there were wide swathes with no consumption of seafood. How then did the dietary habit of consuming salt-cured seawater products develop in inner mountainous regions as it did in coastal areas? In those areas unreachable by boat, goods were transported over land routes. Even in steep mountainous Kyushu terrain, there were trade routes over relatively flat ridges. Salt-cured products were brought in from, for example, Hitoyoshi to Mera and Shiiba over mountains, from Kumamoto to Gokase and Takachiho over Aso, from the Taketa region in Oita Prefecture to Takachiho, and from Kokubu and faraway Izumi in Kagoshima Prefecture to Miyakonojo. These foodstuffs were eaten on special occasions. In this way consumption of seafood brought into mountainous areas from all over Kyushu and along the coast of the Miyazaki Prefecture resulted in the same seafood dishes found along the Kyushu coast.

3.4 Type D [Wide Consumption in Mountainous Areas]

Dishes belonging to this type are distributed from the mountains of Kyushu to the basin of Miyakonojo, located in western Miyazaki. *Bodara* [dried codfish] originated from Hokkaido. Nevertheless, when interviewed, respondents reported that it

was a traditional dish eaten historically during the Bon season. The countrywide distribution routes that brought the dish from Hokkaido to the mountainous interior of Kyushu through a series of wholesalers were formed quite early in Japan's history. Even today stores in mountainous villages such as Takachiho and Shiiba hang *bodara* in the storefront before the Bon season, with signs saying "*Bodara* available here." When we asked at a store in Takachiho, we were told that the *bodara* arrived from neighboring Oita Prefecture.

3.5 Type E [Other Prefecture-Wide Consumption]

Dishes of this type, while not frequently consumed, show no biases in their distribution. Thus they are similar to Type A. In other words, they use popular ingredients easily procured in their respective local areas within the prefecture. However, because they require special methods of preparation or they are eaten only a few times a year, they are included in this category. The dish *kujira-oba-no-su-miso-kake* [whale tail coated with vinegar and miso] is essential as a New Year's dish for bringing good fortune.

3.6 Type F [Consumption in Specific Coastal Areas]

Dishes belonging to this type rely significantly on ingredients produced only in limited coastal areas in Miyazaki Prefecture, as mentioned above, and to cooking methods suited to the tastes of local residents. Because these dishes were originally passed down and consumed only in limited areas, many of them are highly individualistic and appealing even among the diverse seafood dishes found in Miyazaki Prefecture. However, such traditional seafood dishes, which currently have few proponents, also face a high risk of simply disappearing. Reasons include changes in dietary habits in recent years, the decline of traditional fishing methods, and poor catches due to changes in the sea environment.

3.7 Type G [Consumption in Specific Coastal and Mountainous Areas]

While dishes of this type are similar to Type C, they are more limited in regions of consumption. Consumption in coastal areas uses locally caught seafood. In contrast, the vast majority of ingredients of the dishes in mountainous regions arrive from neighboring prefectures through over-mountain distribution routes.

3.8 Type H [Consumption in Specific Mountainous Areas]

Some dishes belonging to this type, such as *enoha (yamame)-no-hodarayaki*, use freshwater fish caught locally in mountainous regions as ingredients. On the other hand, whale meat, used in the dish *shio-kujira-no-mugi-gayu/mugi-zousui*, was widely eaten in the past when animal meat was not a primary ingredient. It was brought as a salt-cured product into mountainous regions greatly distant from the sea. In the Kyushu region, the towns of Yobuko in Saga Prefecture, Nagasaki, and Shimonoseki were centers of whale-fishing in the past. Caught whale were distributed from Hitoyoshi to Shiiba. However, in recent years the amount of whale meat transported and consumed has fallen greatly, and whale meat dishes are declining.

3.9 Type I [Other Specific Area Consumption]

While these dishes are eaten in particular areas, trends in their distribution, such as along the coast or in mountainous regions, could not be discerned. While they use ingredients such as *ayu* and *maguro*, they are special dishes not generally eaten.

4 Conclusions

In this article we clarified the spread of traditional seafood dishes in Miyazaki Prefecture while observing their complex spread within the prefecture. We then discussed local factors that supported these traditional dishes. The results of the research can be summarized as follows.

For analysis of data obtained by the interview survey conducted throughout the entire prefecture, nine types of distribution patterns of seafood dishes could be ascertained: (A) prefecture-wide consumption, (B) coast-wide consumption, (C) wide consumption in coastal and mountainous areas, (D) wide consumption in mountainous areas, (E) other prefecture-wide consumption, (F) consumption in specific coastal areas, (G) consumption in specific coastal and mountainous areas, (H) consumption in specific mountainous areas, and (I) other specific area consumption.

Looking at the background of the distribution patterns, we find that traditional dishes consumed prefecture-wide are dishes familiar in the prefecture both in terms of ingredients and methods of preparation. Many dishes eaten in coastal areas use locally produced ingredients. Dishes consumed in mountainous areas use ingredients that come from over-mountain routes from neighboring prefectures. These distribution routes are connected on a countrywide scale, resulting in dishes like *bodara*, which originated in Hokkaido and was brought to Miyazaki Prefecture.

Using Miyazaki Prefecture as a case study to focus on traditional seafood dishes, we find that even on the scale of a single prefecture, traditional culture is naturally formed in connection with other regions. As a future research topic, I wish to study cultural regions from a wider perspective.

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Society and Culture

Nepalese Food and Its Sociocultural Climate: Changing *Dāl-bhāt* Inside and Beyond Nepal

Izumi Morimoto

Abstract Nepal is located on the southern face of the Himalayas; as a result, geographical and cultural diversities have nurtured its unique gastronomic culture. It is difficult for people living in remote areas to obtain fresh vegetables and meat because of a lack of transportation and electricity, and these restrictions have sparked several local gastronomic cultures. For example, to preserve vegetables and meat, people living in rural areas tend to dry and smoke them. In Nepalese Hindu society, there are taboos on the consumption of certain food and drink, such as meat and alcohol. Recent data suggest that Nepalese people began to eat meat because of economic development and globalization. These sociocultural changes and the development of transportation networks have together promoted homogenization of food throughout Nepal. However, people also seek locality and "authenticity" in their food. For example, *dāl-bhāt*, an "authentic" Nepalese food, has been particularly prevalent in Nepal since the development of transportation services. Furthermore, as Nepalese people have begun traveling abroad, *dāl-bhāt* has spread even beyond Nepalese national borders.

Keywords Nepal · *Dāl-bhāt* · Globalization · Sociocultural climate

1 Introduction

Nepal is located on the southern face of the Himalayas, a region that is heavily influenced by monsoons. Because of its geographical location, the country experiences a variety of climates, which allow for many types of vegetation, and the topography ranges from subtropical plains (Terai) to snowy mountains (the Himalayas). The particular environment of the Himalayas, featuring deep gorges and sharp ridges, has prevented people from easily traveling between the east and the west. This climatic variation has encouraged environmentally based cultural

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diversity throughout the country, which has nurtured Nepal's unique gastronomic culture.

Dāl-bhāt, which consists of *dāl* (bean soup) and *bhāt* (rice), and is usually accompanied by *tarkārī* (vegetables, leafy greens, and sometimes meat and fish) and *acār* (pickles flavored with hot and sour sauce), is one of the most common dishes in Nepal. Although Nepalese people generally eat *dāl-bhāt*, its geographical and cultural diversity has been developed across several different localities.

In contemporary Nepal, which was a Hindu kingdom until 2008, approximately 80% of the citizens are Hindus.[1] Hindus tend to avoid eating meat, especially beef because of cultural taboos.[2] Even individuals who do not hold religious taboos against eating meat still avoid eating beef, as eating it was forbidden within Nepalese Hindu society. Even among Hindus, there are non-vegetarians who eat meat and fish. When Nepalese people do eat meat, they choose specific meats that they believe fit with their sociocultural conventions. Therefore, it can be said that people eat *dāl-bhāt* in accordance with their natural environments and cultural identities, which results in a significant variety of *dāl-bhāt* dishes.

Owing to their geographical and cultural diversity, Nepalese people leading different lifestyles cook and eat *dāl-bhāt* in numerous ways using a variety of ingredients. Thus, this chapter explores the Nepalese sociocultural climate through the common Nepalese dish *dāl-bhāt*.[3]

2 What is *Dāl-bhāt*?

Figure 1 features an example of *dāl-bhāt*.[4] *Bhāt* is first placed on a dish, topped with *dāl* and served along with many kinds of *tarkārī*s. *Bhāt* usually means boiled rice; however, before the development of food delivery services, *bhāt* was often substituted with other grains, such as *kodo* (millet), *phāpar* (buckwheat), or *makai* (maize), especially in hilly and mountainous areas where rice crops were difficult to grow and food grain markets less developed.

[1]Nepal was the Hindu monarchical state that had built a hierarchical society based on caste, ethnicity, race, and gender. The nation's remoteness had also brought about other diversities in Nepalese society. Since 2006 there have been increasing demands for restructuring the modalities of establishing a multi-cultural, multi-social, multi-linguistic, multi-religious, and multi-ethnic federal state. This chapter will examine the transformation of food and its sociocultural climate in this context.

[2]Indeed, some Buddhists of Nepal also have religious taboos against eating meat.

[3]Other than *dāl-bhāt*, there are interesting studies referring to changing gastronomic cultures especially among young people in Kathmandu (see Liechty 2010; Thapa 2016).

[4]This is an example from a local restaurant in a tourist area in Kathmandu. Guests who came here to eat *dāl-bhāt* were usually Nepalese people; therefore, this set of dishes can be understood as a local type of *dāl-bhāt* for native Nepalese, not a "Nepalese ethnic cuisine" for international tourists.

Fig. 1 *Dāl-bhāt* set at a local restaurant in Kathmandu

Dāl is a kind of soup prepared from beans, which serves as an important source of textured vegetable protein, especially for vegetarians. *Dāl* is seasoned with salt and masala containing *jīrā* (cumin seeds), *jimbu* (leaf garlic), and other kinds of Himalayan herbs. Sometimes *ghiu* (melted butter) is also added. People make *dāl* using a variety of beans, such as lentils, black gram beans, green gram beans, kidney beans, and dried peas; different beans are sometimes mixed in a single dish. When people eat *dāl-bhāt*, they first pour *dāl* over *bhāt* and then mix them. The mixture is eaten along with *tarkārī*s and *acār*s (spicy pickles).

Figure 1 shows a variety of *tarkārī*s, including (counter clockwise from the top) *masu ko jol* (meat soup), *khasī ko masu* (goat meat curry), *ghiu* (melted butter), stir-fried *ālu simī* (potato and kidney beans), and stir-fried *rāyo sāg* (broad leaf mustard greens); three kinds of *acār*s: a mixture of fresh tomato, onion, and chili (similar to salad flavored with spices), radish *acār* (hot and sour radish and mustard seeds, which is a mixture for preserving pickles), tomato *acār* (fresh crushed tomato flavored with spices, including *ṭimmur* (Sichuan pepper) and lemon); and salad (carrot, radish, and cucumber). Sometimes, *dāl-bhāt* is also served with *dahī* (yogurt) and *mahī* (part of the milk that remains after purifying *ghiu*). The specific *tarkārī*s and *acār*s eaten with *dāl-bhāt* are often influenced by the geographical environment and the sociocultural climate.

3 Influence of Geographical Differences on Food

As Pathak pointed out, until the middle of the 20th century, when Nepal formally opened its doors, the country's cuisine was characterized by particular foods that people had been eating for centuries, and which they continue to eat, especially in remote areas (Pathak 2008). The country's isolation may have contributed to the development of numerous regional gastronomic cultures. However, for centuries, Nepalese cuisine has also been influenced by the cuisines of its neighbors, Tibet and India. The potato, which is very popular for *tarkārī*s, was introduced to Kathmandu around the end of the 18th century (WFP 2010). It is a staple food crop widely grown in Nepal in regions ranging from 100 m in elevation in the southern plains to as high as 4000 m in the northern mountains.

Compared with the potato, rice is not as widely cultivated because of the geographical and climatic needs of the crop. In places where rice is not easily produced, people eat grain instead. *Ḍhīḍo*, a grain powder that is boiled and stirred until it thickens, is a staple for people inhabiting hilly and mountainous areas. *Ḍhīḍo* is considered a substitute for rice and is recognized as a typical food for the poor in rural areas; however, it has recently been recognized as a more authentic and traditional food that is served in Nepalese restaurants both inside and outside of Nepal. Some people prefer *ḍhīḍo* to *bhāt* because *ḍhīḍo* is considered to be healthier than rice, which is not good for diabetic people. For these reasons, some people living in urban areas have begun to eat *ḍhīḍo* instead of *bhāt*. Simultaneously, people living in remote areas have gained greater access to rice, thanks to the development of highways. As preserved foods, such as rice and beans, become easier to transport to remote areas, more Nepalese people are able to partake of true *dāl-bhāt* (i.e., rice and bean soup).

Figure 2 illustrates the gap in prices per kg of coarse rice in Nepal. Regional market hubs in the Terai, such as Birgunj, are well integrated and governed by established market mechanisms influenced by trade to and from Indian commodity markets. On the other hand, transit markets, such as Kathmandu, are connected by highways to regional market hubs in Terai. Therefore, the prices in these markets tend to follow both the price trends in the Terai market and local consumer demand. Rural market prices in hilly and mountainous areas, such as Jumla and Dolpa, are governed more by transportation costs than by market forces or supply and demand (WFP 2007). The closer markets are located to regional market hubs or large Indian markets, the cheaper coarse rice becomes. As Fig. 2 illustrates, although both Jumla and Dolpa are located in the Himalayas, the market price in Dolpa is more than double that in Jumla. Jumla is connected by highway to regional markets in the Terai, while Dolpa still lacks a well-developed transportation network.

As shown in Fig. 3, the price of coarse rice is higher than previously reported in Kathmandu, Birgunj, Jumla, and Dolpa. During 2015, daily food and necessities, including rice, rose in price following an informal blockade of Nepal's border with India (The Himalayan Times 2015 Oct 10). The effect on Jumla and Dolpa was greater than in other areas. The price of coarse rice in Birgunj is comparatively

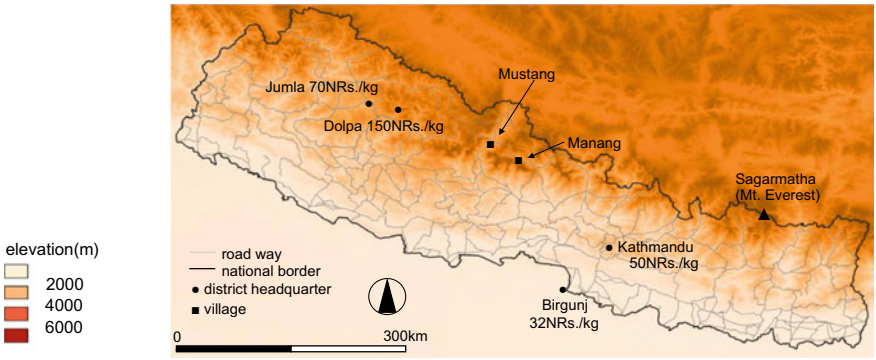

Fig. 2 Price of coarse rice in Nepal (World Food Programme Nepal 2015)
Note ● district headquarter, ■ village, USD 1 = NRs. 73 in August 2011

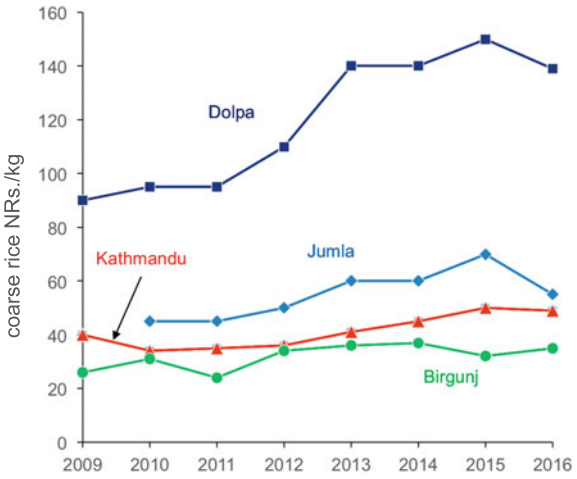

Fig. 3 Prices of coarse rice in December (World Food Programme Nepal 2009, 2011a, b, 2012, 2013, 2014, 2015, 2016)
Note As data for 2010 were unavailable, data for January 2011 were substituted for 2010 data

stable, but has increased in Dolpa. One reason may be that prices in Dolpa are determined by factors, such as the condition of transportation services and fluctuations in local crop production.

Even in remote areas—places taken for a week by foot from the nearest highway—people have access to rice delivered by helicopter or pack-animal, such as mules. Transportation networks carry food and related commodities to the places where people need them (Figs. 4 and 5). Thanks to mule transport, *dāl-bhāt* is available even in remote areas such as Manang, whose central village is a three-day walk from the highway in 2009. There are also several restaurants and lodges located along trekking trails. During a summer 2009 visit to the villages in Manang and Mustang, *dāl-bhāt* with meat cost between NRs. 300 and NRs. 350. This price was controlled by a non-governmental organization created for nature conservation in

Fig. 4 Pack animals carrying gas cylinders along the Annapurna Circuit

Fig. 5 A caravan of pack animals in Mustang

the Annapurna Circuit. At the same time, *dāl-bhāt* with meat cost approximately NRs. 150 at local restaurants in a Kathmandu tourist area. The *tarkārī*s in Manang had less variety than those in Kathmandu, but they were much more expensive because of transportation costs. Such costs are also influenced by the political situation and natural disasters that may obstruct highways and cause slow transportation. Therefore, the price of *dāl-bhāt* is determined by accessible transportation to regional food markets.

Basic national infrastructure, such as transportation services and highway networks, are not yet sufficiently developed, especially in rural areas where fresh vegetables and meat circulate within local markets mostly during harvest season. Nepalese cuisine has distinctive geographical characteristics because the lack of transportation services has created price disparities across the cities of the Terai, the hills, and the Himalayas. The development of electricity has also caused regional food peculiarities. Because fresh foods cannot be preserved or transported without cold storage facilities, people frequently purchase fresh vegetables and meats at local markets or even pick vegetables cultivated in their own fields. The people living in Terai and the mid-hill areas find it easier to access a variety of fresh vegetables, compared with those living in mountainous areas. Therefore, mountain-dwellers tend to dry or ferment vegetables to preserve them for the winter season (Fig. 6). For example, *gundruk* (fermented and dried green leafy vegetables, such as broad leaf mustard greens and radish leaves) are often cooked into *tarkārī*, *acār*, and soup. *Gundruk* is a very important preserved vegetable, especially in areas where people cannot access fresh vegetables during the winter.

During a visit in summer 2009 to the village of Manang, the main vegetables used for *tarkārī* were local potatoes, cauliflower, cabbage, green leaves, and wild mushrooms picked in the woods nearby. Radishes are also cultivated in local fields to be made into *acār*, or preserved pickles. Yak meat is dried and smoked over cooking ovens to make preserved meat, *sukutī* (Fig. 7), because electricity services for preservation are not available. During the dry season, aviation services are available for food deliveries, if the weather is good. Sometimes people bring fresh vegetables and meat from the cities because they are much more expensive in rural areas.

Given these circumstances, people have developed local food knowledge and a diverse gastronomic culture rooted in geographical differences. Although life in remote areas is not easy, daily staple foods, especially *tarkārī*s, are circulated by local supply and consumption, resulting in an environmentally friendly and diverse way of life.

4 Sociocultural Changes and Food

As previously mentioned, Nepalese people—both Hindu and non-Hindu—follow cultural norms based on Hinduism, such as avoiding the consumption of meat. Although different religions, geographical areas, and economic groups have unique

Fig. 6 Drying green leaves for preserved vegetables in Manang

customs in terms of eating meat, both meat-eating and vegetarian practices are prevalent throughout Nepalese society. Some non-Hindus avoid consuming meat, while some Hindus eat a variety of meats. Certain Hindus eat meat because they belong to the untouchable castes[5] who traditionally consumed it. In fact, they eat any meat they believe is allowed for consumption, as long as it is available and affordable. During the "People's War,"[6] some Maoists began eating beef,[7] which

[5]Formally, there are no more untouchable castes; however, discrimination based on the Hindu caste system still exists in Nepal.

[6]In 1996, the Maoists had launched a "People's War," which lasted for ten years, to overthrow the political establishment, including the monarchy of the Kingdom of Nepal.

[7]Other than the Nepalese, Nepal has imported frozen beef from Calcutta since the 1970s for foreign tourists to consume.

Fig. 7 Drying and smoking meat over an oven in Manang

was strictly forbidden because of its sacred stature, to protest Hinduism in Nepal. Therefore, the decision to eat meat, as well as the type of meat, depends on the sociocultural, political, and economic factors affecting Nepalese society.

On the other hand, because of economic development and globalization, which have led to sociocultural changes, people can now afford meat for *tarkārī*. As Hindus have typically sacrificed goats to the gods, Nepalis prefer to eat buffalo meat, followed by goat, chicken, and pork. In 2014, buffalo meat, locally called "buff," represented 58% of total national meat production and cost NRs. 300[8] per kg on average, which was 60% cheaper than goat meat, locally called "mutton." The average price of mutton, which accounts for only two percent of the country's

[8]One US dollar was worth approximately 96 Nepalese rupees in 2014.

demand for meat, was NRs. 700 per kg during the same period. Fish has witnessed a notable increase in demand amid growing health consciousness among consumers.[9]

Recently, meat consumption has increased rapidly. People who did not previously eat meat have begun eating it in response to recent sociocultural changes in Nepalese society. Based on national production figures in 2015, Nepalis ate an average of 11.35 kg of meat annually. In 2000, per capita meat consumption was lower at 9.7 kg. Further increases in meat consumption are expected, driven by demand from the Nepalese middle class. This trend is evidenced by the rapid rise in the domestic poultry market.[10] Furthermore, an increase in meat consumption means a greater variety of available *tarkārī*s.

Even in remote areas where the primary means of transportation are pack animals, rice and beans are available for purchase so that people can prepare *dāl-bhāt*. People have also begun to consume various other products, including Coca-Cola, chocolates, and instant noodles. In urban areas, on the other hand, people have access to many imported products and a variety of cuisines, such as Chinese, Korean, Japanese, and Italian. These trends reflect both the homogenization and globalization of Nepal.

However, differentiation and localization have also occurred in Nepal. In tourist areas, restaurants serve Nepalese cuisine to international tourists, signifying that Nepalese food has become recognized as an ethnic tradition. In tourist restaurants, *dāl-bhāt* is often cooked with catsup and fewer chilies to suit international tastes. At the same time, the number of Thakali-style[11] *dāl-bhāt* restaurants has increased, allowing local people to enjoy regional and ethnic differences inside Nepal (Morimoto 2015).

5 The Dispersion of *Dāl-bhāt* Inside and Beyond Nepal

The ingredients in *dāl-bhāt*—namely, rice and beans—can be transported by truck along highways to urban areas, and then carried by pack-animal along mountain paths to rural markets. Through modernization and the development of transportation, people inhabiting hilly and mountainous areas have been able to eat true *dāl-bhāt*, if they can afford rice and beans. However, even when rice and beans are available, it is very difficult for people living in remote and isolated areas lacking

[9]e-Kantipur (2014). http://kathmandupost.ekantipur.com/news/2014-05-16/per-capita-meat-consumption-up-11-kg.html.

[10]Excluding fish, meat products include buffalo, goat, sheep, pork, and poultry. The world's average annual meat consumption is approximately 42.5 kg per person, while in developing countries it is approximately 32.4 kg per person. Nepal is still far behind other developing countries (e-Kantipur 2015).

[11]The Thakali, whose *dāl-bhāt* has a reputation for being delicious, are an ethnic group from Northwest Nepal.

transportation to obtain fresh vegetables and meat year-round. In such limited circumstances, people have developed gastronomic cultures suitable to their specific environments. In places where rice crops cannot be grown, people often eat *ḍhīḍo* made from grains, such as *kodo*, *phāpar*, and *makai*. Such meals are recognized as poor and are typically only eaten in rural areas. *Gundruk* is also considered a food representative of in hilly and mountainous areas. These foods have recently been recognized as typical rural foods and, consequently, have become known as "authentic," traditional (and healthy) foods served in Nepalese restaurants inside and even outside of Nepal. Throughout the country, people eat *dāl-bhāt*, *ḍhīḍo*, and *gundruk*. Thus, it can be said that homogenization is overcoming geographical limitations and cultural differences.

As Nepalese people now travel abroad more frequently, *dāl-bhāt* has spread beyond Nepal. Nepalese restaurants located outside the country are attractive to traveling Nepalese people as both places to enjoy their own ethnic foods and to seek employment. For example, there are approximately 3000 Nepalese-owned Indian curry restaurants in Japan.[12] Competition is fierce because there are so many Nepalese restaurants, so they must attract customers through the promise of tradition and "authenticity." Recently, some Nepalese restaurants have begun to market themselves as "Thakali" restaurants, despite not belonging to the Thakali ethnic group, because their *dāl-bhāt* has a reputation for being delicious. Others serve Newari,[13] whose *tarkārī* is famous for its varieties, including those with meat. Thus, it can be said that various Nepalese ethnic cultures have begun to be commodified and represented as "authentic." The availability of local cuisines outside of Nepal illustrates a case of food localization in keeping with globalization. As Nepalese people have dispersed *dāl-bhāt* throughout the world, people are able to enjoy "authentic," local Nepalese food both inside and beyond Nepal.

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[12]According to Kharel (2017), Tokyo has the largest concentration of Nepali-owned restaurants, with over 500 distributed throughout the metropolitan area.

[13]The Newar are an ethnic group from Kathmandu.

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Contesting Values of Brewing "*Chang*" in a National Park of Bhutan

Mari Miyamoto

Abstract Many commonalities can be seen in people's eating habits in the Himalayas, and home brewing and distillation of liquor have constituted an indispensable part of these. Home brew or so-called *chang* in Bhutanese is made from a variety of staples. *Chang* is deeply incorporated into people's everyday lives through daily offerings to deities, receiving guests, showing appreciation for family and neighbors' labors, and occasional events and religious ceremonies. The recent attempts of the Bhutanese government to restrain people from brewing and distilling *chang* have been justified mainly on the grounds of national health and social issues. However, they are also connected to the environmental policies regarding swidden agriculture, which produces grain for brewing in rural areas. By restraining themselves from making alcohol and drinking, people choose to restrain themselves from conducting conventional shifting cultivation, which the government intends to end. This study examines how those governmental policies have transformed people's value systems, and how people interpret them in rural areas in relation to their everyday practices.

Keywords Bhutan · Environmental conservation · Swidden agriculture · *Chang* · Hospitality · Home brewing

1 Introduction

Politically independent Bhutan, located on the southern slope of the Himalayas, is bordered by Tibet and the Sinosphere at the great mountain range's northern ridgeline, and by the Indosphere at the southern border where an expanse of dense forests spread out in the lowlands after one crosses the central mountainous region. The country contains differences in elevation of more than 7000 m; mountain peaks around 7000 m in height stand in the cold northern region and a subtropical region

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of about 100 m in elevation can be found in the south. Rivers and streams from glaciers and glacial lakes criss-cross the country. These features create diverse ecosystems and myriad differences in the livelihoods and customs of the Bhutanese people.

For instance, the intermediate mountainous region in central western Bhutan forms a rich rice-producing environment as a result of having a warm and wet climate. On the other hand, in the cold mountainous region near the northern border, people make their living by raising yaks and cows, and cultivating wheat and buckwheat. In the intermediate mountainous region in eastern Bhutan, besides hydroponics, dry field farming and swidden agriculture are popular, and crops such as maize and rice are primarily consumed as staples. Furthermore, in the hilly region near the Indian border, because distribution routes are more established in comparison with mountainous regions, there are many people who grow cash crops such as oranges and cardamom. However, despite differences in such crops, many commonalities can be seen in the Bhutanese people's eating habits, including a diet based on chilies and cheese. Another commonality is the home brewing and distillation of liquor, which is made from a various staples found in Bhutan.

Alcohol in the dominant society in northern Bhutan is generally called "*chang*."[1] *Chang* can be broadly divided into three types. First, there are "*banchang*" and "*shinchang*," which are unfiltered wines. Boiling water (for the preparation of *banchang*) or cold water (*shinchang*) is poured on the fermented grain mash and the product is extracted. The second category is distilled liquor. It includes "*ara*," similar to Japan's *shochu*. The third category is "*chang-ke*," which is a slightly fermented rice drink. *Chang-ke* is consumed to celebrate special occasions such as the birth of a child, the New Year, and annual festivals. These varieties of *chang* can be seen in almost the entire country of Bhutan. In the villages of central Bhutan, where I have conducted field studies for the last decade, the distilled spirit *ara* is offered to indigenous deities and Buddhist gods and goddesses. It is also served to priests and shamans who perform Buddhist services and healing rituals, and to guests. In contrast, in addition to being served to visitors, the unfiltered wine *banchang* is drunk by people as an everyday drink like water and tea. In short, *chang* is deeply incorporated into the Bhutanese people's everyday lives. Without it, ceremonies and rituals cannot proceed, and hospitality cannot be extended to guests.

In these ways, the custom of drinking alcohol is deeply and broadly rooted among the people. However, it is said to be the main cause of cardiovascular diseases, one of the major three illnesses in Bhutan, and cirrhosis of the liver. Furthermore, it has drawn attention as a serious factor contributing to the frequent occurrence of domestic violence. As a result, the government has enacted certain restrictions, such as establishing every Tuesday as a "dry" day; the sale of alcohol in urban areas is prohibited on that day. In Bhutan, types of alcohol such as whiskey, brandy, rum, and beer are frequently consumed. They are brewed and

[1]Ethnic groups from Nepal such as the *Sherpa* (Kimata 2008) also call their alcohol *chang*.

distilled mainly in plants of the Army Welfare Project[2] managed by the government. While the government and a few companies enjoy a monopoly on the production of these liquors, policies that ban the traditional production of home-brewed liquor in village communities have been established. At present, opportunities for residents of urban areas to drink *ara* and *banchang* are very limited.

In the following sections, the sociocultural significance of brewing *chang* is described. The impact of Bhutan's forestry policy as well as recent restrictions on alcohol consumption are then examined.

2 Home Brewing of Local Liquor

It is said that the people living east of the Black Mountains in Bhutan consume the most alcohol in the country. Much of the spirit drunk is home-brewed liquor, especially in rural areas. The ingredients of these spirits differ depending on the area. For example, wheat and buckwheat are predominant in cold regions and maize and millet in areas with relatively lower elevation and warmer temperatures. Of the alcohols mentioned in the previous section, *ara* and unfiltered wine are drunk daily. Of the unfiltered wines, *banchang* is the name of alcohol produced by adding boiling water to fermented grain mash and then extracting the product, and *shinchang* is the name of alcohol produced similarly but by adding cold water. In the case of *banchang*, hot water is added to the mash every time one wishes to drink it. In the case of *shinchang*, cold water is added directly to a pot containing fermented grain mash and left to sit for 24 h. *Shinchang* refers to the top clear liquid layer that is then extracted; people say that it contains a greater amount of alcohol compared with *banchang*. The choice of extraction method depends on the elevation and climate. In cold areas, such as the Bumthang and Gasa Districts, *shinchang* is produced often. In subtropical areas such as the Trongsa and Mongar Districts, *banchang* is often found.

In Bhutan, the brewing of alcohol is often carried out by women. Let us examine the methods of both brewing and distillation used in N Village in Trongsa District as an example (Fig. 1). In N Village, the primary ingredients are maize and millet. Maize harvested by villagers is first left to dry by hanging the ears from ceilings. Afterwards, kernels are removed from the cobs and boiled together with millet in a large pot (Fig. 2). After being sufficiently boiled, excess water is removed, and the cooked kernels are spread on large bamboo mats and left to cool. After they reach the appropriate temperature, homemade yeast is sprinkled over the cooked grain

[2]The Army Welfare Project is a commercial enterprise of the Royal Bhutan Army that was established in 1974 to aid retired veterans of the army and the Royal Bhutan Guard by providing them employment, pensions, and monetary loans. Headquartered in Phuentsholing, bordering India, it has breweries in Gelephu and Samtse. To date the organization has produced more than 18 brands of liquor. Besides commanding an overwhelming domestic market share, it also exports its products to India.

Fig. 1 Study area

Fig. 2 Boiling in a large pot

and the mixture is stirred and folded. Next, it is transferred to a vessel open to the air, such as a bamboo basket, and left for about 24 h. Finally, it is transferred to a large container about the size of an 18 l drum and sealed with a lid to ferment for about two weeks. In this way fermented grain mash is produced. In the past, people used earthen vessels to preserve the mash, which they sealed airtight by covering the opening with leaves and a mixture of ash and cow manure. These days, however, empty containers that previously contained cooking oil or other items are often used.

When drunk as *banchang*, the fermented grains are transferred to a small aluminum pot or earthen pot to which water is added. After the mixture is heated and boiled, a deep bamboo strainer about 8 cm in diameter is placed in the middle of the pot. The liquid that flows into the strainer is ladled into a cup. When a small amount of liquid remains, the strainer is pressed against the mash to scoop out the last drops.

To produce the distilled alcohol *ara*, the fermented grain mash and water are added together into a large stock pot. Three wooden rods about 40 cm long are placed vertically into the pot, where they are crossed and bound to form a tripod. A small vessel already holding about three cups of water is placed on the tripod to collect drops produced through the distilling process. A big brass or aluminum basin whose diameter is just bigger than that of the stock pot is placed on top of the stock pot. Cold water is placed into the basin to cool the steam that forms in the stock pot. To prevent steam from escaping out, a wet cloth is wrapped around the crack between the brass basin and the stock pot (Fig. 3). Vapor from the heated *banchang* comes into contact with the bottom of the cooled basin and becomes water droplets. The droplets run the course of the bowl-shaped bottom of the basin and drip into the small vessel placed in the middle of the stock pot. To ensure the droplets flow smoothly, women minding the distillation periodically ladle up water and pour the water from the ladle into the basin so as to create bubbles and gently vibrate the basin.

Because the water in the basin needs to constantly remain cold, the women use a ladle to scoop out warmed water and replace it with fresh cool water during the process of distillation. The women pay constant attention to the coldness of the water in the basin. They must also continue to adjust the heat of the fire by adding firewood. When the village festival season arrives, families in the village set up the stock pots, which are usually black in color because of the soot, in a row under the eaves of houses. Women stand next to each other and chat while distilling *banchang*.

3 *Chang* and a Hospitable Self

Ara plays an important role as an offering for deities and gods/goddesses during rituals and as a drink to be served to guests. On the other hand, *banchang* is a daily drink rooted in everyday life. It quenches thirst and invigorates the body during and

Fig. 3 A wet cloth is wrapped around the crack between the brass basin and the stock pot

after strenuous farm work in the hot summer and on excursions. It is also drunk before and after dinner to relax after a tiring day of farm work and as an aid in sleeping. When I visited farm families in the evening, I often observed *banchang* being prepared next to the fireplace for family members as well as for day laborers just returning from hard farm work. In this way, *chang* is deeply embedded in people's lives. The villagers not only consume it themselves, but also use it as an indispensable resource to offer to guests.

N Village is well known to surrounding villages and visiting government officials for its hospitality. One of the components behind this reputation is the heavy use of *chang* to entertain guests. *Chang* is found everywhere in the village after a harvest. Families of the village first serve the distilled alcohol *ara* instead of tea when a visitor arrives. It is stored in an empty glass bottle, plastic bottle, or a conventional bamboo container called a "*pharang*" so that if a guest appears suddenly it can be easily served. In N Village, if you develop a good relationship with a villager even slightly, you are not constantly asked "Would you like some *ara*?" Instead, if the host knows that you drink *ara*, you are automatically served *ara* without being asked, as soon as you sit down. Villagers are sensitive to the quality of *ara* they produce. If a guest is slow in drinking the *ara*, they worry that its quality is poor, and steal glances at each other to gauge the mood of the guest. In

response, the guest should declare and show by his or her expression that the *ara* is delicious.

If a guest declines *ara*, *banchang* is offered next. The fermented grain mash is transferred to a small pot, to which water is added and heated. The host then carries the pot toward the guest or guests and sits in the middle facing them. She or he then pours *banchang* in all the cups to the brim. On such an occasion, it is rare to be asked whether one wishes to drink *banchang*. If a guest does not wish to drink at all, he or she must forcefully stop the host when she or he rises to bring the pot. Once you begin drinking, the etiquette is to drink the entire *banchang* in the pot before returning home. This is because *banchang* cannot be preserved once boiling water is added (Fig. 4).

Fig. 4 Pouring *banchang*

If a guest does not drink *banchang* either, then tea is reluctantly served. In contrast, in western Bhutan tea is almost always served first.[3] However, because villagers need to purchase tea leaves and sugar outside the village, these items are not something they normally stock. In short, tea is a luxury item owned by those with cash income. In contrast, home-brewed liquor such as *ara* and *banchang* are produced from grains grown in their fields. They are everyday drinks accessible even to the poor, and allow anyone to be hospitable to guests.

In this way, treating guests with *ara* and *banchang* is taken as a matter of course by the people of N Village. However, it does not necessarily mean that they are not conscious of their reputation of being hospitable. During my field survey in N Village, I sometimes visited neighboring villages to conduct interviews. Upon returning to N Village, I was constantly asked "Did the villagers welcome you sufficiently?," "Did they serve you enough alcohol?," and "Which village do you like best?" as though they wanted to learn the grade of the other villages'reception. Thus, it seems obvious that the people in N Village take pride in the quality and lavishness of their hospitality.

However, the custom of daily alcohol consumption and the people's hospitable nature in eastern Bhutan is seen by the dominant society residing in western Bhutan as the practice of "lazy drunkards" who lack self-control. Areas in western Bhutan, such as Punakha, Thimphu, and Paro Districts, have established themselves as the political centers of Bhutan. People in this region make even stronger *chang* in terms of alcohol content, but it is rare for them to drink it regularly. The people of western Bhutan see themselves as diligent and self-disciplined citizens, and they frequently consider people of eastern Bhutan as their opposite. Although the number of central government officials hailing from eastern Bhutan has become significant, people's perception of the eastern Bhutanese still remains unchanged.

4 *Chang*, Swidden Agriculture, and Nature Conservation

Where, then, is the grain used to produce *chang* harvested? N Village is located in a subtropical region on the southern side of Trongsa District. It is found on gently inclined tableland carved out by the surrounding rivers. An established irrigation system produces fertile rice paddies. Thus, villagers can cultivate sufficient amounts of rice. In addition to growing rice, cultivating maize is considered indispensable, and most maize is grown in the surrounding forest using slash-and-burn methods of cultivation.

Swidden agriculture is basically a renewable and cyclical form of shifting cultivation in which a forest is cut down, left to dry, and then burned; the resulting

[3]In Bhutan, two kinds of tea drinks are commonly enjoyed: "*suja*" (butter tea made from boiled tea bricks to which butter and salt are added and the mixture churned inside a special container) and "*gaja*" (boiled black tea to which sugar, milk powder, and if available a bit of cardamom are added).

ashes serve as fertilizer for the cultivation of mixed crops such as maize, millet, and upland rice. After a few years of cultivation the land is left fallow for a certain amount of time (from 12 to 15 years) to restore the vegetation and soil fertility, before people use the land again. The fallow land is gradually covered by assorted trees. Because good fodder grows during the first four or so years until the forest develops a canopy, the land can also be used as grazing land for cattle.

Maize harvested from swidden cultivation is rarely used as the main staple in N Village. However, it is dried and used as an ingredient for making alcohol as well as for making snacks. To make a snack called "*gezaship*," dried maze is roasted and beaten with a pounder to be thin and soft, like cornflakes. These cornflakes are eaten throughout Bhutan with tea or *chang* as a snack or nibble. They are especially preferred in eastern Bhutan, where the weather and soil are suitable for maize cultivation. At the same time, the same amount or more of maize used for *gezaship* is used to produce *chang* in these areas. According to the village chief, in N Village about 30 to 60% of harvested crops from slash-and-burn agriculture conducted in the forest is used to produce home-brewed liquor. This implies that the people of N Village cut down the trees of their surrounding forests and practice swidden agriculture almost entirely for the purpose of making *chang*.

Meanwhile, the Bhutanese royal government has been gradually implementing nature conservation as a national policy since the end of the 1980s, and enacting proactive environmental measures (Miyamoto 2004). In 1993, 1999, and 2008, the government gradually widened the boundaries of nature conservation areas. By 2008, almost 50% of the country had become protected areas, such as national parks and wildlife sanctuaries (Miyamoto 2015). N Village was incorporated into a new national park as a result of the reorganization of protected areas in 1993. Later, in 1998, specific conservation programs began to be implemented, but a national park field office was not constructed within the village until 2002. For the office, one park ranger and two forest guards were assigned to monitor the villagers' agricultural practices and livestock farming as well as their everyday use of natural resources, such as gathering firewood and non-forest products. Among these concerns, swidden agriculture has been the biggest issue for the national park. It is regarded as a practice that destroys forest vegetation and was completely banned by the 1995 Forest and Nature Conservation Act.

Swidden agriculture in N Village established a fallow period of 12 or more years once people cultivated the land. The duration of this longer fallow period was indispensable for making this cultivation system sustainable. To maintain the fallow period, several households combined their potential forest lands together and worked together to clean one area of the forest every year, so they had enough land to cultivate each year until their own forest land became fertile and ready for the next round of cultivation. This reciprocity-based practice of joint cultivation was also effective in preventing damage to crops by wild animals.

N Village had never been easily accessible until a bridge was constructed in 2013. Until 2002, even forest officers seldom visited. Therefore, it was not difficult for villagers to ignore government rules and regulations, including forestry laws. Although the establishment of the national park field office drastically changed

conditions, persuading or forcing the community to immediately abandon long-practiced swidden agriculture was not an easy task for forest officers. It was also impossible to identify dispersed cultivated areas in the vast mountainous region without the cooperation of villagers. The national park thus tried implementing restrictions gradually. It first made it mandatory for villagers to request permission from the forestry department to carry out swidden agriculture. In addition, cutting down trees five years of age or older was prohibited even inside one's own farm land. In response, people tried to make it possible to continuously use a forest for swidden agriculture by shortening the fallow period to five years.

5 Self-restraint in Making *Chang*

As restrictions against swidden agriculture gradually become stricter, the *Geog Yargay Tshogchung*[4] to which N Village belongs discussed whether or not to ban the custom of home brewing around 2006. Almost all of the grains used as ingredients for *chang* are produced by swidden agriculture in the village. Therefore, restrictions against slash-and-burn farming carried out under the name of environmental conservation directly manifested themselves as pros and cons of continuing to brew *chang*. While at first glance the question of whether or not to produce home-brewed liquor is an extremely individual question, here it transcended an individual's lifestyle and began to be closely related to the government's forest and land use policies.

5.1 Proposal from the Sub-district Chief

At the time, the topic of prohibiting the production of alcohol was introduced by a villager who was the head of the *geog* (sub-district), or *gup*. As *gup*, he argued that if crops used for alcohol production were used for food, they would be sufficient until the beginning of spring, when people started suffering food shortages. Furthermore, excess crops could be sold for cash income, thereby reducing poverty in the villages. He also emphasized that by banning the distillation of *ara*, which requires the use of fire for a long period of time, firewood could be conserved, leading to the conservation of forests.

In addition to being the sub-district chief, for many years the villager had been a forest watcher, or *reesup*. *Reesups* are responsible for monitoring an area's forest to prevent fires and illegal lumbering by outsiders. They can be assigned

[4]"*Geog*" is a group of villages that forms a geographical administrative unit under a district called "*Dzongkhag*." *Geog Yargay Tshogchung* comprises the *gup, mangmi* (an elected representative of the *geog*), and *tshogpa* (a representative of a village, or a cluster of villages) as members (RGoB 2002).

independently by a village, or to new areas by the government's forestry department (Miyamoto 2004). N Village belonged to the second category. The *gup* was first assigned as a *reesup* in the sub-district in 1990, and occupied the position exclusively over a period of many years. His main obligation was to make routine patrols several times a week and submit a report once a month to the department of forestry. According to him, it was not his job to restrain villages from conducting slash-and-burn cultivation in the 1990s. On the contrary, he himself enthusiastically undertook swidden agriculture. However, after the field office of the national park was established, the role of the *reesup* was revised with the main purpose of protecting the natural environment, and it became a task of supporting park monitors to maintain biodiversity and prevent forest degradation.

For the *gup*, his proposal to ban home brewing of alcohol, which promotes the economic development of the community and protects forest resources, was a compromise intended to represent the interest of villagers while at the same time fulfilling his responsibility as a *reesup*.

5.2 Ara or Banchang?

Many elderly people of N Village strongly opposed the idea of banning the old custom of home brewing, saying that "without *chang*, we can't work or enjoy life." On the other hand, it was pointed out by villagers in their 30s and 40s, who are the main workers in the community at present, that there were many who were alcohol dependent. Some of the villagers had started to worry about problems caused by the negative social influence and conflict brought about by excessive drinking. A middle-aged man mentioned that there were always fights between villagers due to drunkenness. Consequently, it was argued that restricting *ara*, which has a strong alcohol content, might be advisable. Furthermore, another man pointed out that there were mothers who drank in the daytime and could not take care of children, and thus it was a good idea to prohibit home brewing to alleviate this situation.

The villagers clearly separated *chang* into distilled spirit *ara* and unrefined maize wine *banchang*. *Ara* is basically produced for Buddhist annual festivals, various religious rituals, and community gatherings. In short, it is a ceremonial drink and an offering to gods and guests. It is also said that *ara* causes hangovers and headaches because of its high alcohol content. There was a relatively large number of heavy drinkers in N Village, and many said they consumed *banchang* but not *ara*. In contrast, *banchang* is a liquor drunk daily. Besides being consumed after a day of hard work and before or after meals, *banchang* is often carried to supply water and restore vigor when embarking on a trip. I remember that whenever I went on an excursion from the village, a member of the host family I stayed with would always fill a bottle with one to two liters of *banchang* for me to carry along. During the dispute about self-restraint in brewing *chang*, it seemed that abolishing *banchang*,

which has deeply permeated into people's daily lives, was not a realistic idea. Thus the village managed to propose a compromise that would initially restrict only the distillation of *ara* but allow the brewing of *banchang* to continue. However, people were still allowed to produce *ara* as an offering to gods and deities.

6 Conclusion

The people of N Village maintain conventional swidden agriculture, and have pride in the quality of their hospitality. They place great value in their self-image of treating guests well. However, their drinking culture draws contempt from the dominant society of Bhutan and warnings about the social ills of alcohol consumption from the government and the Ministry of Health. These external factors are gradually influencing people's livelihoods and existing customs in the village. Furthermore, because of the incorporation of the village into a national park, the government's desire to showcase the "wilderness" of nature and Bhutan's "eco-friendly nature" to tourists is disturbing the use of natural resources by the villagers, as exemplified in the case of swidden agriculture.

In the midst of these changes, the decision by villagers and the gewog development committee to restrain themselves from producing home-brewed liquor can be seen as a proactive attempt by the villagers of their own accord to adjust to a new environment consisting of governmental laws and universal development theories by changing their age-old lifestyle and customs. This adaptation could be an attempt to incorporate the attributes of being "diligent and rational citizens," which have been sought for modernization. Meanwhile, the villagers' choice to prohibit the distillation of *ara* but to keep *banchang* made it possible to maintain their virtue of hospitality, which they regarded as one of their significant attributes, even as they were forced to retreat.

In the village, *chang* is not a luxury item, without which villagers might feel that something was missing, but an essential item for their lives. For the villagers, it is a source of nutrition on par with rice. It also plays an important role as an offering to deities. Furthermore, it is essential as a form of compensation to be paid by hosts for the reciprocal exchange of labor. Therefore, the decision of the village also sought to protect the sociocultural as well as the socioeconomic value of *chang*. However, as economic development and the creation of a rational citizenry to support it are being further pursued in the process of Bhutan's democratization, the custom of producing and consuming *chang*, and its sociocultural value and meaning, is being transformed in various ways.

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Satsuma *Shochu* and Geographic Indication

Masatoshi Motoki

Abstract In this chapter, I take up the subject of Satsuma *shochu*, which has developed into an industry representative of Kagoshima Prefecture, by examining the relationship between the supply of its ingredients and its local culture and environment. Historically, alcoholic beverages have been created in all regions using local ingredients and have been consumed by local people. Satsuma *shochu* is no different. These days, Satsuma *shochu* has currently acquired a geographic indication of its area of production, and the spirit has become established as a global brand. The key to this identity is locality. Using local ingredients, skillfully exploiting the regional climate, and maintaining the flavor beloved by local people is vital. For Satsuma *shochu* to continue as a spirit loved by local people as well as the Japanese nationwide, diligence by the producers is needed. It is also crucial to recognize the significance of producers and consumers working together to cultivate the rich local culture and climate through their involvement in the natural environment, and to take care to maintain this relationship.

Keywords Satsuma *shochu* · Geographic indication · Local culture · Natural environment

1 Satsuma *Shochu* as a Regional Brand

Shochu is a Japanese distilled spirit, generally distilled from rice, barley, sweet potatoes, or buckwheat. At present, with the exception of the Tokara Islands and the Amami Islands (Fig. 1), 86 *shochu* distilleries are located throughout Kagoshima Prefecture (Fig. 2). Their websites and ads prominently feature "the *satsuma-imo* [Japanese sweet potato] and water" and the "landscape" of Kagoshima, and show photos of the place where the distillery is located, sweet potato fields, and sources of water. Sameshima (1992) argues that a distilled liquor

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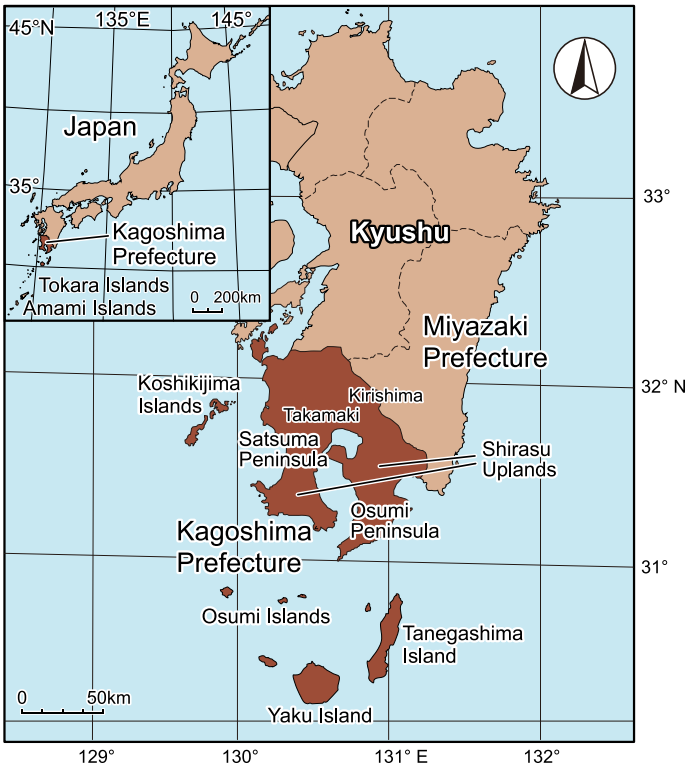

Fig. 1 Study area

such as *shochu* is the product of its given locality—the soil, climate, culture, customs, etc.—while at the same time it is constrained by it. Thus, it is an essential part of the milieu. In the past, the barrier to creating *shochu* had been its very locality, but now that serves as the foundation for its production. In this chapter, I take up the subject of Satsuma *shochu*, which has developed into an industry representative of Kagoshima Prefecture; I examine the relationship between the supply of its ingredients, its local culture, and its environment. Satsuma is a clan belonging to the Edo period, but Satsuma as used in this chapter means the current administrative district of Kagoshima Prefecture.

Since the 1970s, Satsuma *shochu* has enjoyed three booms (1970–1979, 1980–1985, and 2003–2006). Throughout these periods of growth, the market has expanded, and this liquor has grown from being a spirit representative of Kagoshima Prefecture to being a spirit representative of the spirit of the Kyushu region, and, furthermore, one of the alcoholic beverages representative of Japan (Nakano 2006). In 2005, "Satsuma" received geographic indication as the production area of its namesake *shochu* from the World Trade Organization (WTO). The geographic indication of Satsuma *shochu* requires the following four

Fig. 2 Representative brand of Satsuma *shochu* distilleries in Kagoshima Prefecture, Japan

conditions: (a) it is a *shochu* made from only Japanese sweet potatoes; (b) it is a single-distilled *shochu*: sweet potatoes are added to the first *moromi* (fermentation mush) of fermented rice *koji* (addition of fungus *Aspergillus oryzae* to initiate fermentation) or sweet potato *koji* and water, further fermented as second *moromi*, and then distilled in a pot still (Fig. 3); (c) the sweet potatoes used as ingredients are grown in Kagoshima Prefecture; and (d) the process of production from distillation to bottling takes place entirely in Kagoshima Prefecture. The geographic indication of Satsuma *shochu* means protecting the brand of the production region by accentuating its local character to differentiate the productand ensuring consumers of Satsuma *shochu's* quality and production methods.

2 Sweet Potatoes, Rice *Koji*, and Water

Satsuma *shochu* was originally rice *shochu*, but became sweet potato *shochu* as a result of changes in the production method. It is a relatively new *shochu*, with a history of about 260 years. Kagoshima Prefecture has broad swathes of volcanic ash soil called *shirasu*. *Shirasu* land is not suited for rice paddies and makes irrigation extremely difficult. Because of such an environment, procuring rice for *shochu* production is difficult. Kagoshima Prefecture is also a region constantly

Fig. 3 Second *moromi* in a pot still. (Taken by the author, September 2014)

battered by typhoons. Sweet potatoes are hardier against natural disasters than rice and require little manual labor for cultivation. The sweet potato thus came to take hold as the main ingredient of Satsuma *shochu* (Suganuma 2009).

Originally, sweet potatoes left over from making starch were used for brewing. These sweet potatoes were grown close to the distilleries. According to interviews with *shochu* makers, many producers purchased sweet potatoes from farmers in the Satsuma Peninsula, Osumi Peninsula, or Miyazaki Prefecture through agricultural cooperatives or middlemen. However, because procurements of sweet potatoes were transacted between suppliers, *shochu* producers did not know the potatoes' provenance.

In general, raw sweet potatoes are used for brewing. However, as refrigeration technologies improved, *shochu* producers who increased their output by using frozen sweet potatoes also emerged. When the output of *shochu* grew rapidly, there were also producers who used sweet potatoes imported from China.

However, in recent years, in addition to receiving geographic indication of the production area, *shochu* aficionados have also become more interested in local production for local consumption. As a result, there are increasing efforts among Satsuma *shochu* producers to use sweet potatoes grown near distilleries as in the past (Figs. 4 and 5). Besides the benefit of increased cost effectiveness, this allows for fresher sweet potatoes to be used. There are now also *shochu* distillers who,

Fig. 4 Harvesting sweet potato (Koganesengan) for *shochu*. (Taken by the author, September 2011)

instead of directly contracting with farmers, establish their own in-house agricultural corporation to grow sweet potatoes. An increasing number of producers focus not only on the freshness of their sweet potatoes but also on the variety. These distillers seek to create highly distinctive *shochu* resulting from the type of sweet potatoes used, such as the *Koganesengan* variety developed especially for brewing.

The unstable supply of rice in Kagoshima Prefecture has also affected the supply of *koji*, which is essential to the production of *shochu*. There are producers who use sweet potato *koji* for Satsuma *shochu*. However, because the use of rice *koji* has been traditionally emphasized, foreign rice was often used in the past. It is said that the use of foreign rice for *koji* began around the 1910s when the supply of domestic rice became insufficient. However, another reason is that because of its low water absorption compared with domestic rice, foreign rice is considered superior as an ingredient for *koji*. Yet another reason in recent years is the more into about this requirement to provide foreign rice with minimum access opportunities as established in the Uruguay Round of the General Agreement on Tariffs and Trade (GATT). As a result, Thai rice, which is available at low prices, has a stable quality, and can be procured in large amounts, is now used for rice *koji*.

However, in 2008 the problem of illegal resale of rice unfit for consumption surfaced and resulted in a trend to publicize the origin of where rice products are grown. Distrust also grew among consumers, who had believed that domestic rice was used for *koji* in making *shochu*. As a result, the number of producers who seek

Fig. 5 Screening sweet potato in the *shochu* distiller. (Taken by the author, August 2013)

to switch from foreign rice to domestic rice as the source of *koji* for *shochu* is increasing (Yonemoto 2009). The movement toward using domestic rice is rising, as exemplified by the emergence of *shochu* producers that borrow rice paddies near their distilleries to grow rice for *koji*.

In addition to the question of rice used for *koji*, the role of water is especially critical for the production of *shochu*. A great amount of water, specifically *shikomi-mizu* (water used in fermentation), *senjo-mizu* (water used for cleaning and rinsing), and *wari-mizu* (water added to the *shochu* distillate to achieve the desired alcohol content), is used. As 70–80% of *shochu* is water, the amount and quality of water greatly affects the product.

As shown in Fig. 6, Kagoshima Prefecture has one of the highest levels of annual precipitation and annual amount of river discharge (value obtained by dividing the amount of discharge observed at a river by the surface area of the basin upstream from the observation point) in Japan. The region is thus blessed by the water environment needed for *shochu* production. This is because in highly permeable volcanic belts covered by a thick layer of shirasu, the water flows out underground.

A survey of the distribution of *shochu* distilleries in the 1970s revealed that they were not located in Shirasu plateaus where water access was poor. Instead they were concentrated in alluvial plains surrounding the Shirasu plateaus (Kanemaru 1975). The results indicate the close relationship between water in the Shirasu plateaus and *shochu* production.

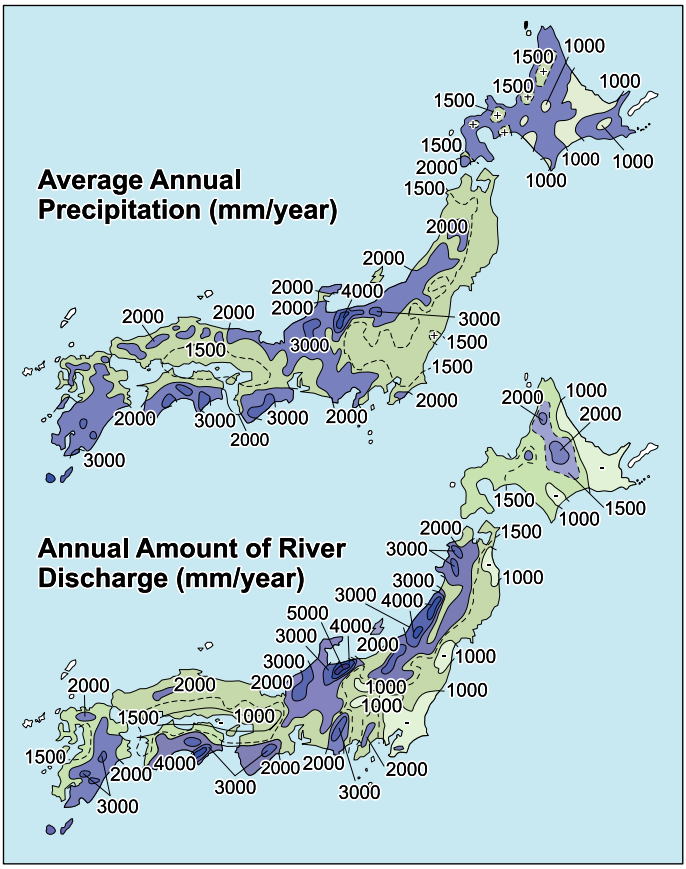

Fig. 6 Average annual precipitation and annual amount of river discharge in Japan (based on Arai (1980) and Japan Meteorological Agency)

According to a survey that I conducted of *shochu* distilleries in Kagoshima Prefecture, *shochu* producers in the past used water that was relatively easy to access, such as shallow groundwater about 10–30 m deep, as *shikomi-mizu*. Later, for new production sites selected as a result of company mergers or partnerships, locations with a rich supply of water were also chosen. There were also producers that moved their distilleries to allow for better access to water supplies. In recent years, seeking more stable water sources and better quality to improve production output, more distilleries are drawing groundwater about 80–120 m deep. Since the late 1970s there have also been *shochu* producers that use as *wari-mizu* water from locations far from their distillery, which they transport with water trucks. Furthermore, the survey also revealed *shochu* producers that seek to make their product highly individualized by using good quality water from around Kirishima and Takamaki, hot springs water, and deep ocean water for *wari-misu*.

2.1 *Satsuma* Shochu *and Locality*

Historically, alcoholic beverages have been created in all regions using local ingredients and have been consumed by local people. Satsuma *shochu* is no different. It is a spirit strongly influenced by its locality. It is a product of the region's environment, history, and culture. However, the market for Satsuma *shochu* has grown through several *shochu* booms, resulting in the need for its mass production. Producers of sweet potato *shochu* using ingredients of unclear provenance also appeared. It became the case that a *shochu* produced in Kagoshima Prefecture using sweet potatoes as the main ingredient could be made commercially with a philosophy that completely departed from that held by traditional distillers of Satsuma *shochu*, and the connection between Kagoshima's locality and *shochu* severed. However, consumers who sought safety in food products and the meticulous care of Satsuma *shochu* producers has resulted in the restoration of the tradition of Satsuma *shochu*—in other words, of the connection between the liquor and its milieu. As a result, Satsuma *shochu* has received geographic indication of its area of production, and the spirit has become established as a global brand.

In a diversified, globalized *shochu* market, the identity asserted by *Honkaku* (authentic) *shochu* (in legal terms a "single-distilled *shochu*") is critical (Noma and Nakamoto 2003). The key to this identity is locality. Using local ingredients, skillfully exploiting the regional climate, and maintaining the flavor beloved by local people is vital. For Satsuma *shochu* to continue as a spirit loved by local people as well as the Japanese nationwide, diligence by producers is needed. It is also crucial to recognize the significance of producers and consumers working together to cultivate the rich local culture and climate through their involvement in the natural environment, and to carefully maintain this relationship.

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Dietary Habits and Kitchens of the Sundanese in West Java Villages

Nao Endo

Abstract This chapter focuses on West Java villages inhabited predominantly by Sundanese people and uses them as a case study. It reveals the actual conditions of dietary habits and kitchen equipment in Indonesian rural villages in recent years, with statistical data and field surveys. Sundanese cuisine is generally considered to be healthy because it uses large amounts of vegetables. However, compared with meals in other provinces, those in West Java villages actually tend to use rice more than vegetables. The idea that Sundanese meals are replete with vegetables probably comes from the fact that the group has the dietary habit of frequently eating raw vegetables while other ethnic groups do not consume them as often. The economic upper class in West Java is also experiencing diversification in food items consumed not only in urban areas but also in rural areas. Although the popularization of foreign cuisines is slow, its eating patterns and menu items have left a mark. As for cooking fuels, the author's surveys revealed that the Sundanese used fuels they can easily procure in accordance with their economic conditions and the fluctuations in fuel prices.

Keywords Dietary habits · Kitchen equipment · Sundanese villages · West Java

1 Introduction

Indonesia comprises a great number of islands scattered throughout a vast region in Southeast Asia, stretching more than 5000 km east to west. It is home to diverse groups of people, including the Javanese, Sundanese, Padang (Minangkabau), Batak, and several hundred other ethnicities, each with its own language and culture.

The ethnic groups differ in their living environments, religions, and cultures. They also have greatly different food cultures. In a major city like Jakarta, many

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restaurants featuring the names of ethnic groups and their regions or cities can be found that serve Javanese, Sundanese, Padang, and other groups' cuisines. It is a stereotype that, the Javanese prefer sweet dishes; Padang dishes are spicy, and many meat and fish dishes are greasy; and in Papua yams are used by many inhabitants as their main staple. The Sundanese, inhabiting the western region of the island of Java, are known to like vegetables. There is a saying that pokes fun at this proclivity, stating, "There is nothing better than marrying a Sundanese. She is easy to support. Just put them in a yard, and they'll eat the leaves like a goat" (Arata 2008). Many Sundanese dishes, which use raw ingredients and are lightly flavored, are also friendly to the palate of Japanese people. Because large amounts of raw vegetables are used, they have been featured in Japanese magazines as a "healthy cuisine" (Enomoto and Murakami 2010).

While the regions of Indonesia have food cultures particular to ethnic groups, foreign fast food shops are making their way into the country's cities, and Western fare has become more familiar. Also, although temporarily stalled after the Asian financial crisis, Indonesia still boasts remarkable economic growth. Home appliances like refrigerators and rice cookers are gradually spreading from urban areas to the rest of the country, thereby transforming people's kitchens.

In contemporary Indonesian villages, then, what do people's dietary habits consist of, and with what sort of equipment are meals prepared? The extent of urbanization and diversification of menus and kitchens can be considered an important aspect of the advancement of urbanization into rural areas. The existence of socioeconomic hierarchies in Javanese and Sundanese societies has also long been observed (Kano 1988). What differences exist between socioeconomic classes in terms of menus and kitchen facilities?

Most Sundanese live in the province of West Java. Bordering the capital of Jakarta, West Java is a region most easily influenced by urbanization. This chapter uses West Java villages as a case study to examine the state of dietary habits in Indonesian rural villages in recent years as revealed by statistical data collected by the Indonesian government and field surveys conducted by the author.

2 The Dining Table in West Java Villages

First, this study explains with specific examples the kinds of food that are eaten in Sundanese rural villages in West Java. Since 2001, the author has lived among the people in three rural villages in West Java to conduct field surveys for several months a year. Village A belongs to Bogor Regency, and Villages B and C belong to Cianjur Regency. All villages are located up to more than ten kilometers from the capital city of each regency (Fig. 1).

These villages are located at the foothills of volcanoes (Fig. 2). According to the village statistics of 2003, paddy fields made up more than half of the villages' land use; however, population density exceeded 2000 persons per km^2, typical of rural villages on the island of Java. Although the surveys did not include detailed items

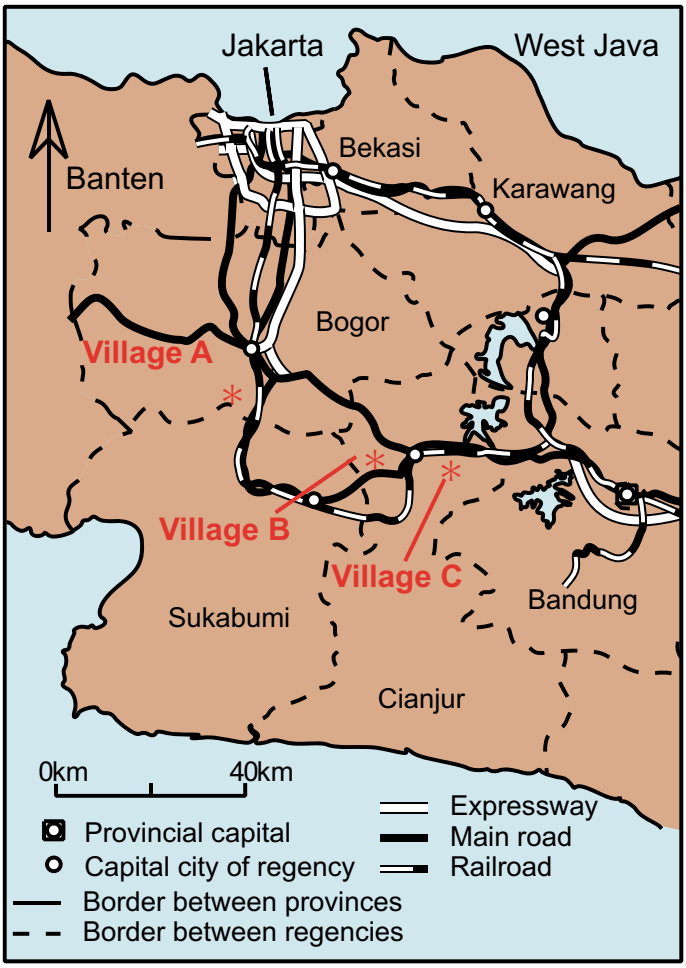

Fig. 1 Study area. (Modified from Endo 2006, p. 4)

about the villagers' meals, the author kept journal records of food items eaten in the households with whom the author lived. This study introduces the daily foods eaten in Sundanese rural villages based on personal experiences as recorded in field journals, and Arata's (2008) case study of Sundanese rural villages.

Table 1 shows the dietary habits of Mrs. T's household, with whom the author stayed in Village A. The author lived in Village A from 2004 until 2011. Mrs. T was in her 50s and lived with her husband; their children had become independent adults and had moved away. However, their daughter's family lived not far away in Bogor City, and Mrs. T's parents and her brothers' family lived nearby. They frequently came to visit, and family relatives often prepared meals together. The daily eating ritual in this household began with a light breakfast called *sarapan*.

Fig. 2 The scenery in Village A (the author 2013)

Table 1 The dietary habits in Village A: The case of Mrs. T's household

Time	Habits
6:00	(Waking up)
6:30	Light breakfast (*sarapan*): boiled bananas, maize, and coffee
8:30	Breakfast: rice and side dishes
	(Farm work, washing clothes, and cleaning rooms)
12:00	Light snacks: vegetable fritters (*bakwan*), fried bananas (*pisang goreng*) and coffee
	(Taking a rest and shower)
16:00	Dinner: rice and side dishes
	(Free time)
19:00	Light snacks: noodles with meat balls (*mie baso*)
22:00	(Going to bed)

Note Gray area: dietary habits (field survey in 2004)

As shown in Table 1, *sarapan* usually consisted of easily prepared items, such as boiled bananas, maize and sweet potatoes, and fried foods and other food items that could be purchased from the nearby *warung* (a small shop selling daily living goods and foods). Afterwards, breakfast was eaten again from 8:30 to 9 a.m. The meal consisted of items such as rice, *sambal* (chili sauce), one or two side dishes of salt-cured fish and vegetables (dishes made with vegetables or tofu or tempeh),

Fig. 3 A usual meal in Village A (the author 2007)

lalab (a salad of raw or boiled or steamed vegetables eaten with sambal), and instant noodles. Each person placed rice and side dishes on his or her own plate (Fig. 3).

After eating, Mr. and Mrs. T attended to household chores and farm work, which ended around noon. During this time they frequently ate *bakwan* (vegetable fritter) and *pisang goreng* (fried bananas) as light snacks. Sometimes, they also ate a light salad called *rujak*, which consisted of raw leafy vegetables and non-sweet fruits (Fig. 4). Eating snacks differed depending on the household; some households often prepared *sarapan*, but there were others that prepared very few snacks.

From noon until evening, the couple rested by taking an afternoon nap, and then took showers and ate dinner. The dinner menu was almost the same as the breakfast menu, and was not considered the main meal of the day. Mr. and Mrs. T relaxed in their home until bedtime, and sometimes consumed snacks during this time.

The above descriptions reveal the daily dietary habits of Mrs. T's household. This pattern of eating rice and side dishes twice a day and perhaps snacks up to a few times a day matched those of other households with whom the author lived and Arata's (2008) case study. According to Arata (2008), in the Sundanese language, consuming a meal consisting of rice and side dishes is called eating (*tnuang*/*neda*); when consuming other food items, a word deeply associated with drinking is used. Not considering food items other than the set of rice and side dishes as "meals" was

Fig. 4 The Sundanese salad *rujak* (the author 2003)

observed in the author's case study of Villages A, B, and C. For example, in all those villages instant noodles were frequently served at the dining table and were considered a "light snack" or a "side dish." As a result, the combination of rice and instant noodles as a meal was not unusual. According to Ishige (1998), the concept of rice and side dishes together as the basic pattern of a meal is common throughout East Asia and Southeast Asia where rice is the main staple.

In agreement with Arata (2008), the author found that ingredients for the daily menu in West Java villages consisted of rice, vegetables, fermented bean products (such as tofu and tempeh), and salt-cured fish. The frequency of animal proteins besides fish appearing on the dining table was low.

In addition, foods on dining tables in the surveyed villages did not include foreign dishes as a part of the daily diet, with the exception of instant noodles. The author believes the reason is that many rural villagers had almost no opportunity to eat foreign cuisines; ingredients and seasonings for cooking were not sold in rural areas. As of 2011, restaurants in Indonesia offering foreign cuisine were concentrated in cities. Also, because the ingredients and seasonings for foreign cuisines were expensive, the procurers were limited to large supermarkets and specialty shops in urban areas. Rural villagers had relatively frequent opportunities to go into cities to work, stock commodities, and shop. However, foreign cuisine restaurants and supermarket products were relatively expensive for the incomes of rural villagers and were difficult to access.

As personal experiences of the author and Arata's (2008) case study confirmed, the diet in Sundanese rural villages contained a high frequency of raw vegetable dishes such as *lalab* and *rujak*. Dishes of vegetables, fermented bean products, and fish were lightly flavored, and there was little consumption of foreign cuisines. What, then, are the characteristics of the Sundanese's meals in comparison with those of other ethnic groups? How do diets differ according to socioeconomic class?

3 Features of Food Consumption in West Java as Revealed by Statistical Data: Is Sundanese Cuisine Really Healthier?

Each ethnic group in Indonesia inhabits a particular region. Those with large populations, such as the Javanese, Sundanese, and Padang (Minangkabau), constitute the majority of the population in their respective provinces (Konishi 2009). As a result, food consumption trends by ethnic group and region in Indonesia can be roughly tracked from the province-level data of the National Socio-Economic Survey (SUSENAS), conducted annually by the government agency Statistics Indonesia (Badan Pusat Statistik (BPS)).

Table 2 shows the daily caloric intake per capita by province in Indonesia. From the data, we can see that the caloric intake in West Java villages is similar to the national average, and therefore it cannot be said that they are particularly healthier than the other regions. The lowest levels of caloric intake per capita can be found in the islands of eastern Indonesia, such as Nusa Tenggara, Maluku, and Papua. The provinces of Bali and Sumatra, on the other hand, have a higher caloric intake per capita than West Java villages. Also, compared with urban regions, the caloric intake per capita is higher in rural regions, such as Sumatra and Java. The greater amount of physical activities due to farming compared with urban regions is surmised to be the reason. In addition, on the islands of Java and Bali, which have high population densities and large markets, and where transportation networks have reached rural areas, there are many opportunities to purchase prepared foods from *warung*, food stall operators, hawkers, and other vendors. As a result, more than 10% of caloric intake comes from prepared foods and drinks, a level that is quite high compared with other regions.

Next, looking at the food group composition of per capita caloric intake, we see that the proportion of vegetables in West Java villages is lower than in the six other provinces shown in Table 3. In fact, people living in central Java and Yogyakarta on the same island of Java consume greater proportions of plants, such as yams, vegetables, and beans, as a part of their caloric intake. However, compared with other provinces the proportions of oils, fats, and beverages including sugar are lower in West Java rural areas. Also, in rural West Java, grains as a percentage of caloric intake (54.3%) are the highest among the areas shown in Table 3, indicating a rice-heavy diet. The data show that while it is true that foods in Sundanese rural

Table 2 The daily caloric intake per capita by province and the percentage of caloric intake coming from prepared foods and drinks in Indonesia (2007) (BPS 2007a)

Area/Province	The daily caloric intake per capita (kcal)		A/B	Prepared foods and drinks (rural areas) (%)
	Rural areas (A)	Urban areas (B)		
Sumatra				
Nanggroe Aceh Darussalam	2249	2113	1.06	8.3
North Sumatra	2153	1972	1.09	6.8
West Sumatra	2178	2094	1.04	9.3
Riau	2159	2099	1.03	6.6
Jambi	2145	1929	1.11	7.7
South Sumatra	2092	2005	1.04	6.7
Bengkulu	2132	2066	1.03	4.8
Lampung	2149	2044	1.05	6.6
Bangka Belitung	2068	2148	0.96	10.6
Riau Archipelago	2055	1921	1.07	7.8
Java, Bali				
Jakarta	–	1943	–	–
West Java	2080	1993	1.04	13.5
Central Java	1953	1895	1.03	14.5
Yogyakarta	2003	1867	1.07	14.8
East Java	1967	1893	1.04	10.1
Banten	2115	2057	1.03	11.8
Bali	2377	2218	1.07	10.1
Nusa Tenggara				
West Nusa Tenggara	1979	1968	1.01	9.3
East Nusa Tenggara	1876	2050	0.92	2.1
Kalimantan				
West Kalimantan	2088	1977	1.06	4.7
Central Kalimantan	2191	1994	1.1	6.3
South Kalimantan	2139	2169	0.99	11.5
East Kalimantan	1927	1967	0.98	4.8
Sulawesi				
North Sulawesi	2138	2048	1.04	5.2
Central Sulawesi	2035	2079	0.98	6.2
South Sulawesi	2078	2130	0.98	5.9
Southeast Sulawesi	2104	2242	0.94	5.6
Gorontalo	1866	1979	0.94	6.1
West Sulawesi	1997	2024	0.99	3.4
Maluku, Papua				

(continued)

Table 2 (continued)

Area/Province	The daily caloric intake per capita (kcal)		A/B	Prepared foods and drinks (rural areas) (%)
	Rural areas (A)	Urban areas (B)		
Maluku	1828	1907	0.96	6.3
North Maluku	1892	2088	0.91	4.8
West Papua	1843	2085	0.88	2.0
Papua	1922	2184	0.88	2.1
Indonesia	2050	1977	1.04	9.5

Table 3 The daily caloric intake per capita by food group in rural areas of seven provinces and Jakarta (2007) (BPS 2007a)

Province	West Java	Central Java	Yogyakarta	West Sumatra	Papua	Maluku	Jakarta
The daily caloric intake per capita (kcal)	2080	1953	2003	2151	1922	1828	1943
Grains[a]	54.3	46.4	37.5	53.4	20.3	35.6	38.3
Tubers	2.0	2.8	4.5	2.3	42.6	16.7	1.0
Fish	1.7	1.2	0.7	2.2	2.8	5.6	2.0
Meat	1.6	1.3	2.0	1.1	4.7	0.7	3.9
Eggs and milk	1.8	1.8	2.6	1.9	1.1	1.2	5.4
Vegetables	2.1	3.0	3.0	2.5	3.7	2.5	1.7
Legumes	3.8	5.3	8.3	1.2	3.1	1.5	3.4
Fruits	2.0	2.1	2.1	1.9	3.1	4.0	2.0
Oil and fats	9.4	11.9	13.6	16.8	10.7	16.3	12.9
Beverages[b]	3.6	5.4	6.5	4.7	3.7	7.1	5.1
Spices	0.8	1.1	0.8	0.3	0.3	0.5	1.0
Others[c]	3.3	3.0	3.8	2.2	1.9	2.0	5.0
Prepared foods and drinks	13.5	14.5	14.8	9.5	2.1	6.3	18.3
Total	100	100	100	100	100	100	100

Note [a]All types of food are indicated in percentages; [b]This category includes sugar; [c]Noodles, etc.

villages in West Java have a light flavor, the Sundanese' diet leans toward grains, that is, the main staple rice, more than toward vegetables.

The stereotypical characteristics of Sundanese cuisine—a "preference for vegetables" and "healthy meals"—are most likely due to the people's frequent consumption of raw vegetable dishes, such as *lalab* and *rujak*, which are not eaten much by other ethnic groups. Also, compared with rural areas in the provinces mentioned above, grains and yams make up an extremely small proportion of the diet in the capital of Jakarta, and the diet is diversifying to a large extent. While not to the extent of Jakarta, the diversification of diets in urban regions can be seen in West Java. As of 2007, grains as a percentage of caloric intake made up 54.3% in rural villages; in contrast, they occupied only 44.3% of diets in urban regions. Also, in rural areas, grains as a proportion of the diet fell five percentage points in a five-year period, from 59.7% in 2002 to 54.3% in 2007, showing an increased diversification in diet.

Differences in the composition of meals consumed due to economic conditions can be studied from per capita caloric intake for each level of monthly expenditure. A high level of expenditure can be considered to correlate with a high level of income, which makes such consumption possible. As shown in Table 4, the higher the level of monthly expenditure in West Java, the higher the average caloric intake per capita. Also, in terms of the composition of food groups, the lower the monthly expenditure level, the greater the reliance on grains and yams. Conversely, the higher the monthly expenditure level, the more diverse the diet. Compared with the lower income class, the higher income class consumes more meat, eggs and dairy, fat, processed foods, and beverages as a part of the diet; the amount of vegetables and beans as a percentage of the diet remains about the same, leading to the concern that such a dietary pattern carries a high risk of lifestyle diseases. We see then from statistical data that, while the Sundanese may prefer raw vegetables compared with other ethnic groups, it does not necessarily mean that they consume more vegetables. Moreover, the foods consumed by those from the urban regions and the economic upper class are diversifying.

4 Kitchens in West Java Villages and Their Changes

What kinds of kitchen equipment do villagers use to produce the meals described above? This study examines the fuels that are required for cooking as used in Villages A, B, and C surveyed in Sect. 2.

First, there were three types of fuels used in 2003: firewood, kerosene, and liquefied petroleum gas (LPG) (Table 5). The kitchen facility of each household differed depending on the type of fuel used. In the case of firewood, the stove was placed inside or outside the home. When cooking rice, traditional tools such as steamer pots (*seeng*) and baskets (*aseupan*) were used (Fig. 5 shows the equipment on top of a kerosene burner). In the case of kerosene fuel, a burner is used and this is also the case with LPG. For these two fuels a deep pot is used to cook rice.

Table 4 The daily caloric intake per capita and the population structure by level of monthly expenditure per capita in West Java (2007) (BPS 2007a, b)

The level of monthly expenditure per capita (Rp. 1000)	Less than 100	100–149	150–199	200–299	300–499	500–749	750–999	1000 and more	Average
The average of daily caloric intake per capita (kcal)	1229	1515	1684	1961	2245	2371	2533	2567	2029
Grains[a]	70.0	64.6	58.5	53.0	45.3	38.3	32.7	30.8	48.5
Tubers	2.4	2.3	2.0	1.8	1.6	1.2	1.2	0.9	1.7
Fish	1.4	1.4	1.4	1.6	1.8	2.1	2.3	2.2	1.7
Meat	0.4	0.5	0.9	1.6	2.7	4.2	4.9	5.7	2.4
Eggs and milk	0.6	0.9	1.5	2.1	3.3	4.8	6.1	6.7	3.0
Vegetables	1.8	1.8	1.9	2.0	2.0	1.9	1.8	1.7	1.9
Legumes	3.4	3.0	3.7	3.7	4.1	3.9	4.1	4.1	3.8
Fruits	1.7	1.4	1.5	1.6	1.8	2.3	2.8	3.2	1.9
Oil and fats	7.1	8.5	9.2	10.0	10.9	12.0	13.1	13.0	10.6
Beverages[b]	1.9	2.8	3.1	3.7	4.4	5.0	5.1	5.3	4.1
Spices	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.1	0.9
Others[c]	1.6	2.4	3.0	3.7	4.7	5.2	5.7	5.1	4.1
Prepared foods and drinks	7.1	9.8	12.5	14.2	16.4	17.9	18.9	20.2	15.2
Total	100	100	100	100	100	100	100	100	100
population structure (%)	1.04	10.01	16.21	27.68	26.01	11.50	4.19	3.35	–

Note [a]All types of food are indicated in percentages; [b]This category includes sugar; [c]Noodles, etc.

Table 5 The type of main fuel used in the surveyed villages in 2003 (field survey in 2003)

	A Village	B Village	C Village
The number of households	85	48	33
Firewood	51.8	8.3	9.1
Kerosene	48.2	77.1	90.9
LPG	0	14.6	0
Total	100	100	100

However, it was possible for equipment to exist together in the kitchen. There were households that had both a cooking stove and kerosene burner, or had all three types of equipment. Households with multiple types of equipment said that the equipment they primarily used depended on the price of the fuels, and that they switched equipment as fuel prices fluctuated. Of the three types of fuel, the most

Fig. 5 A kerosene burner (left) and a stove (right) in Mrs. T's kitchen (the author 2001)

widely used in all three villages was kerosene.[1] The use of firewood and LPG differed in accordance with the location of the village. Firewood was used frequently in Village A as it was located next to a forest. The use of LPG was observed in Village B, close to the nearest city and with easy access to LPG retailers, but not in the two other villages.

The author sought to study the characteristics of households in Village A that use either firewood or kerosene, both of which were widely used. First, the 2003 survey revealed that, in terms of income, the proportion of low-income households (annual income of less than 2 million rupiah) that used firewood was high (Fig. 6).

[1]As of 2003, the use of kerosene had spread widely in West Java villages. However, the interview survey in 2010 revealed a complete change with almost all households that had been using kerosene in 2003 switching to LPG. The background to this change was the issue of insufficient petroleum to meet domestic demand and the resulting sharp spike in petroleum prices. To respond to this state of affairs, the Indonesian government implemented a program in 2006 to convert the choice of household fuel from kerosene to LPG. This program raised the price of kerosene while providing a 3 kg LPG cylinder and gas burner to each household for free and subsidies for additional 3 kg cylinders (Directorate General of Oil & Gas 2007; Higashikata 2010). As a result of this program, the cost of using kerosene compared with LPG became very high, and the conversion to LPG in West Java villages took place in a short amount of time. However, not all households converted to LPG. As of 2003 there were households that continued to use firewood and multiple fuels.

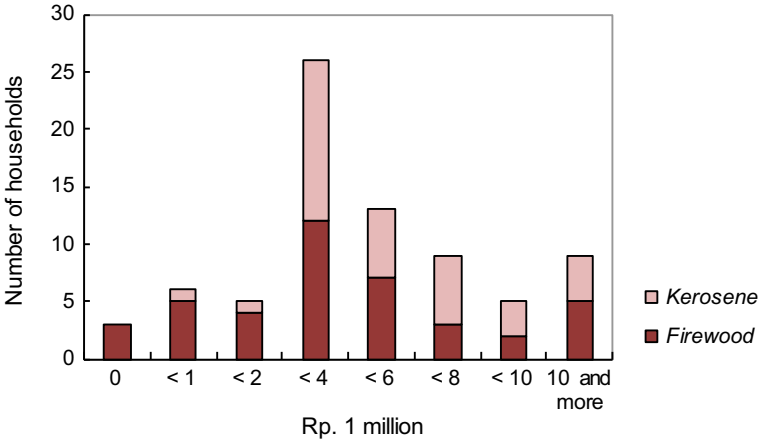

Fig. 6 The type of fuel by level of annual household income in Village A (Field surveys in 2001 and 2003)

In terms of the primary occupation of the head of household, households of farmers and farm laborers made up a large share of firewood users. These households could obtain firewood easily from farmlands and woods; at the same time, they made up a comparatively large percentage of households with low incomes and with older household heads (Endo 2006). A high rate of households in which the heads worked in construction also used firewood. However, five of the eight households involved in construction using firewood also did farming as a side job (Fig. 7).

Also, in relation to the age of the household head, almost all households with heads in their 60s or above used firewood. On the other hand, the majority of younger households with heads in their 20s and 30s used kerosene (Fig. 8). Of the households with heads in their 20s to 30s using firewood, seven of the ten were households of farmers or farm laborers. Low-income households, households with older heads, and households working on farms as farmers or farm laborers in Village A tended to use firewood. Similar trends in firewood-using households were also found in Villages B and C. Meanwhile, households in the upper socioeconomic class, such as the households of government workers and large landowners, made up the those using LPG in Village B. The survey thus revealed that in addition to access to fuel as a result of conditions such as the location of the village and the primary occupation of the household head, a household's economic status greatly affected its choice of fuel.

At the time of the 2003 survey, the spread of home appliances had not extended beyond the use of refrigerators and rice cookers by a handful of households. However, in 2010 when the author interviewed some of the residents of Villages A and B, the author learned that the adoption of refrigerators and rice cookers was increasing. Refrigerators were mainly used to keep drinking water cold. There was

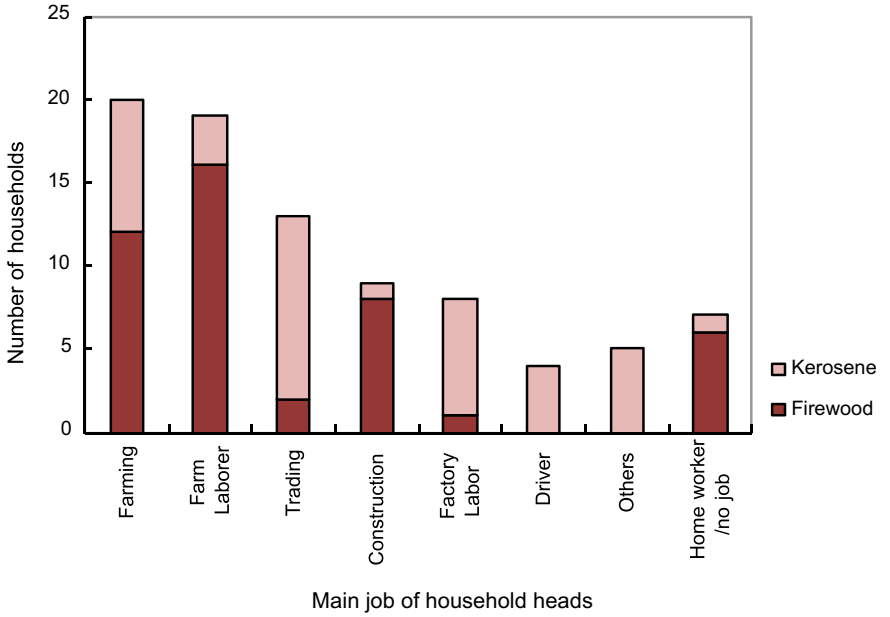

Fig. 7 The type of fuel by main job of household head in Village A (Field surveys in 2001 and 2003)

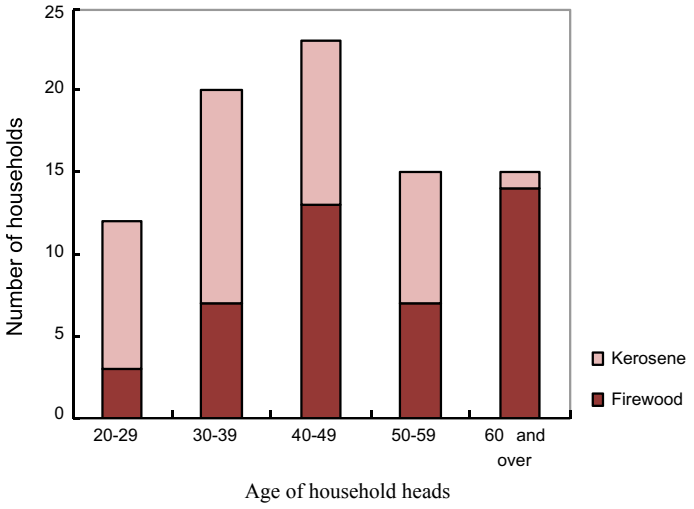

Fig. 8 The type of fuel by age of household head in Village A (Field surveys in 2001 and 2003)

Fig. 9 A peddler of foodstuffs in Village A (the author 2013)

almost no use of the appliance to store food for a few days. Foodstuffs were purchased daily from *warung* and peddlers as in the past (Fig. 9). With regard to the use of rice cookers, the method of cooking rice changed from the conventional method of boiling it in excess water to the optimum water level method,[2] depending on the specifications of the equipment.

5 Conclusions

Using West Java villages bordering the capital of Jakarta and inhabited predominantly by the Sundanese people as a case study, this chapter introduced the actual conditions of dietary habits and kitchen equipment in Indonesian rural villages in recent years. At the same time, it examined the urbanization of meals and kitchen equipment and the differences between socioeconomic classes. In Indonesia, various groups of people have their own unique food cultures. Sundanese cuisine is

[2]For the method of cooking rice in excess water, rice is cooked in an abundance of water at the beginning. The extra water is removed while the rice is cooking, and the rice is finished by steaming. With the optimum water level method, rice is cooked from beginning to end in the amount of water added at the beginning.

generally considered to be healthy because it uses large amounts of vegetables. However, compared with meals in other provinces, those in West Java villages actually tend to use greater quantities of rice than vegetables. The idea that Sundanese meals consist of many vegetables probably comes from the fact that the group has the dietary habit of frequently eating raw vegetables while other ethnic groups consume them less often. Also, in West Java, the economic upper class is experiencing diversification in consumed food items, a pattern that can be seen in both urban and rural areas. Although the popularization of foreign cuisines is slow, the eating patterns and menu items associated with them have left a mark. Accordingly, in West Java villages today, it is not that new foreign cuisines are being incorporated into daily lives; rather, meals are diversifying in terms of ingredients and the addition of in-between-meal snacks and side dishes. As for cooking fuels, the author's surveys reveal that the Sundanese used fuels they could easily procure in accordance with their economic conditions and the fluctuations in fuel prices.

Indonesia's economic growth is still continuing, and the lives of rural villagers continue to change. As this chapter does not contain detailed follow-up surveys related to meals and kitchen equipment since 2003, understanding the changes in rural village life, as represented by changes in meals, fuel, and the rate of home appliance adoption, is a topic for future studies.

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Creating a New Relationship with the Environment Through Food: Learning from Community Development Initiatives in Kaneyama Township in Yamagata Prefecture, Northeast Japan

Toru Sasaki

Abstract Kaneyama Township in Yamagata Prefecture, Northeast Japan, neither grew buckwheat nor had a culture of buckwheat in its past. It is not the case that the natural environment of this township was ever basically unsuitable for growing buckwheat; rather, the crop was not grown because no economic or practical rationale had ever been found to do so. However, the buckwheat in this area has now been found to have unique value through exchange between local residents and urban residents. This chapter will look at how buckwheat has been positioned as a local food in these community development initiatives. We will consider the possibilities for creating a new relationship with the environment through food. We may be able to visualize how what is taken to be a "relationship with the environment" is not some latent or inherent presence, but rather a product of human activity and intervention over time.

Keywords Buckwheat · Environment · Local food · Kaneyama Township · Yamagata Prefecture

1 Foreword

The township of Kaneyama, situated at the northern end of Yamagata Prefecture, has a population of about 6500 (Fig. 1). The township is home to a restaurant that serves handmade buckwheat noodles; it is open on Saturdays and Sundays only. The name of the shop is Taniguchi *Gakko Soba*, and it re-purposes the former Taniguchi Branch School of Kaneyama Municipal Elementary School (Fig. 2). The enterprise is run by the non-profit organization (NPO) "*Shiki no Gakko*

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Taniguchi." Regular farming experience workshops are also held. Almost 14 years have already passed since the "school" opened, but both the Taniguchi *Gakko Soba* restaurant and the farming experience workshops are still thriving.

However, the fact is that Kaneyama originally had no connection at all to the production of buckwheat. The township's main industries are timber from Kaneyama cedar (the area is 80% under forest), paddy-farming on land cleared on the plain and in the mountains, and construction (Fig. 3). Most of the local paddy farmers need second jobs apart from wet-rice farming to get by (Sudou 1997). Nevertheless, when Taniguchi Branch School in Taniguchi hamlet closed down, it was taken as an opportunity to begin the production of buckwheat in this traditionally rice-harvesting area. This new departure was one of a number of community development initiatives, along with holding farming experience workshops and running the *soba* restaurant. What is more, these initiatives are highly distinctive in that they were conceived by the local people themselves, and the same people have developed and broadened them within the scope of their own abilities. Against this backdrop, growing buckwheat has progressively spread all over the township as a means of crop diversification, and it now ranks second to paddy-farming in terms of area under cultivation.

Fig. 1 Study area

Fig. 2 Exterior of Taniguchi Gakko Soba

Fig. 3 Paddy landscape in Kaneyama Township

Taking the *Shiki no Gakko* Taniguchi initiatives as an example, this chapter will look at how buckwheat—a crop that was not harvested at all in the locality—has been positioned as a local food in these community development initiatives. Working from this example, we will consider the possibilities for creating a new relationship with the environment through food.

2 Buckwheat Restaurant Born from the Re-purposing of an Abandoned School

Taniguchi hamlet is a farming settlement of thirty-three households situated in mountainous country in the north-western part of Kaneyama Township. Taniguchi Branch School of Kaneyama Elementary School was a feature of the hamlet from 1950 to 1996. Apart from its obvious function of educating the local children, the Branch School also served as a cultural and social hub for the community that it symbolized. The school's central place in the locality can be seen in how the local residents of the time paid the costs for its construction, including the site, the labor costs, and the wages involved. However, because of the falling numbers of local children, it was decided that the school would close its doors in 1996.

With the school's closure now a direct prospect, the question arose of what should be done with its buildings, which would remain. They were aging, and opinions were voiced that they would need to be dismantled if a way of putting them to use could not be found. However, local residents were both uneasy about losing this vital community platform, and strongly committed to finding some way to re-purpose the buildings and put them to use again. When the Village Office offered to entrust the maintenance and management of the Branch School to the community with the buildings in their current state at the time, the offer was accepted and the Taniguchi Branch School Management Committee was set up by both local supporters and others from outside the area. However, the decision to maintain and manage the school buildings meant that 250,000 yen a year would have to somehow be found to pay for ground rent, repairs, and so on.

It was at this point that running farming experience workshops and a buckwheat cuisine restaurant emerged as potential ways to put the Branch School to use. The first of these initiatives, the farming experience workshops, was given the title "*Shiki no Gakko* Taniguchi." Classes were held four times a year, covering farming experience, edible wild plant harvesting, *soba*-making experience, rice-cake making, and snow-clearing from rooves, among other topics. All of them initiated the participants into the activities of the local people's daily lives. This approach was triggered by the rise of green tourism at the time. The second initiative, the "Taniguchi *Gakko Soba*" handmade buckwheat cuisine restaurant, was conceived as a way to pay for the upkeep of the school buildings. The target clientele includes not only local residents but also urban dwellers, such as local people returning home from the cities. In terms of geographical spread, the target area is not confined

to Yamagata Prefecture and the Sendai area. With visitors coming to study and observe from across Japan, it covers the entire country.

3 The Current Management System

The current NPO *Shiki no Gakko* Taniguchi grew out of the volunteer Taniguchi Branch School Management Committee when it was legally incorporated in 2005. TheNPO consists of 11 members, and the Taniguchi *Gakko Soba* restaurant is run by an all-woman staff of eight. There are thirty-three farming households of Taniguchi hamlet (Table 1). Of the settlement's inhabitants who are involved in these initiatives, two are men in their fifties, two are men in their sixties, two are women in their fifties, four are women in their sixties, and one is a woman in her seventies, a total of 11 people. The female participants are mainly involved in running the *soba* restaurant. In employment terms, almost all of the participants are either working in agriculture or in other local industries. The reason why the farming experience school and the *soba* restaurant are not run right through the week is because priority lies with the participants' jobs and various everyday activities. Now that the *soba* restaurant is doing well, its proceeds can cover not just upkeep of the school buildings but also staff salaries and management expenses. As a result, the project has stabilized and achieved continuity.

4 Creating a New Relationship with the Environment Through Food

As mentioned above, Kaneyama Township had neither buckwheat growing nor a culture of *soba* in its past, nor was the idea of opening a soba restaurant based on any special reason in particular; it was just that *soba* was enjoying a surge in popularity nationwide among an increasingly health-conscious public. However, this rice-growing area, as a matter of course, had no one with any experience in making *soba* noodles by hand. So, local people traveled outside the area to learn the techniques and be trained, and skilled *soba*-makers were also invited to visit and impart their skills. As of now, the flour used to make the noodles is 100% locally grown, and it is local homemakers who make the noodles by hand. The restaurant stays open for an extended period of days during the *O-bon* holidays. There are over 100 customers on some of these days, and at present an average of about 15,000 customers per year.

Apart from the novelty factor of a *soba* restaurant doing business in an abandoned school, *soba* cuisine in this context is positioned as a dining forum for interaction with urban dwellers and local community residents. It is not the case that the natural environment of Kaneyama Township was ever basically unsuitable for

Table 1 Households of Taniguchi farming settlement in Kaneyama Township

Household	Farm land(are)				Male labour force							Female labour force							Agricultural Machines			
	Total	Rice	Others		20	30	40	50	60	70	80	20	30	40	50	60	70	80	Tractor	Rice Planting	Combine	Drier
1	1300	1000	300	(buckwheat)		△			●		□			△		●		□	○	○	○	○
2	600	500	100	(dent corn)			●		●					◎		●		□	△	△	△	△
3	550	500	50	(vegetable)				●		□							▲		○	○	○	○
4	530	450	80	(dent corn)			○		▲							◎			○	○	○	○
5	440	400	40	(oats)					◎					□		◎			□	□	□	□
6	415	400	30	(buckwheat)					◎						○			□	○	○	○	○
7	400	400	40	(buckwheat)	○			◎				○			□				○	○	○	○
8	400	400	40	(buckwheat)	○			●				□			△				△	△	△	△
9	340	300	40	(buckwheat)		△			◎			△			△				○	○	○	○
10	330	280	20	(buckwheat)				○		◎					○		▲		○	○	○	○
11	290	290	30	(buckwheat)		△		◎							○			□	○	○	○	○
12	280	270	10	(garric)				▲							◎				○	○	○	○
13	220	220	20	(buckwheat)				◎		●									○	○	○	○
14	200	200					○		●					○		●		□	○	○	○	○
15	200	200						◎								□			△	△	△	△
16	200	200							▲		□					●		□	○	○	○	○
17	190	170							◎					●			□		○	○	○	○
18	180	180			○			◎			□	○			□				○	○	×	×

(continued)

Table 1 (continued)

19	170	150					◎			△		◎				□	□	□	□
20	150	150				◎		□				△		□		○	○	○	○
21	100	90		△			◎			△		◎			□	○	○	×	×
22	20	0	△				◎						●		□	×	×	×	×
23	15	0					□						●	□		×	×	×	×
24	10	0						○						□		×	×	×	×
25	10	0			△											×	×	×	×
26	0	0				△										×	×	×	×
27	0	0					□						○		□	×	×	×	×
28	0	0			○			□			□					×	×	×	×
29	0	0				○									□	×	×	×	×
30	0	0			△						□					○	×	×	×
31	0	0							□						□	×	×	×	×
32	0	0	△			△						□			□	×	×	×	×
33	0	0	□			○				□		○				×	×	×	×

Date Source: field survey in 2009

Note: ●Full-time Farmer ▲Mainly Engaged in Farming ◎Part-time Farmer

○Other Job(Inside of the town) △Other Job(outside of the Town) □Out of Work or Housewife

The people which engaged in "NPO Shiki no Gakko Taniguchi" are shown by half-tone dot meshing.

growing *soba*; rather, the crop was not produced because no economic or practical rationale had ever been found to do so. Now, however, a practical rationale for growing *soba* has been found—that is, supplying ingredients to a *soba* restaurant being run for the upkeep of a disused school. The value of *soba* cuisine was thus discovered through its consumption by people who sympathized with the culture and lifestyle of the locality.

The term "foodstuffs" refers not only to products derived from nature; it also covers the processes of preservation and preparation (among others) that convey it to the human palate, thereby forming the basis of human life. Advances in refrigeration and transportation technology have made it possible for foodstuffs to be consumed in places far from where they are produced. Nevertheless no matter how far away agricultural products can be transported from where they are grown, the experience of sitting down to a meal of locally produced foods, cooked in the local style and shaped by the area itself, is something that can never be shipped elsewhere (Ikemoto 2008). This is why the handmade *soba* noodles served at the Taniguchi *Gakko Soba* restaurant can only be consumed in this particular spot. The example of Kaneyama Township offers us an understanding of how individuals can coalesce to rebuild their distinctive local culture and lifestyle, in this case by maintaining and activating a disused school by offering diners a unique and non-reproducible experience.

The author does not consider the idea of our "relationship with the environment" to be merely about the natural environment; nature itself is transformed by human intervention, and this transformed nature is in turn understood and experienced by human beings as being buried deep in their own lives in human society. Moreover, our relationship with the environment is by no means fixed; when we understand this relationship as being historically shaped, the initiatives undertaken in Kaneyama Township allow us to visualize the process of creating a new relationship with the environment through food. The reason is that buckwheat and *soba* noodles, which had not been a feature of the locality before, have permeated through community development initiatives into the area's farming production and to some extent into its social life, and have begun to construct new resources for the community. Insofar as this development is understood as a "relationship with the environment," no immediate evaluation of it is possible. However, if we can visualize the process whereby the cuisine (food), which has been created, develops into a relationship with the environment (*fudo*), we may be able to visualize how what is taken to be a "relationship with the environment" (wherever the particular locality may be) is not some latent or inherent presence but rather a product of human activity and intervention over time.

5 Postscript–The Present Situation

Shiki no Gakko Taniguchi had its twentieth anniversary in 2017. With its membership growing older, it was decided that the group would shut down that February. At the same time, this meant that there was no choice but to close the Taniguchi *Gakko Soba* restaurant. However, this was not to be the end of the enterprise. A great many people, both locals and tourists who had visited the restaurant, voiced their regrets about its closure, and their desire to see it stay in business. A young group of interested supporters from Tokyo set up a "Local Revitalization Enterprise Cooperative" and took over the running of the Taniguchi *Gakko Soba* restaurant in April 2017.

What this development suggests is that this initiative, which has prevailed for 20 years, has been appreciated not just by local residents but also by outside visitors to the area, and this has allowed the initiative to take root as an aspect of the locality's unique culture and business life. It appears that the initiative has finally been recognized as a resource of major value for the locality. Furthermore, as we can see from the fact that the management of this enterprise has been taken over by people from outside the locality, the conditions whereby it has generated its appeal up to the present are now ready to be recast in a new configuration.

This chain of events may offer us further opportunity to grasp the fact that the "relationship with the environment" is shaped by human beings' proactive usage of their surroundings, and that this "nature" is in turn incorporated by human beings into their own lives in human society.

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Epilogue

Through this book, we sought to share the fascination of Monsoon Asia. Further, we sought to transcend the long-existing gap between physical geography and human geography. Toward this end, we focused on the concept of *fudo*. In this final chapter, we review the perspectives we took when discussing *fudo*.

The first perspective involved the relationship between the natural environment of Monsoon Asia and agricultural production. The second perspective involved the relationship between the natural environment and food processing and consumption. The third perspective concerned the aspects of society, culture, and tradition in association with food (see Figure in Prologue).

From the first perspective, we examined the relationships between rainfall, floods, and rice production in South Asia in Chapter "Rainfall, Floods, and Rice Production in the Ganges-Brahmaputra-Meghna River Basin" and between global warming and agricultural activities in Asia in Chapter "Global Warming and Agricultural Production in Asia"; the focus was on the cultivation of glutinous rice in Northeast India, a region with a unique natural environment, in Chapter "Cultivation of Glutinous Rice in Northeast India, and Its Food Products", and, similarly, on the fog and lives of people living in Xishuangbanna, Yunnan Province, China, in Chapter "Fog and People in Xishuangbanna, Yunnan Province, China". In all chapters, we focused on agriculture carried out under the monsoon climatic environment, and especially on rice production. Chapters "Rainfall, Floods, and Rice Production in the Ganges-Brahmaputra-Meghna River Basin" and "Global Warming and Agricultural Production in Asia" contained discussions from a macro perspective, while in Chapters "Cultivation of Glutinous Rice in Northeast India, and Its Food Products" and "Fog and People in Xishuangbanna, Yunnan Province, China" we used local perspectives as a lens to view our topics.

From the second perspective, in Chapter "Yamato-Shijimi and Environmental Changes in Lake Jusanko, Northern Japan, Over the Past Several Thousand Years" we focused on the long-term associations between Lake Jusanko and Yamato-shijimi claims; in Chapter "*Natto* in Mainland Southeast Asia" we noted associations between diversity in *natto* (fermented soybeans) and diversity in regions

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in Southeast Asia, and similarly in Chapter "Distribution of Traditional Seafood Dishes and Their Background in Miyazaki Prefecture, South Japan" we discussed diverse seafood dishes in Miyazaki Prefecture and regional variations. In Chapter "Yamato-Shijimi and Environmental Changes in Lake Jusanko, Northern Japan, Over the Past Several Thousand Years", we used a temporal perspective, while in Chapters "*Natto* in Mainland Southeast Asia" and "Distribution of Traditional Seafood Dishes and Their Background in Miyazaki Prefecture, South Japan" we focused on a broad spatial range.

Finally, from the third perspective we discussed not only regionality but also cultural norms and the effects of globalization surrounding a Nepalese dish (*Dāl-bhāt*) in Chapter "Nepalese Food and Its Sociocultural Climate: Changing *Dāl-bhāt* Inside and Beyond Nepal". Similarly, in Chapter "Contesting Values of Brewing "*Chang*" in a National Park of Bhutan", we discussed traditional cultural norms and social norms demanded by the government in association with Bhutan's drinking customs. In Chapter "Satsuma *Shochu* and Geographic Indication", we examined Satsuma *shochu* spirits and focused on how the identity of *shochu* originally produced and consumed in a particular region was maintained in the globalizing *shochu* market. In Chapter "Dietary Habits and Kitchens of the Sundanese in West Java Villages", we considered the changing dietary habits of villagers in Indonesia under the influence of economic growth and urbanization. In Chapter "Creating a New Relationship with the Environment Through Food: Learning from Community Development Initiatives in Kaneyama Township in Yamagata Prefecture, Northeast Japan", using the example of community development involving soba noodles in Yamagata Prefecture, we considered the possibility of creating new *fudo*.

Through each of these discussions, what we sought to demonstrate was that the Asian monsoon has one of the largest movements of any natural phenomenon on a macroscopic scale, as shown in the first half of Part I. In the second half of Part I, we sought to show that the Asian monsoon also manifests itself in unique forms in extremely limited environments. As shown in Part II, these manifest forms are diverse both on a time scale and on a spatial scale, and are extremely diverse in limited regions. The manifestation of such diversity is not just due to the effects of the natural environment. It is also the result of social and cultural forces, as shown in Part III. Here, traditional and religious social norms are becoming entangled with "new" economic and political norms brought in from outside the world of Monsoon Asia by globalization.

Now, we can simply say that the fascination of Monsoon Asia is its high diversity. However, we wish to consider what kind of approach is effective for understanding a subject with such rich diversity (Monsoon Asia). In short, this is the aim of using *fudo* as a framework, which encompasses both a physical geographic approach and a human geographic approach. Here we offer a few additional considerations from the viewpoints of "The Asian monsoon and Monsoon Asia," "*Fudo*: The relationship between the natural environment and human beings," and "Food: Agriculture, processing, cooking, and eating," as presented in Prologue.

Food as a Viewpoint

First, as shown in Prologue, "food" is not simply something to be eaten, but is a concept that encompasses agriculture and livestock production, hunting and fishing, processing, cooking, and eating. Accordingly, we introduced a multifaceted framework that can consider not just the connections between agriculture and the natural environment, and the connections between dietary habits and food cultures on the one hand and the natural environment on the other, but also the connections between agriculture, dietary habits, and food cultures down the line. By laying these connections on the horizontal axis and the relationship between the natural environment, human activities, and the values (social, cultural, traditional) behind human activities on the vertical axis, we believe we have achieved a certain success in offering a framework to comprehend the complex and diverse Monsoon Asia.

For example, in several chapters in Part II, we examined the foods and dishes of Monsoon Asia, in which diverse forms were manifest in limited regions and limited natural environments. We saw that not only the natural environment but also the origin and values of a group making the food or dish, or economic conditions, have no small effect. In the chapters of Part III, we saw that the meaning attached to traditional foods and dishes are changing as values and norms transcend national boundaries due to economic globalization and the globalization of information communication networks in recent years. At the same time, inhabitants in the regions are forced to change their ways of confronting the natural environment as they adapt their agricultural practices, food processing, and hunting and gathering activities to these external forces to produce their foods and dishes. For example, they have changed dietary habits and introduced new foods. The changes are manifested in the decline of gathering activities carried out until now and in emerging new human activities, such as completely new ways of growing crops.

To comprehend such a state of affairs, a framework that perceives agriculture, dietary habits, and food culture on a continuum may make it possible to comprehend domains that cannot be sufficiently addressed by discussions just about agriculture and the natural environment, or about the natural environment, dietary habits, and food cultures. To understand the Monsoon Asia regions where not only concrete goods such as foods but also economic, social, and political norms are expected to be more strongly influenced by the outside world, it will be critical to maintain a framework such as *fudo*. It is especially legitimate in these regions because the conventional lifestyle in which people consume locally produced food continues to collapse, and food products are being increasingly supplied from distant locations.

Rethinking *Fudo*

When using the word *fudo*, one cannot avoid Tetsuro Watsuji's pioneering achievement—or obstacle—*Fudo*. Watsuji (1889–1960) was a philosopher, ethicist, and intellectual historian active both before and after the Second World War. However, he was not a geographer. His representative work, *Fudo Ningenteki*

Kosatsu, was published in 1935 (translated into English by Geoffrey Bownas in 1961 as *Climate and Culture: A Philosophical Study* [Greenwood Press]). We will not discuss the content of this work here. However, we geographers must inevitably deal with the monumental, multifarious effects of this work when discussing *fudo*.

As mentioned in Prologue, *fudo* is not a word coined by Watsuji. It was used a long time ago, as attested by the records of *Fudoki*, or medieval Japanese gazetteers. *Fudo* and *Fudoki* also had the meaning of "topography." To international readers familiar with Watsuji's *Fudo*, we may assert that the word *fudo* used in general by the Japanese people and Watsuji's *fudo* are different, and that *fudo* as depicted in ancient times in chorographies differs from *fudo* as depicted by Watsuji. At the same time, this is also a declaration to us as geographers. (It is about time we liberated ourselves from Watsuji's spell).

We should use the term and the concept of *fudo* in this geographic sense more actively and more freely. We should discuss *fudo* without binding it to Watsuji's context. Watsuji's philosophical theory of *fudo* is too abstract for geographers, who work in the field. In the first place, *fudo* as depicted in *Fudoki* is extremely specific and down-to-earth. *Fudo* depicted in these volumes is a vast collection of mountains and rivers, vegetation and produce, populations, manners and customs, and place names. Physical geographic phenomena and human geographic phenomena are included as a matter of course. If such descriptions are *fudo*, understanding the relationships between these described phenomena is also *fudo*. In this *fudo* lies the advantage of the coexisting approach of physical geography and that of human geography.

While Watsuji classified *fudo* into three types—"monsoon," "desert," and "meadow"—we wish to use *fudo* as a concept for understanding the rich diversity of Monsoon Asia. As already shown in each chapter, Monsoon Asia is a world extremely rich in diversity. Figure in Prologue indicates a framework to understand our areas of research—in short, to understand the relationships between various phenomena. It is a way to perceive not only how the natural environment affects human activities such as agriculture, food processing, and dietary habits. It also shows how human beings' influence on the natural environment is manifest as food processing and dietary habits.

Of course, there is room for discussion about how effective our theory of *fudo* is in our attempt to understand the Monsoon Asia. However, when seeking to comprehend the relationships between the Asian monsoon—which while encompassing great diversity can also be called in its totality an atmospheric phenomenon—and the activities of human beings under this atmospheric phenomenon, an awareness brought about by *fudo* is sufficiently effective. This is because we have been using the concept of *fudo* since olden times to grasp diverse forms manifested in contexts such as the natural environment, society, culture, and tradition.

What Is Monsoon Asia?

Finally, we would like to touch on the topic of Monsoon Asia, a most difficult topic. We can say that it is nearly impossible to answer "What is Monsoon Asia?" In this book we have attempted to explore commonalities in Monsoon Asia while depicting its diversity. Of course, one commonality is the macroscopic atmospheric

phenomenon. That said, there is great diversity everywhere, from the Indian subcontinent to the Japanese archipelago, that is under the influence of the Asian monsoon. That diversity is a common point is somewhat paradoxical. As shown in the beginning of Prologue, the lives of people living in Monsoon Asia are not the same. A difference of just several tens of kilometers or just several kilometers in distance brings about great differences in the conditions of the land such as altitude, distance from the coast, position of mountain ranges, topography and vegetation, and demography. When considering why such diversity is expressed, we get clues from the frames of perceiving people and the environment shown in Figure in Prologue (frames a, b, and c). In Monsoon Asia, these frames can be observed on an extremely small geographic scale, a characteristic unique to Monsoon Asia.

Of course, *fudo* may be nothing more than a simple working hypothesis, or an answer to a Zen riddle. To answer "What is Monsoon Asia?" more clearly, we must conduct further studies in the field to test how valid the framework of *fudo* is that we propose. Although Monsoon Asia is vast, we want to amass fieldwork steadily rather than finding an answer rashly. We would then accumulate experience much as the people living in Monsoon Asia have.

Hitoshi Araki

Afterword

This book is an updated English translation of *Food and Fudo in Monsoon Asia*, a book published in Japan in September 2012. It is not a complete translation of the original book, and some of the contributors to the book differ from the original Japanese version. The background to how the editors came together to publish the original Japanese version is as noted in the Preface. After the Japanese book was published, the three editors got together in January 2014 to discuss the publication of the book through the AJG Library series in order to communicate our activities in English. Five years have passed since that time and we were finally able to achieve the publication of this English version.

We have definitely not been goofing off during these five years. Many of the contributors are university faculty members. Japanese universities have been undergoing huge reforms during the last ten years, causing administrative duties to increase and leaving precious little time to spend on research. That was one of the factors that led to delays in the writing. Another factor is that expressing in English the special terminology and concepts that we frequently use in the Japanese language without a second thought proved to be a serious hurdle. For instance, the term *fudo* that is discussed in detail by Hitoshi Araki in Prologue and Epilogue is intuitively understood by Japanese people as an environmental concept that links the natural environment, culture and society. Thus the word *fudo* is included in the title of the Japanese publication, but there is no term that accurately conveys the sense of *fudo* in English. Since using the Japanese word "Fudo" as it is would be totally incomprehensible to English readers, the book is published under the title *Nature, Culture, and Food in Monsoon Asia* rather than as a direct translation of the Japanese title. The problems encountered in translating from Japanese to English were not limited to the title; it goes without saying that vast amounts of time were spent on all the words expressing the names of local foods and the natural environments that are discussed in each chapter.

Many of the contributors to this book have conducted field work over a span of many years in various parts of monsoon Asia, including Japan, and have experienced long periods of living in countries far from Japan to carry out their research.

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These include Haruhisa Asada, who conducted long-term fieldwork in Assam, Satoshi Yokoyama in Laos, Izumi Morimoto in Nepal, Mari Miyamoto in Bhutan, and Nao Endo in Indonesia. I personally spent a total of four years in Laos from 1992 to 1994 and again from 2000 to 2002. Laos is situated in a typical monsoon climate area, where the rainy season and dry season repeat themselves every six months. When the rainy season comes, rain submerges the land, falling as if a bucket had been upturned during the daily squalls. In the dry season, not a drop of rain falls, completely drying out the soil. In my four years of living in this environment I learned about how the people have nurtured their unique livelihoods and food culture to acquire the skills they need to gain food the year round.

Up to this time, as I had published papers only on the environment and food culture of Laos, I felt I would like to expand this to locations other than Laos and carry out an interregional comparative study, but this proved difficult to do alone. Through this book, however, it has become possible to communicate to the people of the world the results of a comparative study of regions that share a climatic similarity, monsoon Asia, from the viewpoint of the common research framework of food. Not only was I overjoyed at having arrived at the goal I had wanted to achieve, I also feel that this is the kind of important work that geographers ought to be doing.

Finally, I would like to take this opportunity to express our gratitude for the research grant (16H03115) made available to the editors for the translation and proofreading of this book. We also wish to thank the Association of Japanese Geographers for the opportunity to publish this book, the editorial committee members of the International Perspectives in Geography, AJG Library for their valuable comments, as well as Mr. Shin Masuda, Managing Director, Akashi Shoten Co., Ltd. and Mr. Yosuke Nishida, Springer Japan, for their firm support in the publication of this book.

Satoshi Yokoyama