ISSN 1345-0441

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

島嶼研究
OCCASIONAL PAPERS No. 54（2014）

A New Horizon of Island Studies in the Asia-Pacific Region

Edited by YAMAMOTO Sota and RAHARJO Simon H. T.

鹿児島大学国際島嶼教育研究センター
KAGOSHIMA UNIVERSITY RESEARCH CENTER
FOR THE PACIFIC ISLANDS

鹿児島大学国際島嶼教育研究センター

KAGOSHIMA UNIVERSITY RESEARCH CENTER
FOR THE PACIFIC ISLANDS
南太平洋海域研究調査報告　NO.54（2014 年 12 月）
OCCASIONAL PAPERS　NO.54（December 2014）

New Horizon of Island Studies in the Asia-Pacific Region

Edited by YAMAMOTO Sota and RAHARJO Simon H. T.

鹿児島大学国際島嶼教育研究センター
KAGOSHIMA UNIVERSITY RESEARCH CENTER
FOR THE PACIFIC ISLANDS

Preface

This volume is the outcome of a workshop “Research and Education Linkage between Pattimura University and Kagoshima University” (financially supported by the DIPA of Pattimura University of the fiscal year 2014) held on 23 June, 2014 in Ambon, Maluku, Indonesia as an initial step of long-term cooperative researches among scientists of Pattimura University, Maluku, Indonesia and Kagoshima University, Japan. Geographical characteristic of Maluku Province in Indonesia and Kagoshima Prefecture in Japan is very similar; there are many small and isolated islands. Objectives of this workshop were to share and discuss issues in small islands of the Asia-Pacific region by scientists from different disciplines. Topics include “plant and animal genetics and their potential”, “food security”, “issues on marine and land crop resources and their strategic management”, “fly borne diseases”, “insularity in the literary imagination”, and “traditional culture” in islands of Japan, Philippines, Indonesia, Micronesia, and Fiji. It is the time for scientists from both institutes to start to conduct highly scientific works in various fields together and to solve a diverse array of questions in small islands. Many of the staff of Pattimura University and Kagoshima University made a significant contribution to running the workshop as well as to preparing for this volume.

MOSSE Jacobus W.
Vice Rector of Pattimura University

KAWAI Kei
Director of Research Center for the Pacific Islands,
Kagoshima University

December 2014

Opening Speech

Distinguished guests, ladies, and gentlemen:

This morning I am very happy to be able to welcome our distinguish guests from Kagoshima University, Prof. Kei KAWAI, Prof. Sumie NAKATANI, Prof. Masashi YAMAMOTO, Prof. Yasushi OTSUKA, Prof. Satoshi UDO, and Prof. Sota YAMAMOTO. I would like to thank our special guests for reserving your valuable time and traveling such a long distance to our university to realize the initiation of cooperation between two universities. Today I am convinced that this workshop will be an important moment for our guests from Japan and our representative scholars from Pattimura University to show your respective interests, to share ideas, and to build mutual understanding and benefits between two universities. I also wish you to enjoy your visit to Ambon and meeting people here.

Distinguished delegation from Kagoshima University, please kindly pass my sincere greeting and appreciation to Prof. Dr. Yoshizane MAEDA, President of Kagoshima University, for building mutual understanding and cooperation with our university by signing the Memorandum of Understanding in March, 2014 and for my hope that this MoU will produce many mutual benefits between two universities as well as scholars and students. I understand that we will together pursue cooperative educational and research activities by conducting projects of research and education, exchange of publication and information, and exchange of teachers, researchers, administrative staffs, and students.

I also would like to express my appreciation to Vice Rectors, Heads of Institution, Deans, Directors of Post-Graduate School within Pattimura University, and speakers and participants representing Pattimura University at the workshop for accepting my invitation to attend the opening of this event and the following workshop. I hope that today's event will become an initial milestone for all of you to create strong links and to build beneficial activities between institutions, groups, and individuals from both universities.

With this important linkage opportunity, I put my great wishes to all the academic staff-members and scientists of Pattimura University who are participating in this workshop, and stress:

- The importance of those involved to assist us in establishing a progressive link that has been initiated, and filling with productive activities.
- The importance of gaining experience from Kagoshima University in studies of island communities (particularly fisheries, agriculture, health, and education) because there are similarities between Kagoshima Prefecture, which has approximately 600 islands, and Maluku Province with almost 1,000 islands. I believe that cooperation in studies of small islands will have very good prospects.
- My suggestion that the participants from Pattimura University should start to take benefits during this workshop by building group-to-group and person-to-person linkages.

Opening statement:

With our gratitude to God's grace, hereby I officially open the workshop entitled "Research and Education Linkage between Pattimura University and Kagoshima University".

PENTURY Thomas

Rector of Pattimura University

Photo Album

Group Photo

Opening Speech: PENTURY Thomas (Rector of Pattimura University)

Opening Speech: KAWAI Kei (Director of Research Center for the Pacific Islands, Kagoshima University)

Welcome Speech: MOSSE Jacobus W. (Vice Rector of Pattimura University)

Ceremony

Presenters and a moderator (KAWAI, KESAULYA, and NAKATANI, from left to right)

Presenters and a moderator (TETELEPTA, SALAMENA, GIRSANG, LIMMON, MATINAHORU, from left to right)

Presenters (OTSUKA, YAMAMOTO, and UDO, from left to right)

Presenters (NINDATU, LEATEMIA, and RAHARJO, from left to right)

Dusun **(excursion)**
(See Paper No. 8)

Sago processing (excursion)
(See Paper No. 6)

Local market (excursion)

First time to eat *salak* (snake fruit)

Local food of Maluku (*papeda*, *ikan kuah kuning*, etc.) in lunch (excursion)

Farewell party

Contents

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Outline of Kagoshima University: Potential Fields of Research and Education

NAKATANI Sumie

Center for International Planning, Kagoshima University

Abstract

The paper looks at the outline of Kagoshima University and proposes the potential fields of research and education that the university eagers to develop international collaboration in the form of students exchange and academic research. The advantage of Kagoshima University for the researchers is in its geographical location blessed with diverse nature and culture. Especially the islands in Kagoshima provide them with attractive and challenging research fields for tackling the local and global issues such as community development, conservation of biodiversity, and disaster management etc. In these areas, what kinds of research and educational programme have been conducted in the university is discussed.

Keywords: biodiversity, community development, disaster management, island studies, tourism

Kagoshima University is a leading university in the region with 12,000 students and 2,500 staffs. The university is located in the southern end of Japan and it has a unique geography, which includes lots of islands and covers two climate zones from temperate to subtropical. The islands of Kagoshima, with their diverse nature and culture, give us attractive and challenging research fields.

The university strategically promotes research in islands especially focusing on environment, water, energy, and food and health (Fig. 1). Climate changes affect the local environment. Food and health are critical issues under the globalization. Local communities are shrinking under the aging and depopulation. Islands in Kagoshima Prefecture provide ideal research fields for tackling these twenty-first century issues. How to cope with environmental changes and the globalization, how people live with nature, how to keep local communities alive, how to build a sustainable society? We aim to develop a regional model for solving these local and global issues through the research in Yakushima Island and

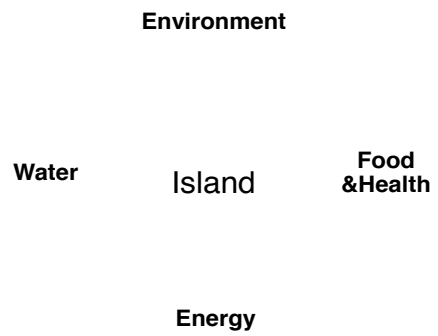


Fig. 1. Research projects promoted by Kagoshima University in islands.

the Amami Islands. In the following, I will explain research projects and education courses focusing on islands in Kagoshima University, and propose potential fields that we would like to develop an international collaboration in the form of student exchange and academic research.

Let me start a discussion from Yakushima Island that was registered as the World Natural Heritage in 1994. The island is some 135 km south of Kagoshima City and is 130 km around and 500 km^2 in area. From coast to peak, it reaches almost 2,000 m. With the differences in temperature, a wide variety of vegetation and plants can be found in vertical distribution up the island, from the banyan trees and strangler figs in the sub-tropical forests, to the laurels and oaks in the warm-temperate evergreen forests, to the fir trees in the cool-temperate coniferous forests, and finally the low scrub of dwarf-bamboo and rhododendrons in the sub-alpine areas. The island is also blessed with 4,000-10,000 mm of annual rainfall giving it unique forest vegetation including Japanese cedar trees which grow to several thousand years old. The island is also home to endemic species such as the Yakushima macaque and a variety of sika deer. It also has the largest sea turtle nesting site in Japan. It was the fact that people live side by side with this unique ecosystem that enabled the island to be registered as the Natural Heritage site.

The current issue in Yakushima Island is how to conserve the island's forest under the pressure caused by the increasing numbers of tourists. The damage is also caused by increasing numbers of Yaku sika deer. Then, there is growing friction between the local community and tourism industries. Successful community development through the eco-tourism is expected and desired. Biodiversity management will be a crucial issue to be tacked.

The same question is also applied to a group of islands called Amami, which is on the tentative list of the World Natural Heritage site. Recently the local community is getting to be active for the registration. Kagoshima University supports the movement and interacts with the local government in the field of environment studies.

In order to promote island studies and to contribute to local society, Kagoshima University boasts the Research Center for the Pacific Islands (KURCPI). The center is a very unique institution and conducts interdisciplinary research. Researchers from different faculties with varieties of disciplines work together for comprehensive understanding on islands. Projects are mainly conducted by three study groups as follows: Environment, Society, and Adaptation. The Environment group focuses on interaction between nature and people in islands for maintaining biological diversity. The Society group investigates the dynamics of social changes and the courses of development. Adaptation group studies on industries of agriculture, livestock, and fisheries in order to find out adaptive measures to the environmental and social changes. The center takes in visiting professors from overseas universities for building international networks of island studies, and it has also collaborations with the local government and NGOs.

A recent publication titled “The Islands of Kagoshima” is the fruits of projects conducted by the KURCPI. Twenty three papers are contributed to discuss island issues from different perspectives. Another project of “Autonomous development of islands” discussed the effective use of islands resources from nature to culture and communities. The KURCPI also has carried out research on islands in abroad. For example, influences of globalization and global warming on the lives of pacific islands have been studied in several islands of Micronesia. “Evaluation of ecology-economy system in Fijian marine resources” is a joint research by professors of marine science and economics. In a project of dengue fever vector mosquitoes, medical scientists, ecologists, ethnobotanists, and social scientists are working together for prevention of a dengue fever outbreak. In this way, islands with isolated environment, autonomous society, and distinctive insular culture provide challenging and interesting fields for research. Studies of islands need comparisons and corroborations locally and globally.

In education, Kagoshima University has special courses focusing on islands. Community Heath Nursing in a remote island is a course in the Department of Health Science. This is a study about the role of nurses and the other health care workers in islands with no doctor. International Islands and Community Medicine Course is provided by the Graduate School of Medical and Dental Sciences. The prevention of lifestyle related diseases such as diabetes and cancer is one of the most important research subjects because islands’ population has unique life style and food habits. Amami Islands Research Course is provided by the graduate school of Humanities and Social Sciences. Kagoshima University has two satellites in the Amami Islands, where island related subjects are offered for graduates students.

So far I have discussed research and education focused on islands, then I propose the following themes to be explored for the future collaboration with Pattimura University, based on the geographical characteristics both universities have in common.

1. Community development based on tourism industries
2. Biodiversity and its management
3. Functional effects of locally produced food on life-related diseases and geriatric syndrome
4. Disaster management of small island

References

KAWAI, K., TERADA, R. and KUWAHARA, S. (eds.) 2013. The Islands of Kagoshima, 158 pp., Kagoshima University Research Center for the Pacific Islands, Kagoshima, Japan.

KITOLELEI, J., NISHIMURA, S., TORII, T. and KAWAI, K. 2014. Multilayer Rules and Governance in Fiji Coastal Communities: A Case Study of Veivatuloa Village. Evolutionary and Institutional Economic Review, 11(1): 53-66.

NODA, S., YAMAMOTO, S. and TOMA, T. 2013. Mosquitoes Collected on Pohnpei Island, Mokil Atoll and Pingelap Atoll, Pohnpei State, the Federated States of Micronesia (Diptera: Culicidae). Medical Entomology and Zoology, 64(4): 197-201.

NODA, S., YAMAMOTO S. and TOMA, T. 2014. Mosquitoes Collected on Weno Island, Romanum Island and Piis-Paneu Island, Chuuk State, the Federated States of Micronesia (Diptera: Culicidae). Medical Entomology and Zoology, 65(1): 23-27.

NODA, S., YAMAMOTO, S., TOMA, S. and TAULUNG, L. 2013. Distribution of Mosquito Larvae on Kosrae Island, Kosrae State, the Federated States of Micronesia. Tropical Medicine and Health, 41(4): 157-161.

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

An Overview of Research Orientation in Pattimura University

OSOK Rafael Marthinus

Research Institution, Pattimura University

Abstract

Along with Tri-Linkage of Higher Education, the role of Pattimura University is to prepare human resources that have the capability and readiness in accordance with the demands of development and to develop institutional partnerships, integrated research, and community services. The role of Research Institute of Pattimura University is to develop the culture of research in the University and to encourage the utilization of the results to support the mission of higher education and national development in a sustainable manner. Therefore, the research activities aim to result not only in the form of research reports, but also in the form of national and international scientific publications, educational materials, patents, and intellectual property right. The key challenge is the research results which bring significant benefits to the community and have to be able to answer the needs of government and private/industrial sectors. Future research orientations of Pattimura University's Research Institution are as follows: (1) marine science, (2) natural-based medicine, (3) small island community health and medicine, (4) climate change adaptation for small islands, (5) local wisdom and small island resource management, and (6) biodiversity and conservation in small islands.

Keywords: research program, vision and missions of Research Institute

Introduction

As the main state university in Maluku, Pattimura University is regarded as a regional role model for education, institutional partnerships, integrated research programs, and the center for training and extension programs. In the regional level, Pattimura University works closely with the local government and private sectors (industry) to improve performance of the university in regional research excellence and community services. In the national and international levels, Pattimura University places emphasis on increasing collaborations and partnerships with other universities and organizations in developing integrated research and strengthening researchers as well as the institution.

Research Institution of Pattimura University was established along with the establishment of Pattimura University by Science and Higher Education Ministry decree No. 99 Year 1962 and was legalized by Presidential Decree No. 66 Year 1963. The role of Research Institution of Pattimura University is to organize and manage research activities in the university and to ensure that all research results are of high quality and meet the needs of stakeholders (such as a community, government, industry, etc.), and not only in the form of research reports, but also in the form of national and international scientific publications, educational materials, patents, and intellectual property rights (RESEARCH INSTITUTE 2011, RESEARCH INSTITUTE 2013a, 2013b).

Vision and Missions of Research Institute

The vision of Pattimura University's Research Institution is "becoming an independent and innovative research institution and professionally in conducting research both at regional and at national-international levels" (RESEARCH INSTITUTE 2011). Our missions are the following.

1. Increasing capacity and quality of research institutions and researchers in research activities including national and international scientific publications, educational materials, patents, and intellectual property rights
2. Improving the quality and quantity of research that are relevant to a research roadmap of faculties and research excellence of the university
3. Improving the quality of research in applied science and technology, art, and culture
4. Providing science and technology based-research products that are benefit to community and are answering the needs of the local government and private sectors

Research Programs

In carrying out research activities, Research Institution is funded by Directorate General of Higher Education (DIKTI) Ministry of Education, Ministry of Research and Technology, University, and by cooperation research programs with the local government, a ministry level in Jakarta, and private sectors (local, national, and international).

Research activities funded by DIKTI include the university excellence research grant, the competitive research grant, the basic research grant, the post-graduate research grant, the higher education cooperation research grant, the higher education and industry research grant, the national strategic excellence research grant, and the research grant for the Master Plan of

acceleration and expansion of Indonesian's economic development. Research funding from the Ministry of Science and Technology supported to Pattimura University has been distributed to support young researchers.

In the last three years (2012-2014), numerous researchers in Pattimura University have received research grants from MP3EI (Master Plan of Acceleration and Expansion of Indonesian Economic Development) national program (GIRSANG and OSOK 2013). With these grants, various research activities have been undertaken, which includes agriculture (cultivation and post harvest technology of tuber/root crops and sago), fisheries and marine science (cultivation and processing technology of fish, crabs, and sea weeds, conservation of mangroves), management of natural resources, and community empowerment.

Research programs in Pattimura University are directed to (1) developing science and technology based on characteristics of existing natural resources in small island, (2) improving partnerships and networks with the local government and industries (ABG = academic, business, government), and (3) creating a network of inter-university cooperation at the national and international levels.

Research Excellence Development

In the line with "core science" of the university, namely "*bina mulia kelautan*" (marine-oriented perfection), and the existing human resources, the university has placed a number of research excellence as follows.

1. **Studies of marine science**
   - Develop a database of marine's natural source and environment
   - Identification of marine biodiversity
   - Studies on marine biotechnology
   - Studies on onshore and deep sea
   - Development of marine eco-tourism

2. **Studies of natural-based medicine (traditional medicine development) and small island medicine**
   - Identification and determination of medicinal plants
   - Identification and elucidation of active chemical constituents of medicinal plants
   - The techniques of isolation and purification of active compounds
   - Production and synthesis bioactive compounds (essential oils: clove oil, nutmeg oil, honey)
   - Small island health services and medicine

3. Food security and safety

- Identification and determination of potential of local food (sago)
- Studies of local food-based products with added health benefit (functional foods)
- Studies of improving local food quality
- Studies of improving local food processing to improve the level of beneficial compound

4. Studies of local wisdom in small islands

- Identification of roles of local wisdom in conservation and protection of natural resource in small island

5. Studies adaptation of climate change in small islands

- Studies of risk, vulnerability, and adaptation of climate change in small island
- Studies of disaster risk reduction

6. Studies of biodiversity and conservation in small islands

- Studies of biodiversity of island and marine flora and fauna and the conservation in Maluku

References

GIRSANG, W. and OSOK, R. 2013. *Kebijakan Percepatan Pembangunan Ekonomi Berbasis Hasil Kajian Bidang Pertaniandan Perikanan di Provinsi Maluku* [Economic Development Acceleration Policy Based on Agricultural and Fisheries Studies in the Maluku Province], 277 pp., *Lembaga Penelitian Universitas Pattimura, Ambon* [Research Institute of Pattimura University, Ambon] (in Indonesian).

RESEARCH INSTITUTE 2011. *Rencana Induk Penelitian Universitas Pattimura 2011-2016* [Master Plan 2011-2016 of Research Institute], 107 pp., *Universitas Pattimura, Ambon* [Pattimura University, Ambon] (in Indonesian).

RESEARCH INSTITUTE 2013a. *Payung Penelitian Lembaga Penelitian* [Research Umbrella of Research Institute], 23 pp., *Universitas Pattimura, Ambon* [Pattimura University, Ambon] (in Indonesian).

RESEARCH INSTITUTE 2013b. *Profil Lembaga Penelitian* [Research Institute Profile], 17 pp., *Universitas Pattimura, Ambon* [Pattimura University, Ambon] (in Indonesian).

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Citrus Genetic Resources Grown on the Ryukyu Islands, Japan

YAMAMOTO Masashi

Faculty of Agriculture, Kagoshima University

Abstract

The Ryukyu Islands are located southwest part of Japan. Various local citrus are grown in this subtropical region. Since there are large geographical and climatic differences between the Ryukyu Islands and the main islands (Honshu, Kyushu, and Shikoku) of Japan, there are unique local citrus genetic resources on the Ryukyu Islands. Shiikuwasha (*Citrus depressa*) is an indigenous mandarin species in this region. This species is clearly distinguished from the mandarin grown in China and India based on the results of isozyme and DNA analyses. DNA analysis also revealed that wide diversity exists in Shiikuwasha. Although Kunenbo (*C. nobilis*) and Daidai (*C. aurantium*) have been grown in most the islands, they were introduced from China and/or Southeast Asia. Indigeneous Shiikuwasha and introduced species probably played a part in the origin of many local citrus on the Ryukyu Islands. Various unique species in this region such as Kabuchii (*C. keraji*), Oto (*C. oto*), and Rokugatsu-mikan (*C. rokugatsu*) have been widely cultivated. Fruit of some local citrus contains high levels of polymethoxyflavonoids, one of the most important health-promoting components of citrus.
Keywords: Amami, citrus, Okinawa, Ryukyu, Shiikuwasha

Introduction

The Ryukyu Islands are located southwest part of Japan. Various local citrus are grown in this subtropical region. Since there are marked geographical and climatic differences between the Ryukyu Islands and the main islands (Honshu, Kyushu, and Shikoku) of Japan, there are unique local genetic resources of citrus on the Ryukyu Islands. Thus, many accessions were recorded and classified in several studies (INAFUKU-TERAMOTO *et al*. 2010, ISHIHATA *et al*. 1997, KINJO 2007, KITA *et al*. 2013, NAKANO *et al*. 2001, YAMAMOTO *et al*. 2006, 2008a) since these local citrus accessions are very important for studies on genetic resources in citrus. The genetic relationships among them were partly clarified (YAMAMOTO *et al*. 1998, 2010a, 2010b, 2011). Recently, fruits produced in this region have attracted attention because they contain high levels of health-promoting components (YAMAMOTO *et al*. 2008b).

Here, local genetic resources of citrus grown on the Ryukyu Islands, with regard to: 1) the distribution of local citrus accessions grown on the Ryukyu Islands, 2) phylogenetic relationships of local genetic resources of citrus grown on the Ryukyu Islands, and 3) phytonutrient components of local citrus grown on the Ryukyu Islands, are discussed.

Distribution of Local Citrus Accessions Grown on the Ryukyu Islands

Among the local citrus accessions grown on the Ryukyu Islands, Shiikuwasha (*Citrus depressa* Hayata) is the indigenous species (TANAKA 1926). Daidai (*C. aurantium* L.) and Kunenbo (*C. nobilis* Lour.) were introduced from China or Southeast Asia. Since then, several species, such as Kabuchii (*C. keraji* hort. ex Tanaka), Oto (*C. oto* hort. ex Yu. Tanaka), and Rokugatsu-mikan (*C. rokugatsu* hort. ex Yu. Tanaka), have grown as new seedlings that have arisen by chance from indigenous or introduced species (TANAKA 1948) (Fig. 1 and Table 1).

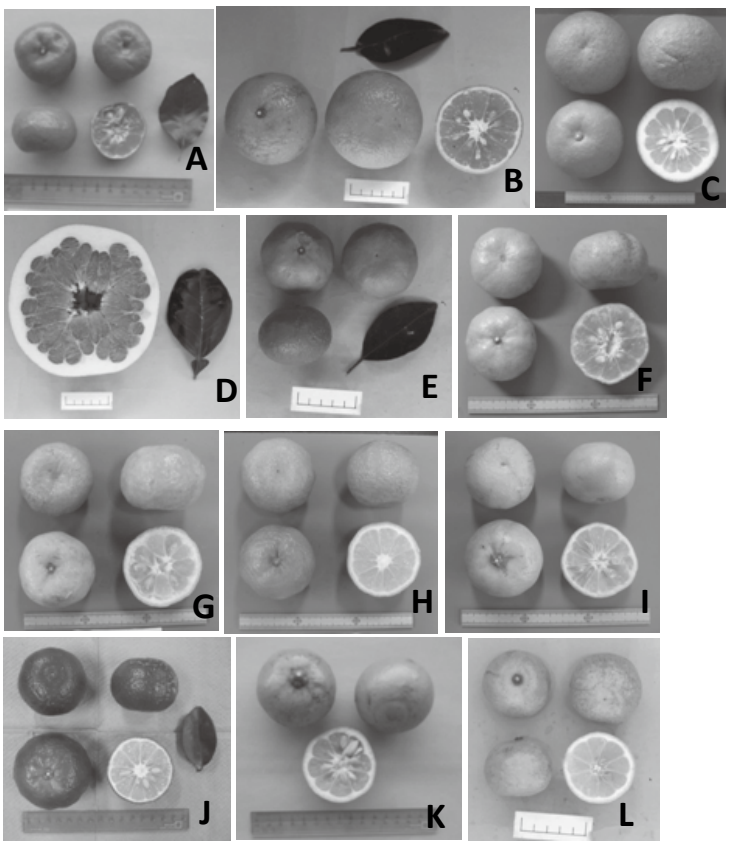


Fig. 1. Fruits of local citrus on the Ryukyu Islands. A: Shiikuwasha (*Citrus depressa*), B: Kunenbo (*C. nobilis*), C: Daidai (*C. aurantium*), D: Buntan (*C. maxima*), E: Akamikan (*C. tangerina*), F: Shimamikan (*C.* sp.), G: Kabuchii (*C. keraji*), H: Keraji (*C. keraji*), I: Oto (*C. oto*), J: Tarogayo (*C. tarogayo*), K: Rokugatsu-mikan (*C. rokugatsu*), L: Shiikuu, Kusa, or Tunugekunin (*C.* sp.).

Table 1. Major local citrus grown on the Ryukyu Islands.

Common name	Latin name	Origin
Shiikuwasha	*Citrus depressa* Hayata	Authigene
Kunenbo	*C. nobilis* Lour.	Introduction
Sour orange (Daidai)	*C. aurantium* L.	Introduction
Pummelo (Buntan)	*C. maxima* (Burm.) Merr.	Introduction
Dancy (Obeni-mikan)	*C. tangerina* hort. ex Tanaka	Introduction
Komikan (Shimamikan)	*C*. sp.	Probably introduction
Kabuchii	*C. keraji* hort. ex Tanaka	Chance seedling
Keraji	*C. keraji* hort. ex Tanaka	Chance seedling
Oto	*C. oto* hort. ex Yu. Tanaka	Chance seedling
Tarogayo	*C. tarogayo* hort. ex Tanaka	Chance seedling
Rokugatsu-mikan	*C. rokugatsu* hort. ex Yu. Tanaka	Chance seedling
Fusu, Kusa or Tunugekunin	*C*. sp.	Chance seedling

Phylogenetic Relationships of Local Genetic Resources of Citrus Grown on the Ryukyu Islands

The results of isozyme and cleaved amplified polymorphic sequence (CAPS) analyses of chloroplast DNA (cpDNA) are shown in Table 2 and Table 3, respectively (YAMAMOTO *et al.* 2011, 2013).

The indigeneous Shiikuwasha and introduced Kunenbo probably played a role in the origin of many local citrus on the Ryukyu Islands. Keraji, Kabuchii, and Oto are closely related to Kunenbo based on the results of isozyme and DNA analyses. The type of cpDNA of Keraji, Kabuchii, Tarogayo, and Oto is the same as that of Kunenbo. This suggests that they arose from Kunenbo as a female ancestor because cpDNA is inherited maternally. On the other hand, the genetic influence of Japanese mandarins such as Shiikuwasha on Kabuchii and Oto was observed. Their *GOT-2* genotype was *MA*, and *A* is a characteristic allele of the Japanese mandarins, Shiikuwasha and Tachibana (HIRAI *et al.* 1986). The involvement of Shiikuwasha in the development of Rokugatsu-mikan and Fusu was identified; all of them possessed *A* in *GOT-2*, a characteristic allele of Japanese mandarin.

In cpDNA analysis, Shiikuwasha belonged to both types 4 and 5 in Table 3. The cpDNA divergence of this species grown in Okinawa was also reported by URASAKI *et al.* (2005). These results suggest a polyphyletic origin of Shiikuwasha.

Table 2. Isozyme genotype of major local citrus grown on the Ryukyu Islands.

Common name	Latin name	Genotype of *GOT-2*
Shiikuwasha	*Citrus depressa* Hayata	MA
Kunenbo	*C. nobilis* Lour.	MM
Sour orange	*C. aurantium* L.	MM
Pummelo	*C. maxima* (Burm.) Merr.	MM
Dancy	*C. tangerina* hort. ex Tanaka	MM
Komikan (Shimamikan)	*C*. sp.	MM
Kabuchii	*C. keraji* hort. ex Tanaka	MA
Keraji	*C. keraji* hort. ex Tanaka	MM
Oto	*C. oto* hort. ex Yu. Tanaka	MA
Rokugatsu-mikan	*C. rokugatsu* hort. ex Yu. Tanaka	MA
Shiiku, Kusa,or Tunugekunin	*C*. sp.	MA
Control		
Tachibana	*C. tachibana* (Makino) Tanaka	AA
Kinokuni	*C. kinokuni* hort. ex Tanaka	MM
Satsuma mandarin	*C. unshiu* Marcow.	MM
Ponkan	*C. reticulata* Blanco	MM
Lemon	*C. limon* (L.) Burm. f.	SM

Modified from YAMAMOTO *et al*. (2011).

Table 3. Types of chloroplast DNA (cpDNA) based on CAPS analysis of major local citrus grown on the Ryukyu Islands.

Type	Common name
1	Kunenobo, Sour orange, Pummelo, Kabuchii, Keraji, Oto, Tarogayo, Sweet orange, lemon
2	Khasi Papeda
3	Ichang Papeda, Yuzu
4	Shiikuwasha, Tachibana
5	Shiikuwahsa, Sunki, Cleopatra, Tankan
6	Dancy, Ponkan, Satsuma mandarin, Kinokuni, Clementine

Modified from YAMAMOTO *et al*. (2013).

Phytonutrient Components of Local Citrus Grown on the Ryukyu Islands

Citrus fruits are essential sources of some phytonutrient components. Among them, polymethoxyflavonoids (PMFs), unique components of citrus, show efficacy against lifestyle-related diseases such as cancer and diabetes (KAWAI *et al*. 1999, LEE *et al*. 2010, MIYATA *et al*. 2008). The PMF content of Shiikuwasha and Kabuchii was much higher than that of Satsuma mandarin (*C. unshiu*), which is a leading citrus species in Japan (Table 4) (YAMAMOTO *et al*. 2008).

Table 4. Polymethoxyflavonoid content of juice and peel in Shiikuwasha and Kabuchii.

Accession	Date (y/m/d)	Polymetoxyflavanoid	
		Juice (pg/mL)	Peel (pg/g)
Shiikuwasha	2004/9/17	17.6	4,699.8
(*C. depressa*)	2004/10/27	9.9	3,523.4
	2004/12/8	0.9	2,848.3
Kuriha	2004/9/17	20.6	3,584.7
(*Citrus keraji*)	2004/10/27	12.1	2,833.4
	2004/12/8	1.9	2,628.0
Control			
Miyagawa-wase	2004/10/27	2.0	369.7
(*C. unshiu*)			

Modified from YAMAMOTO *et al*. (2008).

References

HIRAI, M., KOZAKI, I. and KAJIURA, I. 1986. Isozyme Analysis and Phylogenic Relationship of Citrus. Japanese Society of Breeding, 36: 377-389.

INAFUKU-TERAMOTO, S., YAMAMOTO, M., KINJO, H., KITAJIMA, A., WADA, K. and KAWAMITSU, Y. 2010. Local Citrus Genetic Resources and Their Polymethoxyflavones Content in Northern Part of Okinawa Island. Horticultural Research (Japan), 9: 263-271 (in Japanese with English Summary).

ISHIHATA, K., SHIOTA, H. and ONJO, M. 1997. Some Kinds of Tropical and Subtropical Fruit Trees and Characteristics of Some Native Citrus Fruits in Amami Islands. Bulletin of the Experimental Farm, Faculty of Agriculture, Kagoshima University, 22: 1-13 (in Japanese with English Summary).

KAWAI, S., TOMONO, Y., KATASE, E., OGAWA, K. and YANO, M. 1999. Antiprofiferative Activity of Flavonoids on Several Cancer Cell Lines. Bioscience, Biotechnology, and Biochemistry, 63: 896-899.

KINJO, H. 2007. Acid Citrus "Shiikuwasha" in Ryukyu Island. Studia Citrologica, 17: 137-148 (in Japanese).

KITA, M., YAMAMOTO, M., INAMORI, H., SAKAUE, H., SEKITA, T., TAHARA, A. and MINORU, H. 2013. Exploration of *Citrus* Genetic Resources in Amami Archipelago in Kagoshima Prefecture, Japan. Annual Report on Exploration and Introduction of Plant Genetic Resources, 29: 107-117 (in Japanese with English Summary).

LEE, Y. S., CHA, B. Y., SAITO, K., YAMAKAWA, H., CHOI, S. S., YAMAGUCHI, K., YONEZAWA, T., TERUYA, T., NAGAI, K. and WOO, J. T. 2010. Nobiletin Improves Hyperglycemia and Insulin Resistance in Obese Diabetic ob/ob Mice. Biochemical Pharmacology, 79: 1674-1683.

MIYATA, Y., SATO, T., IMADA, K., DOBASHI, A., YANO, M. and ITO, A. 2008. A Citrus Polymethoxyflavonoid, Nobiletin, Is a Novel MEK Inhibitor That Exhibits Antitumor Metastasis in Human Fibrosarcoma HT-1080 Cells. Biochemical and Biophysical Research Communications, 366: 168-173.

NAKANO, M., NESUMI, H. and YOSHIDA, T. 2001. Exploration for Citrus Genetic Resources on the Nansei Archipelago, Japan. Annual Report on Exploration and Introduction of Plant Genetic Resources, 17: 39-48 (in Japanese with English Summary).

TANAKA, T., 1926. Wild *Citri* of the Japanese Territories. Bulteno Scienca de la Fakultato Terkultura, Kjusu Imperia Universitato, 2: 51-58 (in Japanese with English Summary).

TANAKA, Y. 1948. An Iconograph of Japanese Citrus Fruits. Vol. 2, 525 pp., Yokendo, Tokyo (in Japanese).

URASAKI, N., YOSHIDA, K., UEHARA, T., INOUE, H., ONDA, S., KINJO, H. and KAWANO, S. 2005. Single Nucleotide Polymorphism in Shiikuwasha (*Citrus depressa* Hayata) Chloroplast DNA, trnL-trnF. Japanese Journal of Tropical Agriculture, 49: 246-251.

YAMAMOTO, M., FUKUDA, M., KOGA, T., KUBO, T. and TOMINAGA, S. 2010a. Examination of the Origin of Keraji (*Citrus keraji*), Local Citrus of Kikaijima Island, Kagoshima Prefecture. Horticultural Research (Japan), 9: 7-12 (in Japanese with English Summary).

YAMAMOTO, M., KOUNO, R., NAKAGAWA, T., USUI, T., KUBO, T. and TOMINAGA, S. 2011. Isozyme and DNA Analyses of Local *Citrus* Germplasm on Amami Islands, Japan. Journal of the Japanese Society for Horticultural Science, 80: 268-275.

YAMAMOTO, M., KUBO, T. and TOMINAGA, S. 2008a. Exploration of *Citrus depressa* Hayata Germplasm in Okinoerabu Island. Bulletin of the Experimental Farm, Faculty of Agriculture, Kagoshima University, 32: 7-12 (in Japanese).

YAMAMOTO, M., MATSUMOTO, R., UECHI, Y., IJICHI, T., KUBO, T. and TOMINAGA, S. 2008b. The Polymethoxy Flavones Content of Local Citrus Accessions on the Island of

Kikaijima in Kagoshima Prefecture, Japan. Bulletin of the Faculty of Agriculture, Kagoshima University, 58: 1-7 (in Japanese with English Summary).

YAMAMOTO, M., MATSUO, Y., KUNIGA, T., MATSUMOTO, R. and YAMADA, Y. 1998. Isozyme and RAPD Analyses of Shiikuwashas (*Citrus depressa* Hayata). Bulletin of the National Institute of Fruit Tree Science, 30/31: 39-51 (in Japanese with English Summary).

YAMAMOTO, M., MATSUSHIMA, K., IJICHI, T., UECHI, Y., KAWAGUCHI, S., NAKANO, H., NOMURA, T., TANIMURA, O., KUBO, T. and TOMINAGA, S. 2006. Exploration and Preservation of Local Citrus Germplasms in the Amami Archipelago. Bulletin of the Experimental Farm, Faculty of Agriculture, Kagoshima University, 29: 5-11 (in Japanese with English Summary).

YAMAMOTO, M., TSUCHIMOCHI, Y., NINOMIYA, T., KOGA, T., KITAJIMA, A., YAMASAKI, A., INAFUKU-TERAMOTO, S., YANG, X., YANG, X., ZHONG, G., NASIR, N., KUBO, T. and TOMINAGA, S. 2013. Diversity of Chloroplast DNA in Various Mandarins (*Citrus* spp.) and Other Citrus Demonstrated by CAPS Analysis. Journal of the Japanese Society for Horticultural Science, 82: 106-113.

YAMAMOTO, M., YAMASAKI, A., SHIMIZU, T., KITAJIMA, A., KUBO, T. and TOMINAGA, S. 2010b. SSR Analysis of Local Citrus Accessions Grown in Amami Islands. Horticultural Research (Japan), 9 (suppl. 2): 86 (in Japanese).

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Potential Development of Local Animal Genetic Resources in Maluku

SALAMENA J. F., MALLE D., LATUPEIRISSA C. Ch. E. and SIWA I. P.

Department of Animal Husbandry, Faculty of Agriculture, Pattimura University

Abstract

Maluku has been well known as an archipelagic province consisting of small islands which are rich in natural resources such as exotic animals. Moa buffalo, Lakor goat, and Kisar sheep are local genetic resources of livestock from Maluku which have been endorsed by the Ministry of Agriculture of the Republic of Indonesia to be protected, conserved, and sustainably utilized for human welfare purposes. These three species have been a part of the local people life as food, income, savings, and organic fertilizer sources. Formulation of the Grand Design for the development of these species was completed in 2013, which includes some strategic policies for the development. Real follow-up actions in forms of research should be designed covering various aspects to accelerate the achievement of the development of these potential local livestock. The research aspects that should be considered are local human resource capacity strengthening, genetic quality improvement, animal feedstock development including local forage and pasture quality improvement, animal diseases control, animal waste-based bioenergy development, product and post-harvesting handling, and policy and regulation aspects.

Keywords: Kisar sheep, Lakor goat, Moa buffalo

Introduction

Maluku Province, Indonesia, as an archipelagic province, which consists of small islands, has specific local genetic resources of livestock, namely Moa buffalo, Lakor goat, and Kisar sheep. Moa buffalo, Lakor goat, and Kisar sheep can be found in Moa, Lakor, and Kisar islands, respectively. Those livestock have been existed and survived for generations, so that they have accustomed to specific characteristics possessed only by these livestock.

In 2011, Moa buffalo, Lakor goat, and Kisar sheep have been endorsed by the Ministry of Agriculture of the Republic of Indonesia, as native Indonesian livestock from Maluku.

As the matter of fact, these local livestock have excellent characters that are able to survive on low quality of feed, able to live on pressure of climate, and high endurance to local parasites and diseases. Therefore, these livestock are a good source of special genes that can

be used for breeding livestock to increase production on low cost, to support food variety, agriculture, and culture, and to achieve the aim of local food security (FAO 2002).

Academic researches on Moa buffalo, Lakor goat, and Kisar sheep, such as livestock characterization, evaluation on potential of feed source and farmer potency, and socio-economy analysis, have been done. Special examine in formulating "Grand Design", of development of these three commodities has also been done. In the "Grand Design" document, the development of these livestock aimed to be done on the basis of local resources, based on characteristics of the local area, and it has been formulated in development strategies and policies. In the development strategies and policies, more researches need to be continued in order to achieve targets stated in the "Grand Design" document. Real follow-up actions in forms of research should be designed covering various aspects to accelerate the achievement of the development of these local livestock's potential. Research aspects that should be considered are local human resource capacity strengthening, genetic quality improvement, animal feedstock development including local forage and pasture quality improvement, animal diseases control, animal waste-based bioenergy development, product and post-harvesting handling, and policy and regulation aspects.

Therefore, collaborating research need to be designed in developing Moa buffalo, Lakor goat, and Kisar sheep to support local people welfare.

Morphological Characteristics of Moa Buffalo, Lakor Goat, and Kisar Sheep

Moa buffalo is a swamp buffalo, which has twisted neck by black line "*chevron*". Morphological characteristics of Moa buffalo based on characterization on 174 Moa buffalo is shown in Table 1. Color of body is one of the most specific characters of animal breeding. It can be seen from Table 1 that color of the buffalo vary from black (46. 67%), followed by grey (28.74%), white (15.52%), and combination of these three colors (black, white, and grey) (12.07%). Combination of black and white color of Moa buffalo is similar to Bonga buffalo in Toraja. Bonga buffalo can be found in TO Bada, Central Sulawesi, Sumba, Flores, Roti, and Timor (NOOY-PALM 1979) and it is very expensive up to hundreds million rupiah. Variation in the color of Moa buffalo body is different with swamp buffalo in Kalimantan which states by LENDHANIE (2005), in which those in Kalimantan are brown-grey.

Lakor goat is cross-breed between Etawah goat descendent and Kacang goat (Indonesian native goat), in which genetically Etawah is dominant. A specific character of Lakor goat is color of hair which varies from white, black, brown, grey, crème, and combination of those five colors. Characteristic of Etawah goat which still exists is drooping long ear. Morphological characteristics of Lakor goat is shown in Table 2.

Table 1. Morphological characteristics of Moa buffalo.

Parameter	Character / Percentage (%)
Face line	Strairght
Horn	Presence
Position of horn	Arch-shaped (curve from side to back-side)
Position of ear	Straight to the side
Back-line	Concave (bowl-shaped)
Color of head	Grey (40.80), black (44.25), and white (14.94)
Color of body skin	Grey (28.74), dominant grey, combine with white (2.30), black (43.67), dominant black combine with white (6,32), white (15.52), dominant white combine with grey (1.15), dominant white combine with balck (2.30)
Pattern of skin color	Big pock-mark (9.20), small pock-mark (0.57), speckle (4.02), and smooth (86.21)
Color of toe-nail	Grey (0.57), brown (0.57), black (55.75), white (24.71), combination of black and white (18.39)

Source: SALAMENA *et al*. (2009).

Table 2. Morphological characteristics of Lakor goat.

Parameter	Characteristics
Horn	Presence, small, grow up, and curve to the back
Ear	Long and dropping
Color of hair	White, black, brown, grey, crème, and combination of these five colors

Source: BERHITU (2004).

The measurement of 273 sheep on Kisar island indicates that Kisar sheep is Ekor Gemuk sheep, in which male has horn, while female does not have. A specific character of Kisar sheep is color and motif of body hair color. Hair color is dominated by white-black (55.41%), white (30.30%), and black-white (10.39%). Motif of body hair color varies from small pock-mark (40.26%), plain (28.41%), big pock-mark (21.21%), and speckle 10.39 %). Morphological characteristic of Kisar Sheep is shown in Table 3.

Production and Reproduction of Moa Buffalo, Lakor Goat, and Kisar Sheep

Live weight is one of the production indicators of meat producing animal. Live weight of Moa buffalo, Lakor goat, and Kisar sheep is shown in Table 4. Average live weight of Moa buffalo aged 3-4 years is 228.4 kg for male and 215.68 kg for female. Average live weight of

Lakor goat aged 2-3 years is 70.43 kg and 40.98 kg for male and female, respectively. Meanwhile, average live weight of Kisar sheep aged 2-3 years is 25.82 kg for male and 18.87 kg for female.

Live weight of those animals has decreased dramatically due to two factors. Firstly, farmers tend to sell big and heavy animals, associated with high price, so they will receive enough money to meet their need. Secondly, traditional system in raising animals leads to decreasing in production and live weight.

Reproduction is an important factor which needs to be considered because more efficient reproductive characters will result in increasing population of animals in an area. Reproductive characteristics of Moa Buffalo, Lakor Goat, and Kisar Sheep can be seen in Table 5.

Table 3. Morphological characteristics of Kisar sheep.

Parameter	Proportion (%)
Concave face line	99.13
Presence of horn :	
- Male	100.00
- Female	0.00
- Twisted horn on male	100.00
Ear, downward	97.84
Color of face hair :	
- Black	40.26
- Combination of black and white	33.77
- Combination of white and black	23.38
Color of ear hair:	
- Solid black	52.81
- Solid white	23.38
- Combination of black and white	13.42
- Combination of white and black	10.39
Color of body hair:	
- Black and white (dominant white)	55.41
- Solid white	30.3
- White and black (dominant black)	10.39
- Solid black	0.43
- Brown and black (dominant	0.43
Pattern of body hair color:	
- Small pock-mark	40.26
- Plain	28.14
- Big pock-mark	21.21
- Spotted	10.39

Source: SALAMENA (2006).

Table 4. Live weight of Moa buffalo, Lakor goat, and Kisar sheep.

Livestock	Average live weight (kg) ($x \pm s$)				
	< 1 year	1 – 2 year	2 - 3 year	3 - 4 year	4 - 5 year
			Male		
Moa buffalo	-	79.80 ± 82.70	186.10 ± 34.16	228.40 ± 51.30	288.20 ± 49.10
Lakor goat	-	59.17 ± 3.10	70.43 ± 2.20	80.59 ± 1.80	-
Kisar sheep	13.69 ± 2.11	19.00 ± 3.45	25.82 ± 4.75	29.43 ± 6.69	27.71 ± 8.18
			Female		
Moa buffalo	-	119.50 ± 68.30	171.20 ± 67.20	215.68 ± 30.89	279.70 ± 45.20
Lakor goat	-	34.43 ± 6.44	40.98 ± 1.30	46.64 ± 1.30	-
Kisar sheep	13.44 ± 2.50	20.66 ± 1.88	18.87 ± 2.49	21.74 ± 4.53	19.50 ± 6.33

Source: BERHITU (2004), SALAMENA (2006), and SALAMENA *et al*. (2009).

Table 5. Reproductive characteristics of Moa buffalo, Lakor goat, and Kisar sheep.

Parameter	Moa buffalo	Lakor goat	Kisar sheep
The onset of puberty (month)	25 - 37	6 - 8	6 - 8
Estrous cycle (day)	21 - 23	18 - 21	14 - 19
Length of estrous cycle (day)	1 - 3	1 - 2	1 - 2
Gestation length (month)	9 - 10	5	5
Rate of conception (%)	78.92	100.00	86.36
Age at first calving	41 – 49	11 - 13	15 - 17
Calving interval (month)	19 - 21	8 - 9	8 - 9
Calving rate (%)	55.95	160.00	102.58
Post partum interval (month)	9 - 11	3 - 4	2.5 - 4
Mortality rate (%)	11.23	12.00	21.18
Survival rate of mature animal (%)	88.52	88.00	78.82
Length of raising (year)	11 - 13	5 - 8	5 - 8
Length of life (year)	18 - 20	10 - 12	10 - 12
Reproductive efficiency of female	70.91	-	-
Weaning (month)	8 - 10	3 - 4	3 - 4
Type of birth	Single	Twin	Single

Source: MANUPUTTY (2004) and SIWA (2007).

The Use of Local Animal Genetic Resources: Moa Buffalo, Lakor Goat, and Kisar Sheep

Moa buffalo, Lakor goat, and Kisar sheep have been a part of live of farmers in Moa, Lakor, and Kisar islands.

In Moa, buffalo has been used as ritual animal for traditional ritual, wedding-present, and

fine. It is also has been consumed in both fresh and dried meat which preserved in traditional ways (smoked and dried under the sun). In calving season, milk is consumed in limited amount, both fresh and preserved. Milk is preserved with sap of jawi-jawi tree (local name: *aylieru*) (SALAMENA *et al*. 2009). Moa buffalo is also source of income and live savings which can be sold anytime to meet farmers need. Selling price of mature male of buffalo, weight approximately 300-400 kg on farmer level, is 7-9 million rupiah. Manure of the buffalo has been used as organic fertilizeres by small number of farmers in limited volume.

In contrast to Moa buffalo and Kisar sheep, Lakor goat is mainly used as source of income and live savings for the farmers. Farmers in Lakor sell more goats because of high demand of goat meat and high price. Trading of goats has been done by farmers and vendor, to Ambon, Papua, Kupang, Timor Timur, and Sulawesi (SALAMENA *et al*. 2013). In Kisar, sheep have been used as source of organic fertilizers on an integrated agriculture system, between corn and sheep. Staple food of Kisar people is corn, so it became the main crop planted by local people. On an integrated corn-sheep system in Kisar, sheep manure is used as organic fertilizers, while corn by-products such as fresh leafs and stems, and straws, are used as sheep feed. SALAMENA *et al*. (2013) found that 5,540 sheep produce 465,375 ton (DM basis) manure per year, while only 156,572 ton (DM basis) has been used as organic fertilizer. The excess amount of this manure has been left spreading on nature pasture or dumping in fence. Sheep is also source of income and live saving for the farmers.

Potential Development of Local Animal Genetic Resources of Moa Buffalo, Lakor Goat, and Kisar Sheep

Development parameters of Moa buffalo, Lakor goat, and Kisar sheep have been found based on the “Grand Design” research on development of those animals in 2013, as can be seen in Table 6.

It can be seen from Table 6 that from economics side LQ value >1, shows excellent comparative, therefore development area (Moa, Lakor, and Kisar islands) can be stated as excellent commodities. Trend of population development is high, in which for Moa buffalo 165.45%, for Lakor Goat 124.05%, and for Kisar sheep 529.11%. This indicates that growth increases 1-5 times from population in the early year.

Data from Table 6 also show that surplus of dry matter (DM) for the buffalo is 6,768.03 ton/year which can be used to feed about 2,603 AU of buffalo. Surplus of DM for Lakor goat is 2,502.87 ton/year, so are available for 4,813.21 AU, while for Kisar sheep, surplus of DM is 4,179.38 ton/year therefore are available for 7,970.94 AU. This abundant of feed, need to be wisely utilized through preservation, and used for intensification system in raising the animals.

Table 6. Parameters of population and feed trend of local animal genetic resources.

Parameter	Moa buffalo	Lakor goat	Kisar sheep
Trend of population			
Population	13,012 head	16,132 head	5,540 head
Development trend 2013	165.45%	124.05%	529.11%
Location quantion	1.96	1.12	3.25
Natural increase (NI)	33.58%	188.42%	11.40%
Total breed growth	87 head	1,492 head	197 head
Trend of feed			
Dry matter availability	40,599.23 ton/year	3,760.46 ton/year	4,603.73 ton/year
Requirement of dry	33,831.20 ton/year	1,257.59 ton/year	424.35 ton/year
Excess of dry matter	6,768.03 ton/year	2,502.87 ton/year	4,179.38 ton/year
Increase carrying	2,603.19 AU	4,813.21 AU	7,970.94 AU

Problems Related to Research Development

The “Grand Design” for development of these three commodities has been formulated, but integrated and planned actions facilitated by the local government and the other related side has not been taken yet. On the other hand, the potency of these local livestock should be extensively studied for, in relation to attain maximum production. Several problems faced in developing those animals which need to be examined are as follows.

1. Potency of animal source and feed have not been used optimally to meet the requirement as source of feed from animal, source of income, and source of organic fertilizers.
2. Improve quality of genes in supporting animal productivity in order to produce superior animals.
3. Strengthening capacity of local human resource, in order to support animal productivity and to use natural resources wisely.
4. Policy and regulation on conservation and to establish development area of integrated agriculture, based on animal husbandry, and other social regulation in development of animal husbandry.
5. Utilization of animal manure as source of bioenergy (biogas) and organic fertilizer.
6. The use of animal product and post-harvesting handing of animal product.
7. Control of animal diseases and health of veterinarian in the development of animal husbandry.
8. Development of Integrated Agriculture system based on Animal husbandry.

Closing

Protection, conservation, and utilization of Moa buffalo, Lakor goat, and Kisar sheep are important for human welfare purposes, therefore real actions in form of research need to be designed covering various aspects to accelerate the achievement of the development of these potential local livestock. It is expected that in the future, Pattimura University should have a collaboration research with other universities in the world, such as Kagoshima University, in developing of these commodities. The research aspects that should be considered are local human resource capacity strengthening, genetic quality improvement, animal feedstock development including local forage and pasture quality improvement, animal diseases control, animal waste-based bioenergy development, product and post-harvesting handling, and policy and regulation aspects.

References

BERHITU, S. F. 2004. *Studi Karakteristik Fenotipik Ternak Kambing Lakor di Pulau Lakor di Kecamatan Moa Lakor (MOLA) Kabupaten MTB* [Study of Phenotypic Characteristics Lakor Goat in Lakor Island, Moa Lakor Islands (MOLA) Subdistrict, MTB District], *Skripsi, Jurusan Peternakan Fakultas Pertanian Unpatti, Ambon* [Thesis, Department of Animal Husbandry, Faculty of Agriculture, Unpatti, Ambon] (in Indonesian).

FAO 2002. Conserving and Developing Farm Animal Diversity, Secretariat of the Report on the State of the World's Animal Genetic Resources, Rome.

LENDHANIE, U. U. 2005. *Karakteristik Reproduksi Kerbau Rawa dalam Kondisi Lingkungan Peternakan Rakyat* [Reproductive Characteristics of Swamp Buffalo in the Community Livestock Environmental Conditions]. Bioscientiae, 2(1):43-48 (in Indonesian).

MANUPUTTY, D. 2002. *Keragaan Reproduksi Ternak Domba Lokal di Pulau Kisar Kabupaten Maluku Tenggara Barat* [Livestock Reproductive Performance of Local Sheep in Kisar Island, West Southeastern Maluku District], *Skripsi, Jurusan Peternakan, Fakultas Pertanian Unpatti, Ambon* [Thesis, Department of Animal Husbandry, Faculty of Agriculture Unpatti, Ambon] (in Indonesian).

NOOY-PALM, H. 1979. The Sa'dan Toraja: A Study of Their Social Life and Religion. Vol. I: Organization, Symbols and Beliefs (Volkenkunde, 87.), 338 pp., The Hague: Martinus Nijhoff.

SALAMENA, J. F. 2006. *Karakterisasi Fenotipik Domba Kisar di Kabupaten Maluku Tenggara Barat Propinsi Maluku sebagai Langkah Awal Konservasi dan Pengembangannya* [Phenotypic Characterization of Kisar Sheeps in West Southeastern Maluku District, Maluku Province, as the First Step toward Their Conservation and Development],

Disertasi, Sekolah Pascasarjana Institut Pertanian Bogor, Bogor [Dissertation, Graduate School of Bogor Agricultural University, Bogor] (in Indoensian).

SALAMENA, J. F., PAPILAJA, B. J. and RIRIMASE, P. M. 2009. *Karakterisasi dan Identifikasi Produkstivitas Kerbau di Pulau Moa Kabupaten Maluku Barat Daya Provinsi Maluku* [Characterization and Identification of the Productivity of Buffaloes in Moa Island, Southwestern Maluku, Maluku Province], *Laporan Penelitian, Hibah Penelitian Strategi Nasional. Lembaga Penelitian Universitas Pattimura, Ambon* [Research Report, The National Strategy Research Grant, Research Institute of Pattimura University, Ambon] (in Indonesian).

SALAMENA, J. F., SANGADJI, I., RALAHALO, T. N., TOMATALA, G. S. J., PATTY, Ch. W., PAPILAJA, B. J., SIWA, I. P. and TATIPIJKALAWAN, J. M. 2013. *Penyusunan Grand Design Pengembangan Sumberdaya Genetik Ternak (SDGT) Kerbau Moa, Kambing Lakor dan Domba Kisar di Kabupaten Maluku Barat Daya Provinsi Maluku* [Preparation of Grand Design of Livestock Genetic Resources Development of Moa Buffalo, Lakor Goat and Kisar Sheep in Southwestern Maluku, Maluku Province], *Laporan Akhir, Kerjasama Dinas Pertanian Provinsi Maluku dan Jurusan Peternakan Fakultas Pertanian Universitas Pattimura, Ambon* [Final Report, Cooperation between Maluku Provincial Agriculture Office and the Department of Animal Husbandry, Faculty of Agriculture, Pattimura University, Ambon] (in Indonesian).

SIWA, I. P. 2007. *Pertambahan Alami (Natural Increase) Ternak Domba Lokal di Pulau Kisar Kabupaten Maluku Tenggara Barat* [Natural Increase of Local Livestock Sheep in Kisar Island West Southeastern Maluku District]. Jurnal Agroforestry, 2(2): 102-108 (in Indonesian).

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Food Security in Small Islands:

Case Studies in the Federated States of Micronesia

YAMAMOTO Sota

Research Center for the Pacific Islands, Kagoshima University

Abstract

In the 1950s, people in the Federated States of Micronesia (FSM) still ate a "traditional" diet based on starchy staple crops and marine resources, but this began to be replaced by imported food such as rice, flour, sugar, fatty foods, and other processed foods after the United States Department of Agriculture started its supplementary feeding program in the 1960s. This phenomenon accelerated after a Compact of Free Association was signed between the FSM and the United States in 1986. Since then, the FSM has faced serious public health problems due to this new diet and other lifestyle changes. On small islands and atolls, imported foods and medicines may not arrive for more than a month if a typhoon or an oil crisis occurs. In this study, a detailed study of household food consumption is shown to represent the present situation of food security on Piis-Paneu Island (Chuuk Atoll, Chuuk State) and Pingelap Island (Pohnpei State).
Keywords: banana, breadfruit, canned fish and meat, ethnobotany, MIRAB, root and tuber crops (*Alocasia*, *Colocasia*, *Cyrtosperma*, *Xanthosoma*, etc.)

Introduction

The Federated States of Micronesia (FSM) consists of four states (Yap, Chuuk, Pohnpei, and Kosrae, from west to east) composed of approximately 600 small islands, which amount to an area of approximately 700 km^2. However, the FSM is spread over more than 2,600,000 km^2 of the Pacific Ocean and spans approximately 2,500 km from east to west. In the 1950s people in the FSM still ate a "traditional" diet based on starchy staple crops (e.g., breadfruit, tuber and root crops, banana, etc.) and marine resources (e.g., fish, octopus, clams, turtles, etc.) (MURAI 1954), but this began to be replaced by a diet rich in rice, flour, sugar, fatty foods, and other imported or processed foods after the United States Department of Agriculture started its supplementary feeding program in the 1960s (ENGLBERGER *et al*. 2003). This phenomenon accelerated after a Compact of Free Association was signed between the FSM and the United States in 1986 (HEZEL 2004). Since then, the FSM has faced serious

public health problems due to this new diet and other lifestyle changes, and the government, non-governmental organizations (NGOs), and researchers have attempted to promote a return to local foods because of their higher carotenoid and vitamin contents compared to modern foods (e.g., ENGLBERGER *et al*. 2009). However, the outlook for these programs is still bleak. In the present paper, a detailed study of household food consumption is shown to represent the present situation of food security in Piis-Paneu Island, Chuuk Atoll, Chuuk State and Pingelap Island, Pingelap Atoll, Pohnpei State, the FSM. This paper includes results of presented papers at "Research and Education linkage between Pattimura University and Kagoshima University", at "the 113th and the 116th annual meeting of Japanese Society for Tropical Agriculture", at "the ISISA Islands of the World XIII", and at "the 9th International Conference on Small Island Cultures."

Materials and Methods

Food consumption survey was conducted to three households in Piis-Paneu Island from September 2012 to August 2013 and to two households in Pingelap Island from August 2012 to January 2014 with Questionnaire sheets (Fig. 1). These households were selected to survey dietary patterns because of an average family size and income. Questionnaire items are as follows: starchy staples (rice, breadfruit, *Cyrtosperma merkusii*, banana, others), marine resources (fresh fish, dried fish, canned fish, others), meat (fresh, canned), others (instant noodle, coconut, vegetable, fruit). Frequency of each item in one month is calculated using a following formula: Frequency (%) = (total number of appearances of each item / total number of meals in one month) × 100.

Results and Discussions

Imported food (rice, canned fish and meat, instant noodles, etc.)

Rice consumption of households in Piis-Paneu Island is very high (PIS-A: 99.3%, PIS-B: 96.3%, PIS-C: 72.1%, 12-month average) compared to that in Pingelap Island (PLP-A: 65.7%, PLP-B: 33.2%, 18-month average) (Table 1). Households in Piis-Paneu Island also used imported food more frequently than those in Pingelap Island, e.g., canned fish (PIS-A: 78.3%, PIS-B: 34.6%, PIS-C: 23.4%, PLP-A: 2.8%, PLP-B: 1.0%), canned meat (PIS-A: 52.1%, PIS-B: 2.3%, PIS-C: 8.1%, PLP-A: 1.4%, PLP-B: 0.5%), and instant noodles (PIS-A: 87.4%, PIS-B: 51.2%, PIS-C: 43.1%, PLP-A: 22.5%, PLP-B: 9.9%). This is partly because of the limited access to Pingelap Atoll. Villagers in Pingelap Island said that a public ship operated

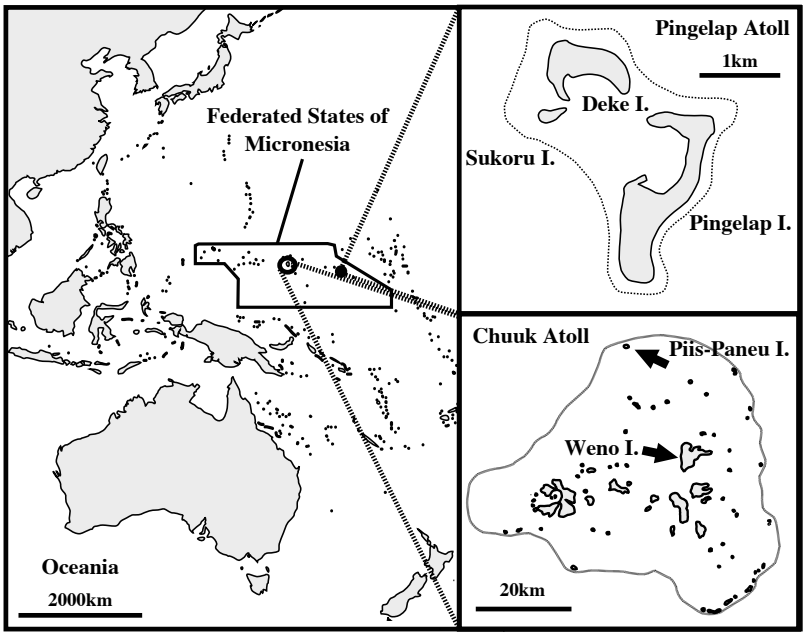


Fig. 1. Location of Piis-Paneu Island, Chuuk Atoll, Chuuk State and Pingelap Island, Pingelap Atoll, Pohnpei State, the Federated States of Micronesia.

Table 1. Frequency (%) of food consumption of households in Piis-Paneu Island, Chuuk State and Pingelap Island, Pohnpei State.

	Piis-Paneu Island Sep. 2012 to Aug. 2013 (12-month average)			Pingelap Island Aug. 2012 to Jan. 2014 (18-month average)	
	PIS-A	PIS-B	PIS-C	PLP-A	PLP-B
Starchy staples					
Rice	99.3	96.3	72.1	65.7	33.2
Breadfruit	90.2	37.6	77.3	20.4	13.7
Cyrtosperma	41.5	10.1	13.5	18.7	16.7
Banana	62.4	32.6	49.1	41.2	22.5
Others	66.7	0.0	11.2	5.2	1.5
Marine resources					
Fresh fish	81.1	68.5	69.2	67.4	54.9
Dried fish	42.9	34.1	33.4	0.2	0.1
Canned fish	78.3	34.6	23.4	2.8	1.0
Others	42.1	12.2	29.0	1.2	4.7
Meat					
Fresh	27.5	30.5	12.5	5.4	2.7
Canned	52.1	2.3	8.1	1.4	0.5
Others					
Noodle	87.4	51.2	43.1	22.5	9.9
Vegetable	67.9	0.5	16.5	1.2	0.1
Fruit	59.7	4.5	11.9	27.7	9.7

by the government (approximately USD 12 per person from Pohnpei Island, the main island of the FSM, to Pingelap Island) came to this island only two times from August 2012 to August 2013. There is a 300 m airstrip in Pingelap Island, and Caroline Islands Air serves a light aircraft (for eight persons) to the island, but a flight schedules is irregular and one way costs USD 190. If people would like to send some stuff to Pingelap Island via Caroline Islands Air, it costs USD 0.75 per pound, which is very expensive to villagers. Compared to Pingelap Island, people in Piis-Paneu Island can easily access to Weno Island, the main island of Chuuk Atoll, and buy any kind of imported food there.

Local food (breadfruit, root and tuber crops, marine resources, etc.)

All households in Piis-Paneu and Pingelap islands ate fruits of breadfruit with high frequency in especially May to September because of the seasonality of breadfruit. Preserved breadfruit was also used. If they cannot get breadfruit, they ate banana and/or *Cyrtosperma merkusii*. The frequency of use of marine resources was not very different among months; fresh fish (PIS-A: 81.1%, PIS-B: 68.5%, PIS-C: 69.2%, PLP-A: 67.4%, PLP-B: 54.9%), dried fish (PIS-A: 42.9%, PIS-B: 34.1%, PIS-C: 33.4%, PLP-A: 0.2%, PLP-B: 0.1%), and other marine resources such as clam, octopus, land crab, sea turtle etc. (PIS-A: 42.1%, PIS-B: 12.2%, PIS-C: 29.0%, PLP-A: 1.2%, PLP-B: 4.7%).

Good candidates for food security crops

It is found that people in two islands still use crops and marine resources obtained from the island (or atoll) with high frequency. However, people in Piis-Paneu and Pingelap islands somewhat depended on the imported rice. Moreover, the frequency of other imported food such as canned fish, canned meat, and instant noodles was high in Piis-Paneu Island. On small islands and atolls, imported foods and medicines may not arrive for more than a month if a typhoon or an oil crisis occurs. Therefore, it is very important to re-discover plants already naturalized on each island, for food security. From this perspective, *Alocasia macrorrhizos* and *Tacca leontopetaloides* are a very important starchy crop for emergency in Piis-Paneu and Pingelap islands. However, a young generation has never eaten them and/or does not know how to cook (Fig. 2). It is necessary to document how to eat these plants for the next generation.

One more important candidate plant for food security is chili peppers (*Capsicum frutescens*), which can serve not only as a spice (fruits) but also as a vegetable (leaves) rich in carotenoids and vitamins (RESOURCES COUNCIL OF THE SCIENCE AND TECHNOLOGY AGENCY 2001). People in Piis-Paneu and Pingelap islands don't often eat vegetables (PIS-A: 67.9%, PIS-B: 0.5%, PIS-C: 16.5%, PLP-A: 1.2%, PLP-B: 0.1%). However, it is known that leaves of chili peppers are used in the FSM as a vegetable (Table 2). YAMAMOTO (2011) reported

Fig. 2. *Alocasia macrorrhizos* (upper left, upper right, lower left) and *Tacca leontopetaloides* (lower right) in Piis-Paneu Island.

Table 2. Use of leaves of chili peppers (*Capsicum frutescens*) in Chuuk, Pohnpei, and Kosrae states (YAMAMOTO 2011, 2012, 2013b).

	Use of leaves of *C. frutescens* as vegetable			Frequency of use of leaves of *C. frutescens* per[*2]				
				Week		Month		Year
	Yes	No	Total	Several times	One time	Several times	One time	Several times
Chuuk State								
Weno	19 [SO:18, FR: 4][*1]	19	38	0	7	5	4	3
Romanum	15 [SO:15, FR: 0]	4	19	0	1	2	4	8
Piis	15 [SO:13, FR: 2]	4	19	0	4	1	7	4
Sub-total	49 [SO:46, FR: 6]	27	76	0	12	8	15	15
Pohnpei State								
Pohnpei	23 [SO: 23, FR: 2]	17	40	0	0	7	10	6
Mokil	20 [SO: 20, FR: 1]	0	20	3	8	3	6	0
Pingelap	35 [SO : 35, FR: 2]	1	36	5	13	3	14	0
Sub-total	78 [SO: 78, FR : 5]	18	96	8	21	13	30	6
Kosrae State								
Kosrae	17 [SO: 12, FR:12]	5	22	1	0	3	3	10
Total	144 [SO:136, FR:23]	50	194	9	33	24	48	31

[][*1]: They used leaves for SO: soup and FR: fried vegetables. Results from multiple answer.

[*2]: Qustions for people who eat leaves of *C. frutescens*.

that, in Pohnpei State, the frequency of using the leaves is much higher in remote atolls, such as Mokil and Pingelap, than on the main island, Pohnpei Island. This phenomenon was also confirmed in Chuuk Atoll (YAMAMOTO 2012). It is known that the lifestyle on Pohnpei Island is more modernized than that on Mokil and Pingelap atolls (KAWAI *et al*. 2010), which seems to have affected the use of *C. frutescens* leaves. YAMAMOTO (2009) also reported that the indigenous people of Taiwan seem to rarely use the leaves of *C. frutescens* because they can buy other vegetables at markets. These results suggest that the leaves of *C. frutescens* may be used less in modern society. To improve the situation of food security and public health on Pacific islands, there should be a renewed focus on these naturalized plants on each island.

Maluku Province in Indonesia, where Pattimura University is, has the very similar geographical characteristic to the FSM. It is very important to compare the data of this paper with research results/resources in Pattimura University from the viewpoint of food security in small islands of the Asia-Pacific region. I have great hopes of a further collaboration research with Pattimura University in the near future.

References

ENGLBERGER, L., MARKS, G. C. and FITZGERALD, M. H. 2003. Insights on Food and Nutrition in the Federated States of Micronesia: A Review of the Literature. Public Health Nutrition, 61: 5-17.

ENGLBERGER, L., SCHIERLE, J., HOFMANN, P., LORENS, A., ALBERT, K., LEVENDUSKY, A., PAUL, Y., LICKANETH, E., ELYMORE, A., MADDISON, M., DEBRUM, I., NEMRA, J., ALFRED, J., VANDER VELDE, N. and KRAEMER, K. 2009. Carotenoid and Vitamin Content of Micronesian Atoll Foods: Pandanus (*Pandanus tectorius*) and Garlic Pear (*Crataeva speciosa*) Fruit. Journal of Food Composition and Analysis, 22: 1-8.

HEZEL, F. X. 2004. Health in Micronesia: Over the Years. Micronesian Counselor Issue 53, 15 pp., Micronesian Seminar, Pohnpei, FSM.

KAWAI, K., KUWAHARA, S., ONJO, M., NODA, S., NISHIMURA, A., TOMINAGA, S. and NAGASHIMA, S. 2010. The Influence of Environmental Changes on the Micronesian Area: A Case Study of Islands in Pohnpei State, Federated States of Micronesia. South Pacific Studies, 30(2): 23-43.

MURAI, M. 1954. Nutrition Study in Micronesia. Atoll Research Bulletin, 27: 1-239.

RESOURCES COUNCIL OF THE SCIENCE AND TECHNOLOGY AGENCY (ed.) 2001. Standard Tables of Food Composition in Japan, 464 pp., Kagawa Nutrition University Press, Tokyo, Japan (in Japanese).

YAMAMOTO, S. 2009. Use of *Capsicum frutescens* by the Indigenous Peoples of Taiwan. Studies on Indigenous Peoples of Taiwan, 13: 39-75 (in Japanese).

YAMAMOTO, S. 2011. Use of *Capsicum frutescens* on Pohnpei Island, Mokil Atoll, and Pingelap Atoll, Federated States of Micronesia. People and Culture in Oceania, 27: 87-104.

YAMAMOTO, S. 2012. Use of *Capsicum frutescens* in Chuuk Atoll, Federated States of Micronesia. Tropical Agriculture and Development, 56(4): 151-158.

YAMAMOTO, S. 2013a. Food Security on Chuuk Atoll, Federated States of Micronesia. Paper presented at the 9th International Conference on Small Island Cultures, Tual, the Kei Islands, Indonesia,10-13 July, 2013.

YAMAMOTO, S. 2013b. Use of *Capsicum* on Kosrae Island, Federated States of Micronesia. South Pacific Studies, 33(2): 87-99.

YAMAMOTO, S., NISHIMURA, S. and KAWANISHI, M. 2013. Food Consumption Survey in Chuuk Atoll, Federated States of Micronesia. Paper presented at the 113th Annual Meeting of the Japanese Society for Tropical Agriculture, Ibaraki University, Ibaraki, Japan, 30-31 March, 2013.

YAMAMOTO, S., NISHIMURA, S. and KAWANISHI, M. 2014. Food Security on Pingelap Island, Pohnpei State, Federated States of Micronesia. Paper presented at the ISISA Islands of the World XIII, Penghu Archipelago, Taiwan, 22-27 September, 2014.

YAMAMOTO, S., NISHIMURA, S. and KAWANISHI, M. 2014. Food Consumption Survey in Pingelap Atoll, Pohnpei State, the Federated States of Micronesia. Paper presented at the 116th Annual Meeting of the Japanese Society for Tropical Agriculture, Kyushu University, Fukuoka, Japan, 4-5 October, 2014.

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Food Security Systems in Indonesia: Challenges and Implications to Food Security in Maluku

GIRSANG Wardis

Faculty of Agriculture, Pattimura University

Abstract

National food security policy is actually preceded by food self-sufficiency at national level which is focused on rice, corn, soybean, and meat. In fact, the priority target is more focused on rice self-sufficiency to produce as much as of 10 million tons of rice surplus or equals to 75.7 million tons in 2015. This target is achieved by integrating national food security systems. Because Java has complex problems of rice production, particularly in line with agricultural land conversion to non-farm activities, climate change, and small scale farm, therefore all provinces are asked by the central government to support and make the program of rice self-sufficiency as a main indicator to food security. Even though Maluku has 4.6 million ha of agricultural land but only of 20,000 ha of the land is cultivated by wet land rice that produced around 80,000 tons of rice or 50% of total rice demand in Maluku Province. This implies that rice self-sufficiency is very difficult to achieve because it needs three folds of rice land area and this is probably not suitable to apply in Maluku. Expansion of the wet land rice should be discontinued but intensification should be continued on the existing rice field. On the contrary, the area of agricultural land that suitable to dry land food crops is accounted around of 718,466 ha. Location specific, optimalization, clustering, regulation, and expansion of the area of dry land food crops, particularly for up land rice, sago palm, cassava, sweet potato, breadfruit, and corn, should be made as a main indicator of non-rice food self-sufficiency, food security, and nutrition security development in Maluku.

Keywords: food security policy, Maluku, non-rice food self-sufficiency, rice food self-sufficiency

Introduction

Indonesia is known as an archipelago region that has abundance of agricultural, fishery, and marine resources. Besides, Indonesia has also human resource potential that reached up to 237.6 million in 2010. Population growth cannot be avoided and will influence the higher need of food demand, particularly the source of carbohydrate such as rice and flour and the source of protein like meat and fish, including fruits, vegetable, and clean water. At this condition, how does Indonesian government achieve rice-self-sufficiency and provide enough

food for all population that tend to grow faster (1.4%/year) than the growth of food crop (1%/year)?

The answer to the question is to maintain suitable land for food/rice crop in Java. Why? Because land of food crops in Java is more fertile than food crop land in out of Java, irrigation water dam is more established. Therefore, the central production of rice, soybean, and corn is more suitable and relevant to develop in Java. In fact, Java faces a serious challenge in terms of agricultural land conversion into non-farm activities such as resettlement, real estate, road, building offices, and industry development. At the same time, the area of food crop (rice) in Indonesia decreased around 100,000 ha/year (SUSWONO 2012), rice productivity is relatively stagnant and the size of farm per household or land fragmentation tends to become smaller in the last decade. These issues and the challenge to climate change and global warming impact on food production are the main constraints to sustain rice base staple food to all population in Indonesia.

Rice Bias Policy

Rice crop was developed by the Dutch as the part of ethical politics during the colonization in the 1905. Then, Indonesian government continued to expand rice land outside of Java through transmigration program in Sumatra, Kalimantan, Sulawesi, Papua, and Maluku. In the 1960s and 1970s, Indonesia developed green revolution to imboost rice production through extensification and intensification of the rice crops. At this stage, the government introduced mass guidance in the 1960s, special intensification in the 1970s and then supra-special intensification in the 1980s. These government programs provided input production such as seeds, pesticides, herbicides, fertilizers subsidy as well as irrigation water dam infrastructure, village unit cooperatives, and agricultural extension agents. As a result, Indonesia achieved rice self-sufficiency in 1984.

Besides, the central government also determines the price of rice in terms of floor price and ceiling price of rice. To maintain the buffer stock, the government developed Logistic Business Board to keep national stocks of rice, flour, and sugar. Rice is strategic commodity because it is crucial food and crop in Indonesia and in the other Asian countries. As staple food, rice is the main source of carbohydrate and protein to most people in Indonesia, absorb most of rural labors and contribute to the gross domestic product. However, all these government interventions might be successes to achieve production in the short term but it failed to address farmer's household income significantly because 75% of the poor people in Indonesia are categorized as food crop farmers.

Rice is pivotal commodity because rice influence inflation and if rice price increase by 10% thus it will increase of around 1.3% of the number of poor people. Due to the small size

of farm and low level of production per household, it can be argued that 70% of rural households are net rice consumers. To fulfill the national rice consumption/demand that increased considerably (around 130 kg/capita/year), the government policy is to increase rice production, to reduce rice consumption by 1.5%/year, to accelerate food diversification consumption and/or to support rice import policy.

Food Crops in Indonesia: Potential and Productivity

The main food crops in Indonesia were rice, corn, and soybean. In the last 5 years, the central government made all these food crops as the top target priorities. The government targeted the growth of 3.2%, 10%, and 20.1% for rice, corn, and soybean, respectively. In order to achieve food self-sufficiency and dependency on rice import, President of Indonesia instructed to achieve 10 million tons of rice surplus (SUSWONO 2011). At this stage, the top target of rice production is 76 million tons of milling dry paddy. In fact, this target is still difficult to achieve in 2014 (Table 1).

The average rice productivity in the last decade is of 4.35 ton/ha. This implies that Indonesia needs to expand wet paddy land from 15.3 million ha in 2010 into 17.4 million ha in 2014. As agricultural land's conversions continue and there is no special effort to create new high yield varieties, it will be difficult to achieve the target. This occurs because rice productivity is relatively constant. To achieve the main target of 10 million tons of rice surplus at the end of 2014/2015, the government needs to extent around 2.1 million ha of new wet land rice or 525,000 ha/year whilst at the same time the area of suitable land for food crops in Western and Eastern part of Indonesia is questionable.

Table 1. Production targeted for three main food commodities in Indonesia, 2010-2014.

Commodities	2010	2011	2012	2013	2014	Growth/ year (%)
	(thousand tons)					
Rice[1]	66,680	68,800	71,000	73,300	75,700	3,22
Corn[2]	19,800	22,000	24,000	26,000	29,000	10,02
Soybean[2]	1,300	1,560	1,900	2,250	2,700	20,05

[1]Milling dry paddy.

[2]Dry corn and soybean.

Source: SUSWONO (2011).

The top ten rice producers in the world are China, India, Indonesia, Bangladesh, Vietnam, Thailand, Myanmar, Philippines, Brazil, and Japan. Among all these rice producers, China, India, and Indonesia are the biggest rice producers in the world that is of 129.5 million ton/year, 94 million ton/year, and 35.5 million ton/year, respectively (SANTOSA 2008). Rice productivity in Indonesia is lower than those of rice productivity in Vietnam, China, USA, and Egypt, but higher than those in India, Thailand, Philippines, and African countries (Fig. 1).

Rice consumption in Indonesia has decreased from 139 kg/capita/year in 2010 to 130 kg/capita/year in 2012 but this consumption is still high when it is compared to the other Asian countries that consume around 65-70 kg/capita/year. At this moment, the government increase rice production through multiple strategies including extensification and optimalization of food crop land areas, intensifying the use of input production technologies and to find out the new high rice yield varieties. At the same time, the government also promotes a strategy to reduce consumption of imported rice and wheat flour, to accelerate variation of food consumption, and to increase local food consumption that is stated in the President Decree No 22/2009. The main government goal to develop all these strategies is to achieve and to sustain food self-sufficiency particularly for rice, and then soybean, corn, and meat. In fact, food self-sufficiency faces complex, diverse, and dynamic problems for the years to come.

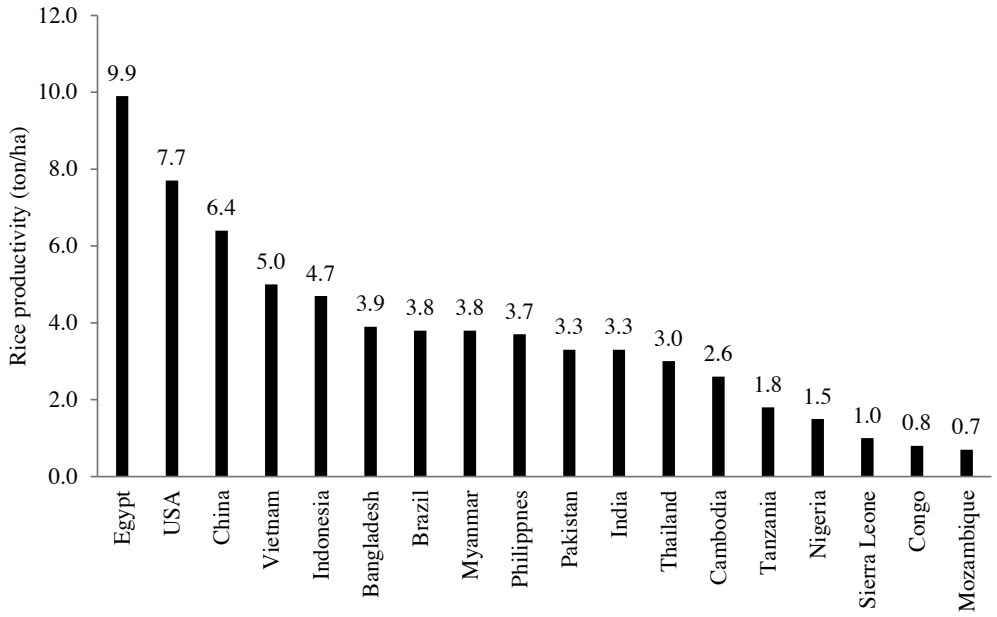


Fig. 1. Wet land rice productivity in Indonesia and several rice producer countries in the world (Source: SUSWONO [2011]).

Challenges of Food Security

The main challenges of food crop development are food usage efficacy, economic scale of farm size, production oriented, low competitiveness of food products, and low agricultural labor productivity. In general, these problems can be seen from the contribution of agricultural sector around 14% to the Gross Domestic Product (GDP) whilst at the same time 40% of national labor still work in agricultural sector. Therefore, the first challenge for food security is low labor productivity and efficiency in agricultural sector because of 40% of agriculture's labor produce of 14% only to GDP.

The second challenge is usage of water competitiveness between water irrigation for agriculture and need of industries in urban areas. Water problem will become more serious because of deforestation and climate change impacts on agricultural production. The climate change impact becomes more serious and more difficult to anticipate as the number of floods in Indonesia occurred around 113 times between 1998 and 2000.

The third challenge is the conversion of agricultural and food crop land into non-farm activities that is around 100,000 ha per year in Java (SUSWONO 2011). The problem is that the agricultural land in Java is 13% of national areas agricultural land but it produces around 60% of food production in Indonesia. Besides, of 60% of population of Indonesia live in Java and Java is the central of industry, trade, and services development that contribute around 50% to national GDP but at the same time conversion of agricultural land to non-agricultural activities in Java probably will cause the loss of the best fertile soil for food crops as the crucial foundation of food self-sufficiency development in Indonesia.

The next challenge of food security is competition of population growth and food production. In 2050 the number of world population will reach around 9.1 billion and it will need to increase 70% of total food production to fulfill global food demand. Asian countries are the place to cultivate of 90% of rice in the world and rice is staple food and the source of calorie to 40-45% of people in the Pacific and even of 70% people in Vietnam, Bangladesh, and Cambodia. If there is no substitution from rice to non-rice staple food, the need of rice will increase by 60% in 2020 and will need to increase rice productivity around 3%/ ha on the existing farm (DOWLING and GREENFIELD 1998). This becomes more difficult as rice productivity tends to stagnant in the last decade. Green revolution technology proved that production can be improved but created new problems in terms of environmental and social economic inequality issues between the large and small size of food crop land.

The last food security challenge is high wheat flour import that is 14% of total Indonesian agricultural products import (SUSWONO 2011). High dependency on wheat flour and other food import will deteriorate the bargaining position of most farmers household who live under poverty line.

The Current Government Policy on Food Security

In facing the dynamics and complex problems of food security, the Indonesian government stated seven components of agricultural revitalization. These components are land consolidation, high seeds productivity, infrastructure, skilled labor, financial capital, institutional development, and technology improvement and downstream industry development. The basic purpose of agricultural revitalization is to enhance food/rice production up to surplus of 10 million tons of rice in 2015, to achieve and sustain rice self-sufficiency, strengthening food security and nutrition security, to increase competitiveness and added value, and to improve farmer income as well as to conserve environment and climate change adaptation (SUSWONO 2011). In order to enlarge the area of rice cultivation outside of Java, the government created the Master Plan of Acceleration Indonesian Economy Development that proposes to develop million hectares of 'rice estate' in Merauke-Papua Province and Eastern Kalimantan. However, this policy is still questionable because of inefficiency in terms of higher price of food because of high transportation and input production costs to distribute food from Papua and Kalimantan into Java.

Next, the government makes a broader perspective and comprehensive approach to the food security and poverty alleviation program. In this case, the main goal of the government subsidized rice policy for the poor is to avoid poor households from the dangerous of food vulnerability. In this term, the government distributes rice and direct cash money to help the poor in rural and urban areas to fulfill the basic needs of household members. At the same time, the government also develop program that is called Community Development National Program (*Program Nasional Pemberdayaan Masyarakat*, PNPM) that promote infrastructure or physical development (human made capital). This program is designed by contemporary bottom up approach that involving NGOs, professional facilitators, and communities. Then, the government provides health insurance and school operational cost as well as scholarship for children of the poor who have good grade in school. At this moment, education is believed by the government as the solution to free the poor household from the poverty trap/deprivation. The basic consideration is good education will produce good job and salary. If one family member of the poor gets a chance to enter a university, to graduate from it, and to have a good job, he will then become the source of financial capital for his/her family members to enter a better school and to get a better job. This action will free the households from poverty deprivation that might be derived from generation to generation.

The Community Empowerment National Program facilitates both infrastructure and micro finance development for the poor households in rural and urban areas. It can be seen from the Fig. 2 that the government focus on material capital rather than strengthening institutional capacity and human skill development. As a result, a physical program may be useful to the whole community but it might have no direct benefit to the poor households.

Base on systems thinking perspective, food security systems in Indonesia can be depicted into three components: input, process, and output. Input of food security consists of four aspects: (a) economic policy on agriculture, fishery, and forestry; (b) infrastructure development including transportation, irrigation water, financial capital, and land protection; (c) social welfare including health, education, and population control; and (d) national stability and security. These four components are the basic national policies as input to shape the performance of the food security policy. The process of food security policy consists of three components at three different levels: (a) national level: availability, distribution, and consumption; (b) household level: income, food access, household consumption behavior, sanitation, and health; (c) individual level: consumption according to the need of nutrition balanced. These food security components are integrated within each other. Both input and process will produce outputs in terms of nutrition status that consists of three components: (a) human right on food; (b) the quality of human resource; and (c) national security. Therefore, the key success factor of national food security in Indonesia will be determined by harmony, synergy, and integrated cooperation between the national government policies that promote rice as staple food and the local government policies that promote local food as staple food.

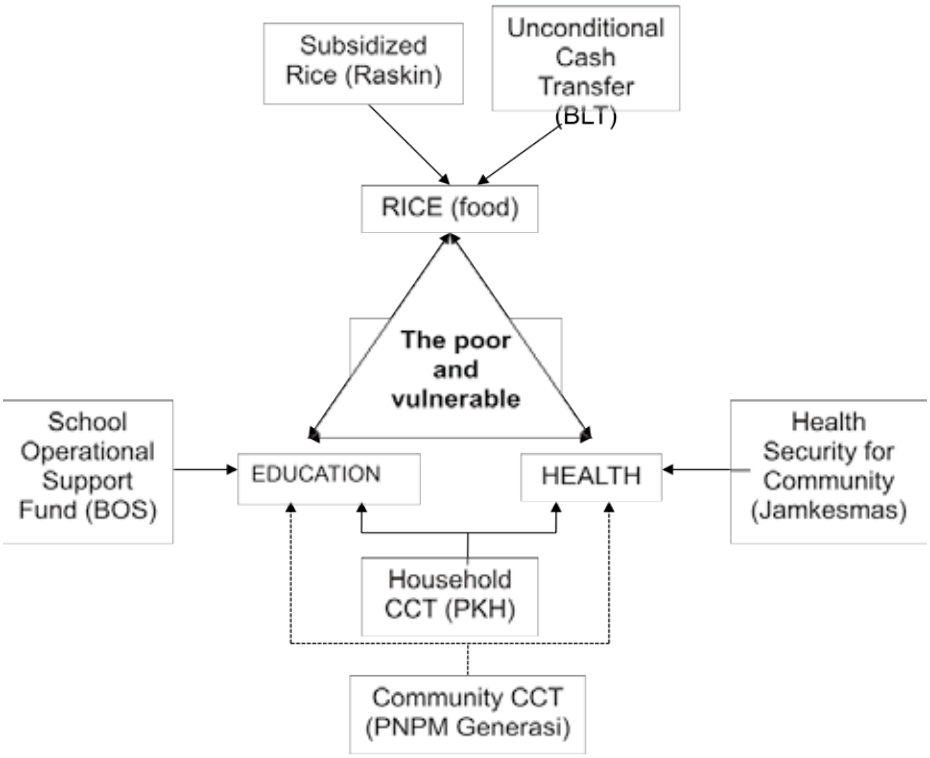


Fig. 2. The government policy on subsidized rice, direct cash money, education, health, and community empowerment for poor households in Indonesia.

Different from Indonesia, it might be useful to learn how Chinese government develops food security policy to fulfill around 1.2 billion of people in China (TAN 2011). Chinese government develops four food security policies. First, Chinese government makes regulation to protect the basic fertile land for agriculture, particularly food crop land. At the same time, Chinese government makes land consolidation to create an efficient or profitable land size and economic scale. It means that there is a no space for land conversion of food crop land and there is a serious sanction to people who disobey the regulation. Food crop land is developed in the frame of cluster of food crop regions that is protected by Chinese government regulation. Second, Chinese government provides special budget to improve agricultural infrastructures, particularly irrigation water dam, fertilizers and other production inputs, transportation, and advanced technology development. Third, Chinese government motivates farmers to cultivate rice by giving incentives and subsidy for fertilizers, tax free for the agricultural products, and technical assistance for agricultural tools and machines. The last policy is to improve farmer's non-formal education and skill through strengthening the role of agricultural extension. The main role of agricultural extension is agent of learning to bridge technology and innovation from research institutions into the farmer/ farmer groups.

In fact, Indonesia has applied the same policies, but controlling on government regulation implementation is lack in the field. As a result, food crop land conversion is still continued in Java and out of Java. The other problems are low quality of agricultural infrastructures and lack of creativity agricultural extension and technology or innovation from research institution to farmers, vice versa. The main difficult problem to solve is land consolidation between and among small scale farmers in rural areas into one cluster of food crop region that might be called as rice estate or 'corporate farming' or 'estate food crop farming'. Land consolidation is pivotal in Indonesia because up to 70% of total farmers are small farmers that need to manage into a partnership relation between farmer groups and food corporate.

Implication to Food Security Systems in Maluku Province

The main goal of national food security policy is to achieve food self-sufficiency particularly in four commodities: rice, corn, soybean, and meat. The central government gives special attention to rice self-sufficiency through targeting 10 million tons of rice surplus in 2015. As a result, the central government promotes rice as the main food security program at the national, provincial, and district levels. What is the national food security policy implication to Maluku Province that has a different food crop resource base with Java?

First, macro policies regarding of food security and nutritional security are suitable to Maluku Province in terms of agricultural and water management, education, health, trade, and

transportation. The other macro policies are economic growth, equality of economic distribution, investment, social and political stability, and institutional development. The goals are to support income improvement, better public services, and access to nutritional food so that people, households, and individuals can have healthy, active, and productive life. These macro policies are the basic input to anticipate external problems such as climate changes and global warming whilst at the same time micro policies like social protection, health, and nutrition are needed to anticipate shock in terms of natural disaster, social conflict, pest, and disease (AZIZI 2013).

Second, different from continental region like Java, Maluku Province is an archipelago region that consists of thousands of small islands. Maluku has 4.63 million ha of agricultural land and most of them are forestry (2.3 million ha), plantation (1.3 million ha), and dry land/ up land food crops (718,466 ha). The area of suitable wet land rice is 1.2% (57,120 ha) of total land area (Fig. 3). Therefore, the basic food crop to develop in Maluku is not wet land rice crop but dry land food crops. It means that Maluku food security policies should be based on dry land rather than wet land food crops. The next implication is that the central and provincial governments need a paradigm shift and mind set changes from wet land rice as the only source of staple food and self-sufficiency into dry land non-rice crops. In short, food self-sufficiency should be based on dry land food crops (local food crops) in Maluku. This is pivotal as rice crop has complex challenges because rice crop land in Java has converted into non-farm activities and additional input production tend to stagnate rice productivity and farmer income. Therefore, Indonesian government should make food self-sufficiency based on rice and non-rice crops both in Java and outer of Java.

The crucial problem of food crop land in Maluku is that the usage of agricultural land use is not optimal. It can be seen that wet land rice is used up to 33.28% whilst plantation and dry land for food crops were used 16.48% and 2.85%, respectively (Fig. 4). Food security development based on food crops in the dry land is the pivotal challenge in Maluku Province.

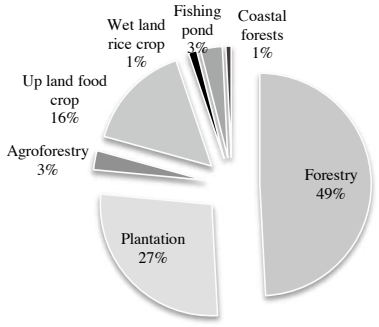


Fig. 3. The potential of agricultural land.

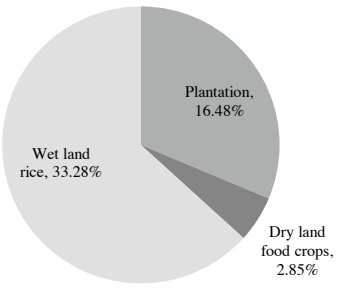


Fig. 4. The usage of plantation, wet land rice, and dry land food crop in Maluku.

Third, wet land rice development is still the priority of the central and local government in Maluku because wet land rice production is the main indicator to measure food self-sufficiency level. If Maluku government follows the central government policy to use wet land rice production as the main indicator of food self-sufficiency, Maluku government needs to extent about 2-3 folds of new wet land rice crops (20,000-60,000 ha) to support rice demand around 170,000 tons per year to feed of 1,63 million of Maluku population. This is an impossible target to achieve because the total area of rice crop that was developed in the last 60 years in Maluku was of 20,000 ha only. The other consequences are high dependency on rice field labor demand from outside of Maluku and environmental degradation problems because Maluku government should converse sago forests into wet land rice. Therefore, rice policy should be focused on intensifying existing rice field in Seram and Buru islands.

Therefore, different from the national food security policy, the foundation of food security and nutrition in Maluku should be based on a local natural and cultural resource base, especially 52,000 ha of sago palm in Maluku as well as tubers and corn in Southeast Maluku regions. Wet land rice, sago palm, cassava, sweet potato, corn, dry land rice crop, breadfruit, and banana should be the source of carbohydrate whilst marine fish is the source of protein. Besides, local vegetables and fruits as the source of mineral and vitamin need to develop in Maluku in order to substitute imported vegetables and fruits.

The important political action plan of food security in the near future is to develop clustering of food crop cultivation regions which is backed up by government regulation. Then, food commodities need to develop through food processing technology prototypes to produce competitive food products. High yield seeds and technology food processing prototypes are the key success factors to accelerate food and nutrition security and dignity in Maluku Province. Food processing technology will promote nutrition security based on flour of sago, cassava, potato, breadfruit, banana, marine fish, and vegetables. This is probably the basic foundation of food product development in the future in Maluku.

Conclusions and Policy Implications

Food security systems in Indonesia are based on rice, corn, soybean, and meat. Food self-sufficiency at the national and provincial levels is the prerequisite to food security at the household and individual levels. In fact, Indonesia still imports all these foods each year, including wheat flour. Because food self-sufficiency is difficult to achieve, the main indicator for food self-sufficiency and food security is limited into wet land rice production. The central government has made a target to achieve of 10 million tons of rice in 2015. As a result, each region including Maluku Province is pushed to cultivate rice to fulfill national target. Due to the complex problem of rice production in line with land conversion, climate change, and

stagnating productivity and farmer's income, a wet land rice production target becomes probably more difficult to achieve in the future. Therefore, it is proposed to change paradigm from wet land rice crop into both wet land rice and dry land food crops. Based on land suitability for food crops in Maluku, it is recommended that the main indicator to measure food self-sufficiency and food security in Maluku should be based on dry land food crop rather than wet land rice crop whilst existing wet rice field need to sustain and intensify.

References

AZIZI, M. N. 2013. Crops for the Future Research Centre: Beyond Food Security. Paper presented at the International Conference on Science and Innovation, British Council, Jakarta, 17-19 September, 2013.

DOWLING, N. G. and GREENFIELD, S. M. 1998. Introduction and Overview. In: Sustainability of Rice in the Global Food System (DOWLING, N. G., GREENFIELD, S. M. and FISCHER, K.S. eds), 1-7 pp., Pacific Basin Study Center, Davis, Calif, USA, and International Rice Research Institute, Manila, Philippines.

SUSWONO 2011.The Indonesian Food Security in the Perspective of Global Economy and National Sovereignty. Paper presented at the International Conference on "The Future of Global Food Security and Safety: Issues and Justification", IPB International Convention Center, Bogor, 27 October, 2011.

TAN, X. L. 2011. How China Feeds Its Increasing Population? Paper presented at the International Conference on "The Future of Global Food Security and Safety: Issues and Justification", IPB International Convention Center, Bogor, 27 October, 2011.

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Integrated-Disciplinary Evaluation of Ecology-Economy Interacting System in Marine Resources in Fiji

KAWAI Kei[1], KOBARI Toru[2], TORII Takashi[2] and NISHIMURA Satoru[3]

1: Research Center for the Pacific Islands, Kagoshima University
2: Faculty of Fisheries, Kagoshima University
3: Faculty of Low, Economics and Humanity, Kagoshima University

Abstract

Republic of the Fiji Islands (Fiji) is one of the Melanesian countries. There are social systems dependent on the nature that is highly productive for fishery resources in mangrove-coral ecosystems. Such beautiful natures and specific cultures are tourist resources for not only Fiji but also the other islands, but the tourism has been resulted in various problems. Thus, it is a challenge to make a good living for island people with "symbiosis" between the natures and human activities. In the present study, we evaluate the relationships of ecological and social systems on fishery resources in a Fijian local village from the viewpoint of natural and social sciences (integrate-disciplinary study).

In the objective village, there was a life style dependent on farming and fishing. The number of people in a family was less than those in the neighboring village because young people were working in urban areas or overseas to send living expenses to the village people. A major fishery resource was a bivalve "*kaikoso*" which was collected and sold by women and important seafood and income for the village people. *Kaikoso* inhabited at the coastal sites between mangrove and coral reef and was more abundant than the other islands.

In this paper, we will show a simple model which factors have most affected the fishery resource and also we introduce a significance to study the lure of islands from the viewpoint of "integrate-disciplines".
Keywords: bivalves, ecology, economy, Fiji, integrate-disciplinary

Introduction

The Republic of the Fiji Islands (Fiji) is one of the Melanesian countries. Fiji's social systems depend on a natural environment that has highly productive fishery resources in mangrove-coral ecosystems. This beautiful natural environment and Fiji's many different cultures are tourist attractions, not only for Fiji, but also for other islands in the region. Tourism, however, has resulted in various problems. Thus, it is a challenge for island people to make a good living while depending on the co-existence of nature and human activities. In

the present study, we evaluate the influences of ecological and social systems on fishery resources in a local Fijian village, from the interdisciplinary viewpoint of the natural and social sciences.

Natural environments and their resources are vital to human existence. Human activities in many localities have led to environmental pollution and decreased biodiversity, and this phenomenon has become global in scale. Understanding the relationship between humankind and the nature from a global perspective is crucial.

In a traditional village, the lifestyle was dependent on farming and fishing. A bivalve called "*kaikoso*," which was major fishery resources, was collected and sold by women, and provided important seafood and income for the village people. *Kaikoso* inhabited coastal sites between mangroves and coral reefs, and is more abundant here than in the other islands.

The relationship between the nature and human activities encompasses a complicated system affected by many factors. Therefore, the study of such systems requires an interdisciplinary perspective (e.g., REPKO 2012). For example, coastal marine resource management is related to a wide array of academic fields, including sociology, economics, and ecology. Consequently, it is preferable to study this topic from both ecological and socio-economical perspectives, as advocated by interdisciplinary research.

Interdisciplinary Study

The primary component of the present study's research method is the integrated-disciplinary evaluation of ecology and economics. A complicated ecosystem comprising tidal flats, mangrove forests, and coral reefs is important to both the islands' environment and its society (Fig. 1), due to its high biodiversity and its residents' reliance on marine resources for consumption and commercial purposes.

Ecologists and economists participated in our research group, and although group members focused on their own respective fields, collective meetings were held monthly. Also, because field research occurred concurrently in the same village, a shared experience and understanding of *kaikoso* existed, which was further enhanced through frequent discussions. Since group members shared their data, experiences, and thoughts, it was possible to comprehensively understand other academic specializations and to conduct an interdisciplinary evaluation. Finally, group members proposed a conceptual model of the interactions between ecological and economic systems and their relationships with the marine resources, and assessed this model using a statistical method, namely, Structural Equation Modeling (SEM) (BOWEN and GUO 2011).

Fig. 1. The coastal area, coexisting mangrove forest, tidal flat, and coral reef on the Viti Lavu Island in Fiji.

Study Site

The study village—Viti Lebu—is located on the eastern side of the main island of Fiji. Although the mangrove forests are not rich, they grow in the island's coastal areas; coral reefs are present in the offshore areas (KAWAI *et al*. 2008, MANABE *et al*. 2008).

The village's lifestyle is dependent on farming and fishing (NISHIMURA 2006). The number of members in each household is less than the number of household members in the neighboring village. This is so because many youths are employed in the tourism industry, and live either in urban areas or overseas, and regularly send money home to sustain their relatives in the village. *Kaikoso* is a major fishery resource. It is collected by the women and sold to earn an income. *Kaikoso* is a bivalve, and feeds on organic matter in the seawater; it inhabits the coastal sites between mangroves and coral reefs, and is more abundant in Viti Lebu than on other islands.

Objectives

This paper will begin by demonstrating the ecological importance of *kaikoso* to mangrove-tidal flat ecosystems, and the island's economic and social systems. Then, a Fijian village's *kaikoso* resource management practices will be evaluated from a natural and social science viewpoint. The model is simple, and considers which factors have most affected this fishery resource, while also explaining the significance of studying the location from an interdisciplinary perspective.

The Impact of *Kaikoso* Feeding on Nature

An experiment was conducted to determine the importance of *kaikoso* feeding activities on the mangrove-tidal flat ecosystem. Four aquarium tanks were prepared and filled with seawater, with one pair of tanks containing *kaikoso* and the other none. The dry weight of the suspended particles and plankton biomass (i.e., food organisms for *kaikoso*) were compared between both pairs of tanks. In natural seawater, suspended particles and plankton increased without the *kaikoso*; however, in the presence of filter-feeding *kaikoso*, the opposite occurred. This result is in agreement with BUHADI *et al*. (2013), who suggested that *kaikoso* feeding plays an important role in the removal of tidal flat particles supplied by the mangrove.

Kaikoso is usually found near sandy shallow areas of tidal flats that are easily accessible from the shore by foot. The average density of *kaikoso* varies between 13 and 15 each/m^2 (unpublished data). However, the density of a bivalve of the same genus in Kiribati is approximately 5 each/m^2. This suggests that even under the impact of an intense fishery, the densities reported in Fiji are higher than those in other Pacific Islands. Furthermore, the results indicate that *kaikoso* plays a very important role in the research location's coastal ecosystem.

The Economy: A Case for Women Collecting *Kaikoso*

A household survey was conducted to investigate the *kaikoso* fishing habits of women in the village. The sample included 15 women who regularly collect *kaikoso*. The average number of households surveyed was 4.3 ± 0.38 (mean ± SE), with an average income per week of 116.7 ± 28.03 F$ (mean ± SE) (unpublished data).

The daily catch of *kaikoso* varied between 2 to 5 heaps, while the women's weekly catches were between 5 to 15 heaps, with an average of 11 (unpublished data). Each heap includes approximately 65 individual *kaikoso*. Because each heap is worth 2 F$ at the Suva Market, the weekly income generated from the *kaikoso* is 22 F$, or approximately 20% (22 F$/117 F$) of the total weekly income. These results indicate that *kaikoso* is a very important source of income for the community.

Structural Equation Modeling: Natural-Social System Concept

A model depicting the relationship between the ecological and economic factors of *kaikoso* fishing activities was developed. The natural and social parameters were collected in Fig. 2 (unpublished data). Ovals indicate concepts describing natural-social systems. The

model's hypothesis is that Fijian people have a "consciousness of the ecosystem's service" and a "monetary lifestyle," both of which affect the environmental conditions of *kaikoso* and the villagers.

Modeling Results

There were no significant interactions between villagers' consciousness of the ecosystem's services and monetary lifestyles. However, villagers' consciousness of monetary lifestyles significantly affected the number of *kaikoso* sold and collected. This means that when a small amount of money is needed, the villagers collect *kaikoso* to sell at markets, which subsequently indicates that sustainable resource use exists in the study location.

Summary

1) The *kaikoso* feeding activities are of significant ecological importance to the tidal flat ecosystem
2) The *kaikoso* is an important source of income for women in the village
3) SEM is a powerful tool for evaluating natural-social system concept, and interdisciplinary research promotes a better understanding of the relationship between the nature and humans

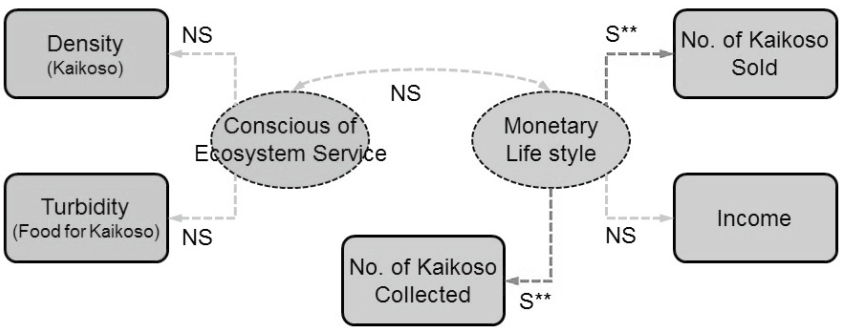


Fig. 2. Results of SEM. NS: not significant, S**: significant.

Acknowledgments

The authors wish to express their thanks to Dr. Joeli VEITAYAKI for his kind help and cooperation in conducting the fieldwork and respiratory experiments at the University of the South Pacific. A portion of this study was supported by the Japan Society for the Promotion of Science (JSPS) (21401013). This report was modified by the report of KAWAI *et al*. presented at the 1st East Asian Island and Ocean Forum on 11 November, 2013, which will be published soon.

References

BOWEN, N. K. and GUO, S. 2011. Structural Equation Modeling, 240 pp., Oxford University Press, UK.

BUHADI, A. E. S. M. Y, KOBARI, T., KAWAI, K., YAMAMOTO, T., SUZUKI, H., NISHIMURA, S., TORII, T. and VEITAYAKI, J. 2013. Food Availability for Particle-Feeding Bivalves, *Anadara* spp. in Fiji. Pacific Science, 67(4): 539-551.

KAWAI, K., KOBARI, T., MANABE, H. and ZANN, L. 2008. Fisheries and Marine Environments in the Coastal Area in the Island Coexisting Mangrove Forest and Coral Reef – A Case Study at the Village in Viti Levu Island, Republic of the Fiji Islands. The Journal of Island Studies, 7: 1-16 (in Japanese).

KAWAI, K. 2011. Molluscan Biodiversity in Replanted and Natural Mangrove Forest: A Study on the Island of Viti Levu in Fiji. The Journal of Island Studies, 11: 25-34.

MANABE, H., KOBARI, T., KAWAI, K. and ZANN, L. 2008. Ichthyfauna around Coastal Area Coexisting Mangrove Forest and Coral Reef in Viti Lavu Island, Fiji. The Journal of Island Studies, 7: 17-26.

NISHIMURA, S. 2006. Fijian State and the Traditional Society. Journal of Economic and Society, 65: 49-66.

REPKO, A. 2012. Interdisciplinary Research: Process and Theory. 2nd ed., 544 pp., SAGE Publications, Los Angeles, USA.

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

A Review on *Dusun* as an Indigenous Agroforestry System Practiced in Small Islands

MATINAHORU Johan Markus

Faculty of Agriculture, Pattimura University

Abstract

Since the ancient time, farmers in Maluku have practiced *dusun* as an agroforestry system to develop spices crops in some parts of the Maluku, such as Banda, Ternate, Saparua, and Seram islands. *Dusun* is an indigenous agroforestry model of the Maluku farmers, where perennial, annual, and forest crops are grown together. In *dusun*, the perennial crops are considered as main crops, while annual and forest crops are considered as secondary crops. The most important perennial crops of *dusun* in Maluku are cloves, nutmegs, sago, coconuts, cacao, and edible fruit trees. The dominated annual crops are cassava, sweet potato, cocoyam, yam, maize, beans, and vegetables, while forest crops in general are shading trees and timber species. *Dusun* has been known for a long time as a source of local security foods, because it support meeting daily needs of farmers, generate cash money, increase household income, and conserve the ecosystem. Therefore, *dusun* may be considered as a farmers' bank in some isolated islands.
Keywords: agroforestry, annual crops, conservation, *dusun*, forest, perennial crops

Introduction

Maluku Province consists of approximately 659 small islands and the total population is about 1.8 million people. The majority people are farmers (80%), governmental servants (15%), and others (5%). In general, the communities live in the coastal areas of each island. THE REGIONAL MALUKU PLANNING AND DEVELOPMENT BOARD (2005) reported that about 20% of small islands in Maluku Province are occupied by the communities, and the other islands are not inhabited. Most of the empty islands are atolls or coral islands and their size is smaller than 2 km^2. Therefore, the majority of the communities occupy only some islands, such as Seram, Buru, Jamdena, Wetar, Kei, Ambon, and Lease islands.

The capital city of Maluku Province is Ambon, and it is located in Ambon Island. Ambon Town is the center places of offices, business, education, and culture. There are also some other small towns, such as Masohi, Piru, Bula, Tual, Saumlaki, and Dobo in different islands.

Maluku Province has about 5 million ha of forests, but the rate of deforestation is

predicted about 1.2% per year. The dominant factors of this problem are shifting cultivation, forest logging, and some other activities to change forest land to other uses, such as palm oil plantations, transmigration programs, and mining activities. To overcome these problems, the Forestry Department of Indonesia has introduced some national programs, such as Community Forest, 'Gerhan', One Man One Tree' and 'One Million Trees Planting'. However, these programs are not yet successful because of their incompatibility to local customs of farmers in Maluku Province. Therefore, *dusun* as an indigenous agroforestry system in Maluku, where forest trees are combined with the annual and perennial crops, must be in priority to consider as one of the national program for Maluku farmers.

Dusun in Maluku is almost similar to a multiple cropping system in Java and Malaysia, *taungya* system in Myanmar, or agroforestry systems in the other parts of the world. The difference is only in the priority crops species and management system. Spices, food, and fruit trees are the priority crops of *dusun* in Maluku; meanwhile in the other parts of Indonesia annual crops dominate in the system. In Java or other parts of Indonesia, the multiple cropping system or agroforestry system is more intensively managed than *dusun* in Maluku.

The main activity to do and develop by the indigenous farmers in Maluku is *dusun*. Some ethnic groups or family groups consider *dusun* as a livelihood, and therefore special rituals related to *dusun* have been developed by some ethnic groups, such as Wemale or Alone ethnics in Seram Island. These rituals are conducted by the head of the ethnic group (*kepala adat*) in the location where a *dusun* will be opened and developed, to ask the deity for permission, protection, successful activities, and the highest productivity of *dusun*.

Short History of *Dusun*

Dusun is an indigenous agroforestry system of farmers in Maluku, and in this system farmers grow a combination of annual, perennial, and forest crops. This model has been long time practiced by the Maluku peoples since the eighth century for planting spices. In the thirteenth century, Maluku was famous as a source of spices, and therefore it attracted the Asian and European traders. Today *dusun* systems are practiced by almost 50% of the small island farmers, while about 40% practice shifting cultivation, and about 10% practice permanent agriculture. *Dusun* systems are applied almost in all regions of Maluku; however, the majority are found in the districts of Central Maluku, Western Seram, and Eastern Seram.

Types and Characteristics of *Dusun*

Many types of *dusun* can be found in Maluku. There is a classification of *dusun*s based

on land owners, such as *dusun milik* (owned *dusun*, developed by a farmer in a land area of himself), *dusun dati* (communal or clan *dusun*, in a land of family groups), and *dusun negeri* (village own *dusun*, in a land owned by a village, managed for the needs of the village). Based on the performing process of *dusun*, a natural and an artificial *dusun* can be found. The natural *dusun* is established through the natural process without significant human intervention. For instance, *dusun sago* (sago palm forest), *dusun damar* (agathis forest), *dusun* kayu putih (*Melaleuca* spp forest), and *dusun mayang* (sugar palm forest). Human interventions in natural *dusun* are mainly focused on product extraction and processing. Meanwhile, the artificial *dusun* is established by in intervention of farmers who grow a certain combination of annual, perennial, and forest crops, with their activities from land preparation to harvesting. The examples include *dusun cengkih* (dominated by cloves trees), *dusun pala* (dominated by nutmeg trees), *dusun kelapa* (dominated by coconut trees), and *dusun coklat* (dominated by cacao plants). *Dusun* has been practiced for a long time by farmers in Maluku as an exertion land, which can support meeting the farmers' needs, because *dusun* has many different plants (MATINAHORU 2011).

The important characteristics of *dusun* are; (1) easy accessibility because *dusun* is located close to the residential area or village, (2) high species diversity, (3) consist of multiple combination of crops, including annual, perennial, and forest crops, (4) several harvest times of crop products, (5) semi-intensive management system, (6) with low economic values of the forest crops (MATINAHORU 2007).

The advantages of the *dusun* practices are; (1) reduction of the erosion and sedimentation during rainy season, (2) stabilization of microclimate and soil water system, (3) creation of laminar canopy structure, (4) increase of species diversity, (5) domination by species with high economic value, (6) increase of activities of wild animals, especially birds and microorganisms, (7) increase of quality of land and ecosystem, (8) making available security foods, (9) increase of household income, and (10) sustainance of local community customs. The main disadvantages of *dusun* are: (1) strong change of microclimate and animal habitats in the initial stage of land preparation, (2) low productivity of some crops because of high competition in growth space, radiation, nutrients, and water (MATINAHORU 2007).

Crop Species of *Dusun*

The important species of perennial crops are clove (*Eugenia aromatica*), nutmeg (*Myristica fragrans*), cacao (*Theobroma cacao*), sago palm (*Metroxylon sago*), and some edible fruits, such as durian (*Durio zibethinus*), Canarium nut (*Canarium commune*), *kemiri* (*Aleurites moluccana*), *gandaria* (*Bouea macrophylla*), langsat (*Langsium domesticum*), jackfruit (*Artocarpus heterophyllus*), mangosteen (*Garcinia mangostana*), avocado (*Persea*

americana), mango (*Mangifera indica*), and *jambu* (*Syzygium* spp.).

The main annual crops are cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), *ubimerah* (*Dioscorea* spp.), taro (*Colocasia esculenta*), cocoyam (*Xanthosoma sagittifolium*), banana (*Musa* spp.), maize (*Zea mays*), peanut (*Arachis hypogaea*), and some vegetables, such as *melinjo* or *genemo* (*Gnetum gnemon*), *bayam* (*Amaranthus* spp.), long bean (*Vigna unguiculata*), *sawi* (*Brassica* spp.), cucumber (*Cucumis sativus*) and tomato (*Lycopersicon esculentum*).

The important forest crops are salawaku (*Paraserianthes falcataria*), *lenggua* (*Pterocarpus indicus*), *gofasa* (*Vitex gofasus*), *pulaka* (*Octomeles sumatrana*), teak (*Tectona grandis*), mahogany (*Swietenia macrophylla*), *samama* (*Anthocephalus macrophylla*), *makila* (*Litsea* spp.), and *merbau* (*Intsia bijuga*).

Usefulness of *Dusun*

Dusun contributes to meet daily needs of farmers. In a food security aspect, *dusun* can supply food, medicines, and cash money. LOUHANAPESSY (2010) reported that in Seram Island *dusun* contributed to each households a cash of about a million rupiah (USD 90) per month. While in Ambon Island each of farmer household earned about USD 210 per month (MATINAHORU 2011). In contrary, the farmers of Allang Village earned only about USD 70 per month (LOPUMETEN 2011), which means that farmers there obtained very small income from *dusun*. However, based on the analysis, it was shown that farmers income from *dusun* are inconstant because crop production depends more on the season, climate, and soil factors. Some perennial crops have a certain habit in their productivity if there is no intensive management. For instance, clove trees may give a high fruit yield only once in 5 years. However, if there is an intensive control of nutrients, pest, and disease, continuous production in every year can be reached (MATINAHORU 2011).

The importance of *dusun* in the conservation aspect are; (1) species diversity increases because many species are introduced into *dusun*, compared to monoculture agriculture, (2) erosion and sediments are limited by a root system, a canopy structure, and tree density of crops, (3) a water system and microclimate are more stable because of canopy and root density of crops.

Construction Process of *Dusun*

Based on the land conditions, two types of *dusun* have been identified. The first type is the development of *dusun* by opening “forest lands”. The activity stages of this type are; (1)

determination *ofa* forest land, (2) clearance of forest covers, (3) selection of important trees, (4) cutting of unimportant trees, (5) clearance of the land, (6) preparation of seeds or seedlings, (7) planting seeds or seedlings of annual and perennial crops, (8) construction of fences, and (9) protection and maintenance of the crops. The second type is to develop *dusun* by using "marginal lands". Its activity stages are; (1) determination of a marginal land, (2) clearance of bushes or under-brushes, (3) clearance of the land, (4) preparation of seeds or seedlings of annual and perennial crops, (5) planting seeds or seedlings of annual and perennial crops, (6) introduction of forest crops, (7) construction of fences, and (8) protection and maintenance of the crops.

The principle difference between both types is the status of land conditions and the supplying process of forest crops. Trees selection and cutting are applied in the first type of *dusun* when the forest land started to open. Normally, the tree selection is a priority to keep the shading trees or timber species. This type is practiced by farmers with large forest land areas, such as farmers in Seram, Buru, and Jamdena islands. While in the second type, the supplying process of forest crops is done after the stage of planting annual and perennial crops. This model is applied in many parts of small islands, such as Saparua, Haruku, Ambon, and Kei islands.

Productivity of *Dusun*

The main problem of *dusun* is the low productivity of the crops; and the reasons are poor growth space, nutrients, and genotypes of the crops. Many *dusun*s are established without considering the space of growth, and therefore the crops there will be difficult to develop optimally and produce flowers and fruits (MATINAHORU 2011).

Many species of plants are grown in shaded areas because of canopies of the dominant and taller species. The next data are collected from farmers at Hative Besar Village in Ambon Island, where most farmers never consider supply of nutrients and growth space of the crops (SAHULATA 2008). Many crops do not reach the optimal production (Table 1, Table 2). For instance, one durian tree in the age of about 50 years can only reach about 30% production capacity from its total fruit productivity at the heavy harvest season (MATINAHORU 2011). If farmers can apply additional nutrients and control plant parasites, each crop can increase its productivity every year. The other reason of low productivity is the spacing among crops. In general, farmers believe that increasing the number of crops per area can directly increase total productivity, which is not necessarily true. The same problem of low productivity also occurs for the annual crops, as indicated in Table 3 (HATULESILA 2008).

SAHULATA (2008) reported *dusun* potentials of farmers at Hative Besar Village as shown in Table 4. Durian, *gandaria*, and mangosteen are grown by farmers in high density. In an

hectare of land for all levels of tree growth (seedlings, saplings, poles, and trees), they are the dominant species. The main reason is that they are famous fruits for local markets. Some of these fruits are specifically consumed or processed, such as durian fruits for fresh food, meanwhile, *gandaria* and mangosteen are for making juice.

Table 1. Productivity of perennial crops in *dusun* at Hative Besar Village.

No.	Tree species	Productivity (kg/tree/year)
1	Durian (*Durio zibethinus*)	50 – 70
2	Jackfruit (*Arthocarpus heterophyllus*)	20 – 50
3	*Kedondong* (*Spondias pinnata*)	10 – 30
4	Canarium nut (*Canarium commune*)	10 – 20
5	Rambutan (*Naphelium lapaceum*)	5 – 20
6	Langsat (*Langsium domesticum*)	5 – 12
7	*Gandaria* (*Bouea macrophylla*)	5 – 10
8	*Jambu* (*Syzygium* spp.)	5 – 12
9	Mangosteen (*Garcinia mangostana*)	5 – 8
10	Nutmeg (*Myristica fragrans*)	3 – 6

Table 2. Productivity of forest crops in *dusun* at Hative Besar Village.

No.	Trees species	Productivity (m^3/hectare)
1	*Lenggua* (*Pterocarpus indicus*)	1
2	*Pule* (*Alstonia scholaris*)	3
3	*Salawaku* (*Paraserianthes falcataria*)	2
4	*Samama* (*Anthocephalus macrophylla*)	3
5	*Titi* (*Gmelina moluccana*)	2

Table 3. Productivity of annual crops in *dusun* at Hative Besar Village.

No.	Crops species	Productivity (kg/species/year)
1	Cassava (*Manihot esculenta*)	50 – 70
2	Banana (*Musa* spp.)	50 - 100
3	Taro (*Colocasia esculenta*)	30 - 50
4	Peanut (*Arachis hypogaea*)	25 - 50
5	Maize (*Zea mays*)	50 – 80
6	Water morning glory (*Ipomoea aquatica*)	50 – 70
7	*Bayam* (*Amaranthus* sp.)	40 – 50
8	*Sawi* (*Brassica* spp.)	40 – 60
9	Cowpea (*Vigna unguiculata*)	50 – 70
10	Egg plant (*Solanum* spp.)	50 - 75

Table 4. Potential of edible fruit trees at Hative Besar Village.

No.	Crops species	Potential (individual/hectare)			
		Seedlings	Saplings	Poles	Trees
1	Durian (*Durio zibethinus*)	19	32	25	42
2	Jackfruit (*Arthocarpus heterophyllus*)	2	1	3	4
3	*Kedondong* (*Spondias pinnata*)	-	-	2	3
4	Canarium nut (*Canarium commune*)	-	1	3	11
5	Rambutan (*Naphelium lapaceum*)	1	6	10	2
6	Langsat (*Langsium domesticum*)	8	24	33	22
7	*Gandaria* (*Bouea macrophylla*)	61	18	15	34
8	*Jambu* (*Syzygium* sp.)	8	3	2	6
9	Mangosteen (*Garcinia mangostana*)	13	26	12	16
10	Nutmeg (*Myristica fragrans*)	7	20	12	20

Conclusions

Conclusions from this study are:

1. *Dusun* is the local custom of Maluku farmers, and therefore it must be sustained as an important culture for new generation in Maluku Province. It has been practiced since the ancient time, and it is still continued by new generation in Maluku.
2. *Dusun* has many important roles to support daily needs of farmers and also to protect and conserve the ecosystem.
3. Productivity of *dusun* should be increased by supports of the regional government, especially in the aspects of management system, farmers' capacity, and the marketing system of *dusun* products.

References

HATULESILA, Y. 2008. *Bentuk-Bentuk Penggunaan dan Productivitas Lahan Sistem Dusun di Kecamatan Leihitu Kabupaten Maluku Tengah* [Land Use Forms and Productivity of *Dusun* Systems, in Leihitu sub-district, Maluku Tengah District.], 61 pp., *Tesis Fakultas Kehutanan IPB, Bogor* [Thesis, Faculty of Forestry, Bogor Agricultural University, Bogor] (in Indonesian).

LOPUMETEN, A. L. 2011. *Kajian Sosial Ekonomi Masyarakat Pengelola Dusun di Negeri Allang Kecamatan Leihitu Barat Kabupaten Maluku Tengah* [Socio-Economic Study of *Dusun* Manager Community in Allang, West Leihitu, Central Maluku], 45 pp., *Skripsi*

Jurusan Kehutanan Fakultas Pertanian Unpatti, Ambon [Thesis, Faculty of Agriculture, Pattimura University, Ambon] (in Indonesian).

LOUHATAPESSY, H. 2010. *Kontribusi Dusun Terhadap Pendapatan Masyarakat di Desa Piru Kecamatan Seram Barat Kabupaten Seram Bagian Barat* [Contribution of *Dusun* to Social Income in Piru, West Seram, West Seram Regency], 51 pp., *Skripsi Jurusan Kehutanan Fakultas Pertanian Unpatti, Ambon* [Thesis, Faculty of Agriculture, Pattimura University, Ambon] (in Indonesian).

MATINAHORU, J. M. 2009. *Kontribusi Pola Pertanian Dusun Bagi Ketahanan Pangan Masyarakat Maluku* [Contribution of *Dusun* Agriculture System to Food Security in Maluku]. Jurnal Agroforestri, 2(2): 79-83 (in Indonesian).

MATINAHORU, J. M. 2011. *Strategi Pengembangan Model Dusun sebagai Sistem Agroforestry Khusus Bagi Pulau-Pulau Kecil di Maluku* [Development Strategy of *Dusun* Model as Agroforestry System Especially in Small Islands of Maluku]. Paper presented at the Training of Shifting Cultivation Control in Mountain Villages in Inamosol Sub-District of Seran Bagian Barat District, Nuduasiwa Development Foundation, Ambon, 10 August, 2011.

SAHULATA, Y. A. 2008. *Potensi dan Keragaman Pohon Penghasil Buah (Edible Fruit Trees) Pada Lahan Agroforestry Tradisional di Desa Ema dan Hative Besar Kota Ambon* [Potential and Diversity of Edible Fruit Trees at Traditional Agroforestry Farms in Ema and Hative Besar, Ambon], 43 pp., *Skripsi*, *Jurusan Kehutanan Fakultas Pertanian Unpatti, Ambon* [Thesis, Faculty of Agriculture, Pattimura University, Ambon] (in Indonesian).

THE REGIONAL MALUKU PLANNING AND DEVELOPMENT BOARD 2005. *Rencana Pembangunan Provinsi Maluku* [Development Plan of Maluku Province], 71 pp., *Badan Perencanaan dan Pembangunan Daerah Propinsi Maluku, Ambon* [The Maluku Province Regional Planning and Development Board] (in Indonesian).

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Species Diversity of Black Fly in Southeast Asia: Phylogenetic Analysis of Three Subgenera, *Asiosimulium*, *Daviesellum*, and *Wallacellum*, of the Genus *Simulium* s. l.

OTSUKA Yasushi

Research Center for the Pacific Islands, Kagoshima University

Abstract

Black flies (Diptera: Simuliidae) are distributed worldwide. The biting habits of black flies are known to cause medical and veterinary problems including transmissions of filarial diseases of humans and animals. In Southeast Asia (Thailand, Malaysia, Philippines, and Indonesia), eight subgenera (*Asiosimulium*, *Daviesellum*, *Gomphostilbia*, *Montisimulium*, *Morops*, *Nevermannia*, *Simulium* s. str., and *Wallacellum*) of genus *Simulium* s. l. are known. Of these subgenera, three subgenera (*Asiosimulium*, *Daviesellum*, and *Wallacellum*) are small, endemic only in the Oriental region (except one species of *Wallacellum*), and recently established. To confirm the subgeneric status, phylogenetic analysis was conducted using mitochondrial 16S rRNA sequences. As results, the three subgenera were clearly separated from other subgenera. Their subgeneric status was confirmed both by phylogenetic analysis and morphological characters.

Keywords: *Asiosimulium*, black fly, *Daviesellum*, phylogeny, *Simulium*, *Wallacellum*

Introduction

In a revision of supraspecific taxa of the genus *Simulium* Latreille s. l. which includes about 10 subgenera in the Oriental region, two subgenera: *Nevermannia* Enderlein and *Himalayum* Lewis have already been evaluated by phylogenetic analysis of mitochondorial 16S ribosomal RNA (rRNA) gene sequences (OTSUKA *et al*. 2001, 2003). Genus *Simulium* s. l. is the largest genus in the family Simuliidae, having 1,745 species in the 37 subgenera (ADLER and CROSSKEY 2014). Among these, ten subgenera are reported from the Oriental region. Moreover, in Southeast Asia (Thailand, Malaysia, Philippines, and Indonesia), eight subgenera (*Asiosimulium* Takaoka and Choochote, *Daviesellum* Takaoka and Adler, *Gomphostilbia* Enderlein, *Montisimulium* Rubtsov, *Morops* Enderlein, *Nevermannia,*

Simulium Latreille s. str., and *Wallacellum* Takaoka) are known (Table 1). Of these subgenera, three subgenera (*Asiosimulium*, *Daviesellum*, and *Wallacellum*) are small, endemic only in the Oriental region (except one species of *Wallacellum*), and recently established (Fig. 1). To confirm the subgeneric status, phylogenetic analysis was conducted using mitochondrial 16S rRNA sequences.

Table 1. Number of black flies in countries of Southeast Asia.

Genus	Subgenus	Thailand	Malaysia	Philippines	Indonesia
Simulium	*Asiosimulium*	3	0	0	0
	Daviesellum	2	1	0	0
	Gomphostilbia	23	26	33	44
	Montisimulium	6	0	0	0
	Morops	0	0	0	26
	Nevermannia	2	7	4	8
	Simulium	43	31	34	40
	Wallacellum	0	0	14	2

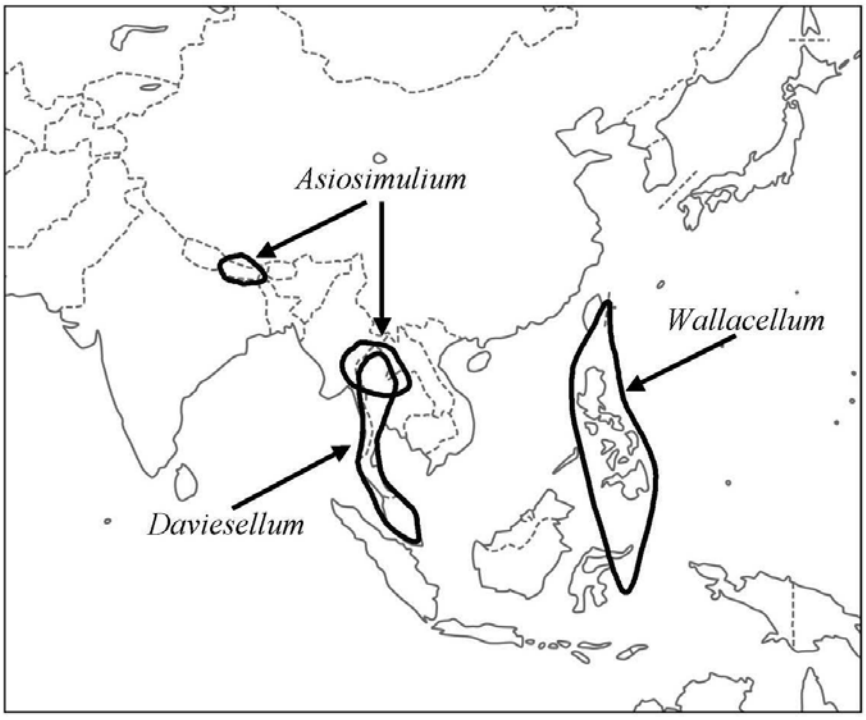


Fig. 1. Distribution of three subgenera, *Asiosimulium*, *Daviesellum*, and *Wallacellum*.

Materials and Methods

Phylogenetic analysis was conducted using the 16S mitochondrial sequences of 28 species (OTSUKA *et al*. 2001, 2003, 2007) (Table 2). The sequences were aligned by the program CLUSTAL W, and the alignment was then adjusted manually. Sites containing alignment gaps were excluded in the following analysis. The number of nucleotide substitution per site was estimated between each pair of the sequences, using Jukes-Cantor methods. Construction and bootstrap probability estimation of the neighbor-joining tree were performed by MEGA6 (TAMURA *et al*. 2013).

Table 2. Black fly species used for the phylogenetic analysis.

Species	Locality	Accession number
Simulium (*Asiosimulium*) *oblongum*	Muk Da Han, Thailand	AB334089
S. (*Daviesellum*) *courtneyi*	Doi Phu Kha, Thailand	AB334090
S. (*D.*) *pahangense*	Peninsular Malaysia	AB334091
S. (*Gomphostilbia*) *palauense*	Palau	AB056742
S. (*G.*) *whartoni*	Peninsular Malaysia	AB056743
S. (*Hellichiella*) *chiharuae*	Kyoto, Japan	AB334092
S. (*Montisimulium*) *kobayashii*	Mikurajima, Japan	AB334093
S. (*Mon.*) *merga*	Doi Inthanon, Thailand	AB334094
S. (*Morops*) *farciminis*	Irian Jaya, Indonesia	AB056744
S. (*Nevermannia*) *aureohirtum*	Peninsular Malaysia	AB056736
S. (*N.*) *feuerborni*	Peninsular Malaysia	AB056729
S. (*N.*) *ornatipes*	Irian Jaya, Indonesia	AB056737
S. (*N.*) *uchidai*	Oita, Japan	AB056740
S. (*Simulium*) *eximium*	Flores, Indonesia	AB093100
S. (*S.*) *malayense*	Peninsular Malaysia	AB093112
S. (*S.*) *nobile*	Peninsular Malaysia	AB093115
S. (*S.*) *tani*	Peninsular Malaysia	AB093123
S. (*Wallacellum*) *cabrerai*	Luzon, Philippines	AB093128
S. (*W.*) *carinatum*	Luzon, Philippines	AB093129
S. (*W.*) *celebesense*	Sulawesi, Indonesia	AB334095
S. (*W.*) *claveriaense*	Luzon, Philippines	AB334096
S. (*W.*) *recurvum*	Luzon, Philippines	AB334097
S. (*W.*) *spinosibranchium*	Luzon, Philippines	AB334098
S. (*W.*) *suyoense*	Luzon, Philippines	AB334099
S. (*W.*) *tuyense*	Luzon, Philippines	AB334100
S. (*W.*) *yonakuniense*	Yonakuni, Japan	AB334101
Austrosimulium bancrofti	Australia	AB093130
Prosimulium kiotoense	Oita, Japan	AB056747

The sequenes were determined in OTSUKA *et al*. (2001, 2003, 2007).

Results and Discussions

Sequences of the mitochondrial 16S rRNA gene region of the 26 species of genus *Simulium* s. l. were aligned with the two species from other genera as outgroup (Table 2). To reveal the evolutionary relationship among the species of the genus *Simulium* s. l., a neighbor-joining tree was made (Fig. 2). The tree shows that all subgenera, except for subgenus *Nevermannia*, occur in a clade, and supports the independence of the subgenera *Asiosimulium*, *Daviesellum*, and *Wallacellum*, which have been recently established. OTSUKA *et al*. (2001) reported that *ruficorne* species-group of *Nevermannia*, which includes *S. aureohirtum* Brunetti and *S. ornatipes* Skuse, was genetically and morphologically different from the other species-groups, and suggested that revision of the definition of *Nevermannia* was needed.

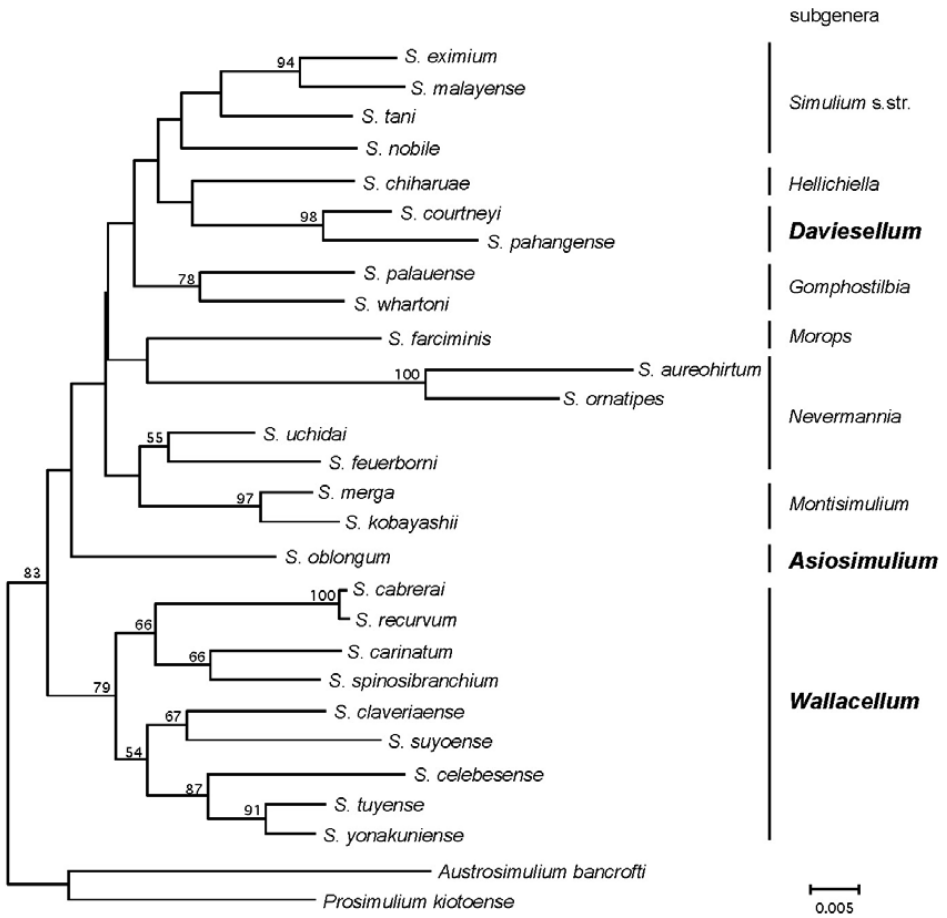


Fig. 2. Phylogenetic tree obtained by neighbor-joining method for a partial mitochondrial 16S rRNA sequence of 28 black fly species. The values at branch points indicate the percentage support for a particular node after 1,000 bootstrap replicates were performed. Values less than 50% are not shown.

Asiosimulium was recently established based on a unique species, *S.* (*A.*) *oblongum* Takaoka and Choochote, found in Thailand, and was reported to have more similarities morphologically to three subgenera, namely: *Boreosimulium* Rubtsov and Yankovsky in the Holarctic Region, *Inseliellum* Rubtsov in Micronesia and Polynesia, and *Nevermannia*, a cosmopolitan heterogeneous taxon (TAKAOKA and CHOOCHOTE 2005). *Daviesellum* is also a small subgenus, represented by only two species, *S.* (*D.*) *pahangense* Takaoka and Davies, and *S.* (*D.*) *courtneyi* Takaoka and Adler, collected from Peninsular Malaysia and Thailand, and has distinctive genitalia in both sexes, suggesting no close relationship to other subgenera of the genus *Simulium* s. l. (TAKAOKA and ADLER 1997). On the other hand, *Wallacellum*, represented by 11 species mostly from the Philippines, seems to have a close relationship to an Australasian subgenus *Morops* by having hairs on both katepisternum and pleural membrane (TAKAOKA 2003). However, the phylogenetic tree in this study did not show a close relationship between *Wallacellum* and *Morops*. Phylogenetic analysis of black flies using the mitochondrial 16S rRNA region can be a tool in determining the identity of the subgenus of *Simulium* s. l., but does not seem to resolve relationships among the subgenera due to low bootstrap values. More information on other genes as well as cytogenetic study is needed to clarify the relationships among subgenera of *Simulium* s. l.

References

ADLER, P. H. and CROSSKEY, R. H. 2014. World Blackflies (Diptera: Simuliidae): A Comprehensive Revision of the Taxonomic and Geographical Inventory [2014], 122 pp. Retrieved 11 November, 2014, from http:// entweb.clemson.edu/biomia/pdfs/blackflyinventory.pdf.

OTSUKA, Y., AOKI, C., CHOOCHOTE, W., DE LA LLAGAS, L. and TAKAOKA, H. 2007. Phylogenetic Analysis of Three Subgenera: *Asiosimulium*, *Daviesellum* and *Wallacellum*, of the Genus *Simulium* s. l. Endemic in the Oriental Region. Medical Entomology and Zoology, 58: 329-233.

OTSUKA, Y., AOKI, C., SUZUKI, H., SAITO, K., HADI, U. K. and TAKAOKA, H. 2001. Phylogenetic Analyses of a Blackfly Subgenus *Simulium* (*Nevermannia*) Based on Mitochondrial 16S Ribosomal RNA Gene Sequences. The Japanese Journal of Tropical Medicine and Hygiene, 29: 261-266.

OTSUKA, Y., TAKAOKA, H., AOKI, C. and CHOOCHOTE, W. 2003. Phylogenetic Analysis of the Subgenus *Himalayum* within the Genus *Simulium* s. l. (Diptera: Simuliidae) Using Mitochondrial 16S rRNA Gene Sequences. Medical Entomology and Zoology, 54: 113-120.

TAKAOKA, H. 2003. The Black Flies (Diptera: Simuliidae) of Sulawesi, Maluku and Irian Jaya, xxii+581 pp., Kyushu University Press, Fukuoka, Japan.

TAKAOKA, H. and ADLER, P. H. 1997. A New Subgenus, *Simulium* (*Daviesellum*), and a New Species, *S.* (*D.*) *courtneyi*, (Diptera: Simuliidae) from Thailand and Peninsular Malaysia. The Japanese Journal of Tropical Medicine and Hygiene, 25: 17-27.

TAKAOKA, H. and CHOOCHOTE, W. 2005. A New Subgenus and a New Species of *Simulium* s. l. (Diptera: Simuliidae) from Thailand. Medical Entomology and Zoology, 56: 33-41.

TAMURA, K., STECHER, G., PETERSON, D., FILIPSKI, A. and KUMAR, S. 2013. MEGA6: Molecular Evolutionary Genetics Analysis Version 6.0. Molecular Biology and Evolution, 30: 2725-2729.

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Mosquito Borne Diseases in Ambon Municipality

NINDATU Maria[1] and LEATEMIA J. Audrey[2]

1: Faculty of Medicine, Faculty of Mathematics and Natural Sciences, Pattimura University
2: Faculty of Agriculture, Pattimura University

Abstract

Mosquitoes are very dominant vectors of common diseases in tropical region including Ambon Municipality, Indonesia. Three genera of mosquitoes namely *Anopheles*, *Aedes*, and *Culex* transmitted malaria, dengue fever, and lymphatic filariasis, respectively. Breeding sites of *Anopheles* and *Culex* are usually outdoors in dirty water such as drainage, gutters, and swamps, while that of *Aedes* is indoors in clean water such as flower vase, tubs, and opened water drum. Annual Parasite Incidence (API), which is number of cases per a thousand populations, is used to determine malaria cases in Ambon Municipality. The highest API of 6.54 was in Nusaniwe District in 2012, while that of 5.92 was in Teluk Ambon-Baguala District in 2013. Number of cases of dengue fever increased in the last three years. Since 2011, there are 8 cases of lymphatic filariasis in Ambon Municipality. Methods that are commonly used to control the vectors are source reduction as well as larval and adult controls. Surveillance was generally done by observing only the presence or absence of larvae in their breeding sites. Intensive surveillance in terms of collection and identification of the vectors as well as development of effective control methods are needed.
Keywords: dengue fever, lymphatic filariasis, malaria, mosquitoes

Introduction

Mosquitoes have been one of the most important insect pests in the history of humankind. They are still significant as medical pests today, especially by vectoring organism that cause some diseases. In Ambon Municipality, three genera of mosquitoes namely *Anopheles*, *Culex*, and *Aedes* causes many health problems since they transmit malaria, elephantiasis (lymphatic filariasis), and dengue haemoraggic fever, respectively. Malaria is a diseases caused by unicellular blood-dwelling parasite of genus *Plasmodium*. ARYANTI *et al*. (2006) stated that Eastern Indonesia including Ambon Municipality is the region with heavy malaria distribution. Dengue haemorragic fever is caused by virus carried by several species of mosquitoes, of which *Aedes aegypti* is the main vector. Elephantiasis (lymphatic filariasis) is caused by nematode worms of genus *Filaria* transmitted by several species of mosquitoes including *Culex* spp. and *Anopheles* spp.

Ambon Municipality is an administrative area of 377 km^2 in Ambon Island which is a capital of Maluku Province. Ambon Municipality consists of five districts, namely Nusaniwe, Sirimau, Baguala, Teluk Ambon, and Letimur Selatan with 50 villages and/or *kelurahan*. There are 22 community health centers that spread in these five districts. The total population of Ambon Municipality in 2013 was 379,615 and it has the highest population density in the province by 1,007 people per km^2 (BPS 2014).

Vector

Number of mosquito's species as diseases vectors that had been reported in Indonesia was more than 457 species in 18 genera and dominated by genus *Aedes*, *Anopheles*, and *Culex* that consist of 287 species (SUWITO 2008).

HIZWANI (2004) reported that there were 20 species of *Anopheles* that transmit malaria in Indonesia. Some species of *Anopheles* are also vector of elephantiasis (lymphatic filariasis) (SYAHRIAL *et al*. 2005). Fifteen *Anopheles* species were found in Maluku (WEPSTER and SWELLENGREBEL 1953) where 5 of them were found in Seram, Ambon, and Ternate, i.e., *Anopheles subpictus* in Seram, Ambon, and Ternate, *A. parangensis*, *A. isulaeflorum*, and *A.vagus* only in Seram and Ambon, and *A. orientalis* in Seram, while another 10 species were generally found in Maluku. SUKIRNO (1994) reported about 10 *Anopheles* species found in Halmahera, North Maluku where 4 out of them were vectors of malaria.

Aedes spp. as vectors of dengue haemorragic fever as well as e elephantiasis lephantiasis (lymphatic filariasis) were also found in Ambon. PAGAYA *et al*. (2005) reported that *Aedes aegypti* was found indoors and *A. albopictus* were found outdoors in Waimahu Village, Nusaniwe District, Ambon Municipality.

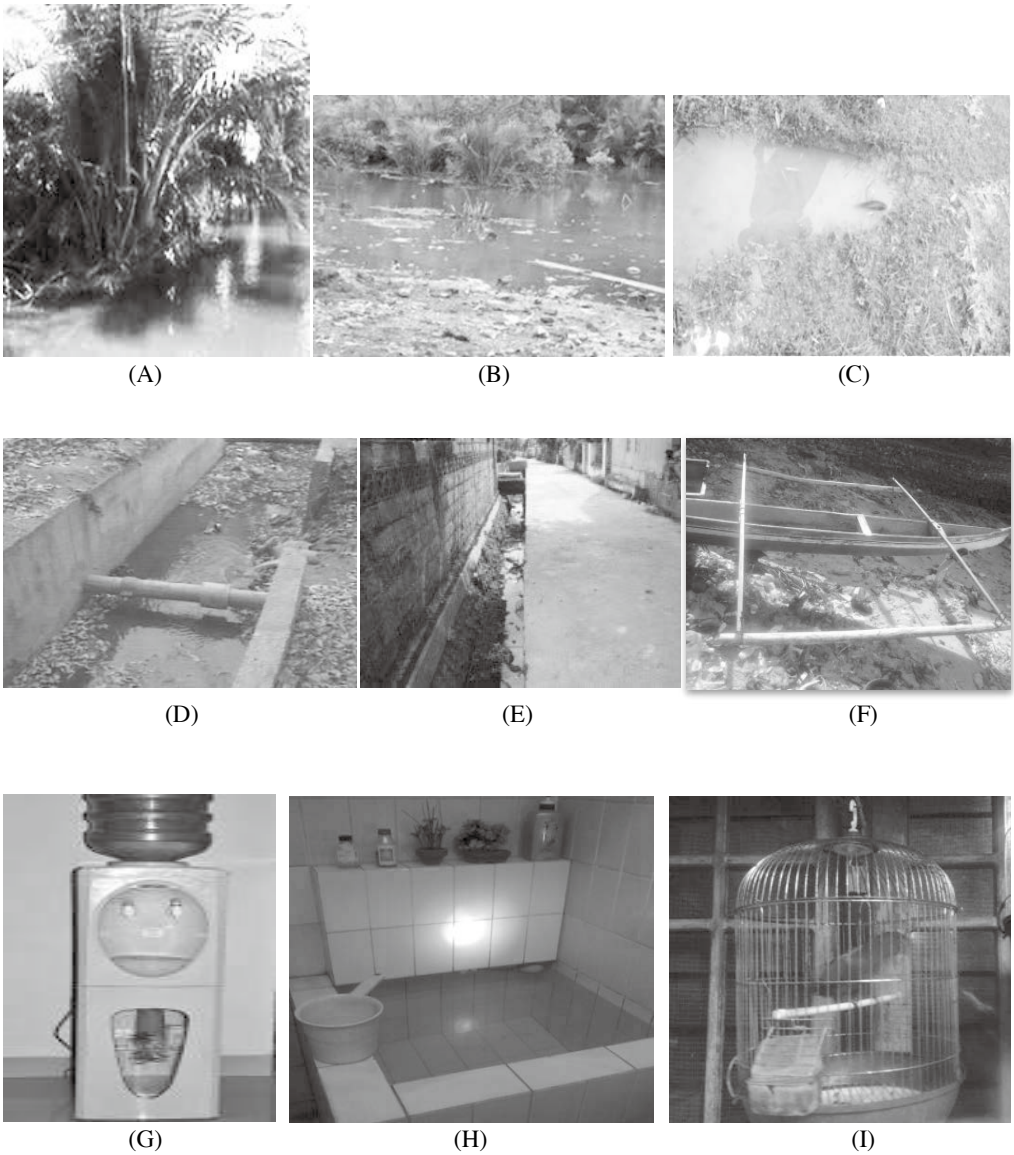
Culex is cosmopolitan genus of mosquitoes especially in warm region. Some species transmit filariasis and encepalitis. In Ambon, larvae of *Culex quinguifasciatus* were often found. Larvae of *Culex* spp. sometimes become a predator of larvae of *Anopheles* spp.

Habitat

Adult mosquitoes are differentiated by their long proboscis and scales along the wings vein. Adults female feed on blood and are responsible for transmitting disease organism. Adult males (and occasionally females) feed on nectar and other plant exudates. The immature (larvae or wrigglers) are found in water, where most consume algae and organic debris (PEDIGO 1998).

Members of genus *Anopheles* lay their eggs singly on the water surface. Most of *Anopheles* larvae were found in dirty slowly running water. Breeding sites of *Anophelidae* family is outdoors in water pool in grasses, swamps, mangrove areas (Fig. 1).

Members of genus *Culex* lay eggs in clusters as rafts on the water surface. In Ambon Municipality, *Culex* larvae were found in outdoor dirty water such as in stagnant water in gutters and fishing boat (Fig. 1) and many stagnant water pools around houses.



(A) (B) (C)

(D) (E) (F)

(G) (H) (I)

Fig. 1. Habitats of mosquitoes; A-C: habitats of *Anopheles* spp., D-F: habitats of *Culex* spp., and G-I: habitats of *Aedes* spp.

Members of *Aedes* lay eggs in depressions, along high water lines and in almost any container of rain water. These eggs lie dormant until flooded with water, after which they hatch and wrigglers develop in the flooded area (PEDIGO 1998). PAGAYA *et al*. (2005) reported that breeding sites of *Aedes* larvae were found both indoors and outdoors. Larvae of *A. aegypti* were found in indoor clean water in water container such as in water dispenser, bathroom, fresh water vase as well as in birdcage (Fig. 1). While *A.albopictus* larvae were found outdoors in tree holes, banana stem, open coconut shell, and any used container containing water.

Diseases Conditions

Malaria

Health Research and Development Institute, Indonesian Ministry of Health stated that prevalence of malaria in Indonesia was 417,819 positive cases in 2012 and 70% was in Eastern Indonesia including Maluku. Malaria is a dominant disease among the community in Ambon Municipality and is measured using Annual Parasite Incidence (API) which is number of positive cases of a thousand risk populations (DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2012, 2013). In general, average API in Ambon Municipality decreased from 4.49 in 2012 to 4.15 in 2013 (Table 1), but there were increasing of API in two out of five districts, i.e., Teluk Ambon Baguala and Letimur Selatan (Fig. 2). Besides that, all of API in five districts of Ambon Municipality in 2013 are still consider high since an indicator that a region is free of malaria if it has an API below 1.00 per a thousand population and there is no malaria cases in local population for three years in a row (Table 1).

Table 1. Number of malaria prevalence in Ambon Municipality in last two years.

No.	District	Number of community health center	2012				2013			
			Total population	Positive case		API	Total population	Positive case		API
				Male	Female			Male	Female	
1	Nusaniwe	6	100,307	168	167	3.34	103,423	171	159	3.19
2	Sirimau	8	156,337	542	480	6.54	162,263	404	392	4.91
3	Baguala	4	59,685	107	116	3.74	62,347	191	178	5.92
4	Teluk Ambon Baguala	2	42,918	40	31	1.65	44,618	49	19	1.52
5	Letimur Selatan	2	10,493	6	3	0.86	10,135	14	11	2.47
	Total	22	369,740	863	797		382,786	829	759	
	Average					4.49				4.15

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2012, 2013).

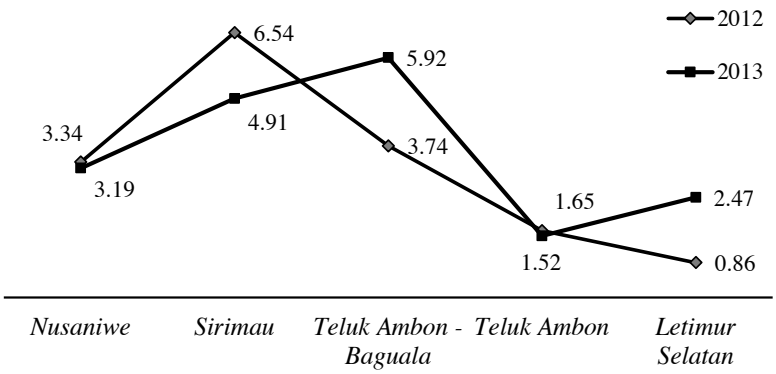


Fig. 2. Annual Parasite Incidences (API) in five districts of Ambon Municipality in the last two years.

Table 2. *Plasmodium* species causing malaria in Ambon Municipality in the last two years.

No.	Species	2012 (%)	2013 (%)
1	*Plasmodium vivax*	99.4	98.7
2	*Plasmodium falciparum*	0.4	0.9
3	*Plasmodium malariae*	0.0	0.2
4	*Plasmodium ovale*	0.0	0.0
5	Mix	0.2	0.2

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2012, 2013).

In Indonesia *Plasmodium* species that cause malaria are *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlensi*. In Ambon Municipality 99% of malaria cases was caused by *P. vivax* both in 2012 and 2013 (Table 2) and *Anopheles subpictus* was the dominant species as major vector of *P. vivax* (DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2013).

The endemic zone of malaria in Eastern Indonesia spread in 84 regencies/municipalities including Ambon Municipality (INDONESIAN MINISTRY OF HEALTH 2013). Efforts to control malaria have been done around the world. World Health Organization (WHO) set a global malaria day on April 25. Declaration "toward malaria-free Indonesia" had been done by Indonesia President on 2008 and publication of the decree of Indonesian Health Ministry no 293/MENKES/SK/IV/2009 dated 28 April 2009 regarding elimination of malaria in Indonesia. Elimination of malaria is expected to be done in Java, Bali, Riau, and Aceh in 2015; in Sumatera, Kalimantan, Sulawesi, and Nusa Tenggara Barat in 2020. Elimination of malaria in Papua Barat, Maluku, Maluku Utara, and Nusa Tenggara Timur are expected to be done in 2030 and at the same time Indonesia is targeted to be malaria-free (INDONESIAN MINISTRY OF HEALTH 2013). Many challenges faced in efforts to eliminate malaria especially in islands including Maluku Province, such as remote areas that are difficult to reach, there is no effective cure as well as resistant to some antimalarial drugs.

Elephantiasis (Lymphatic Filariasis)

There were 8 cases of elephantiasis in Ambon Municipality in 2011 where 4 were chronic patients and 4 were new patients. Most of the patients (87.5%) are in Sirimau District and the rest are in Nusaniwe District. In 2012, there was no new case and in 2013 there was 1 new case in Sirimau District (Table 3).

Dengue Haemoraggic Fever (DHF)

Dengue haemorragic fever incidence in Ambon Municipality increased in the last three years by 19 % and 37%, respectively. Most cases were in Sirimau District, followed by Nusaniwe, Teluk Ambon Baguala, and Leitimur Selatan districts. No incidence was reported in Teluk Ambon District (Table 4).

Table 3. Elephantiasis incidence in Ambon Municipality in the last three years.

District	2011		2012		2013	
	Community health center	Cases	Community health center	Cases	Community health center	Cases
Nusaniwe	Latuhalat	1	-	0	-	0
	Rijali	2	-	0	-	0
Sirimau	Air Besar	4	-	0	Karang Panjang	1
	Ch.M.Tiahahu	1	-	0	-	0
Baguala	-	0	-	0	-	0
Teluk Ambon Baguala	-	0	-	0	-	0
Leitimur Selatan	-	0	-	0	-	0
Total		8	-	0	-	1

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2011, 2012, 2013).

Table 4. Dengue haemorragic fever incidence in Ambon Municipality in the last three years.

No.	District	2011	2012	2013
		Cases	Cases	Cases
1	Nusaniwe	8	5	9
2	Sirimau	6	13	10
3	Baguala	2	0	4
4	Teluk Ambon Baguala	0	0	0
5	Letimur Selatan	0	1	3
Total		16	19	26

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2011, 2012, 2013).

Integrated Approaches to Mosquitoes Control

Mosquitoes management that has been done so far are integrated approaches such as source reduction by elimination of mosquitoes habitats by sanitation of environment, chemical and biological control of larvae and adults, as well as prevention of mosquitoes bites using repellent and mosquitoes net. A program of environmental health, Ministry of Health Ambon Municipality is sources reduction by draining, washing, and burying any water containers and water pools which are habitats of mosquitoes. This program is done by educated community through environmental health extension.

Research toward Vectors Control

Research towards vectors control that had been done so far is general monitoring and surveillance by determining the presence or absence of larvae in their habitats. Development of botanical insecticide as larvicide of *Culex* spp. and *Aedes* spp. by bioassay of crude seed extract of *Barringtonia asiatica* (Lecythidaceae) (PAGAYA *et al*. 2009, PELAMONIA *et al*. 2009).

Future research need to be done on intensive monitoring and surveillance by collection and identification of vectors, efficacy of botanical insecticide (plant extracts) on larval in their habitats as well as genetic control of the vectors.

References

ARYANTI, B. M., EMAYANTI, T. M., PRINADI, I. K. and DEWI, R. M. 2006. Test of Antimalarial of *Artemisia* sp. against *Plasmodium falciparum*. Indonesian Journal of Pharmacy, 17(2): 81-84 (in Indonesian).

BPS 2014. *Kota Ambon dalam Angka* [Ambon in Figures], 406 pp., Badan Pusat Statistik, Ambon, Maluku, Indonesia (in Indonesian).

DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2011. Annual Report of Transmittable Diseases in Ambon Municipality in 2011, 28 pp., Department of Health of Ambon Municipality, Ambon, Maluku, Indonesia (in Indonesian).

DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2012. Annual Report of Transmittable Diseases in Ambon Municipality in 2012, 27 pp., Department of Health of Ambon Municipality, Ambon, Maluku, Indonesia (in Indonesian).

DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2013. Annual Report of Transmittable Diseases in Ambon Municipality in 2013, 30 pp., Department of Health of Ambon Municipality, Ambon, Maluku, Indonesia (in Indonesian).

INDONESIAN MINISTRY OF HEALTH 2013. Malaria Cases in Indonesia is Still High. Retrieved 11 November, 2014, from http://www.voaindonesia.com/content/kasus-malaria-di-indonesia-masih-tinggi/1648507.html.

PAGAYA, J., KAIHENA, M. and NINDATU, M. 2005. Survey of Breeding Sites and Analysis of Density of *Aedes* Mosquitoes at Waimahu Village, Nusaniwe District, Ambon City. Indonesian Journal of Tropical Medicine, 16 (3): 51-62 (in Indonesian).

PAGAYA, J., KAIHENA, M. and NINDATU, M. 2009. Biolarvicidal Effect of Hutun (*Barringtonia asiatric*) Seed Extract against the Mortality of Mosquito Larvae *Culex* spp. Indonesian Journal of Tropical Medicine, 20(2): 56-68 (in Indonesian).

PEDIGO, L. P. 1998. Entomology and Pest Management. Third Edition, 688 pp., Prentice Hall, New Jersey, USA.

PELAMONIA, J., RUPILU, N., WATUGULY, T. and NINDATU, M. 2009. Bioinsecticide Effect of Ethanol Extract of Hutun (*Barringtonia asiatica*) Seeds against *Anopheles maculatus* (Diptera: Anophelidae). Molluca Medica Jurnal, 2(1): 73-81 (In Indonesian).

SUKIRNO, M. 1994. Anopheles Fauna with Status, Transmission Pattern and Endemicity of Malaria in Halmahera (Maluku Utara), Especially in Transmigration and Industrial Areas. Papers presented at one day seminar: "Some Problems of Parasite Diseases on Human and Animal in Indonesia", Surabaya, 20 December, 1994 (In Indonesian).

SUWITO, A. 2008. The Mosquito (Diptera: Culicidae) of Boganinani Wartabone National Park, North Sulawesi: Diversity, Status and Habitat. Zoo Indonesia, 17(1): 27-34 (in Indonesian with English Summary).

SYAHRIAL, Z., MARTINI, S., YUDHASTUTI, R. and HASAN HUDA, A. 2005. The Adult Mosquito Population in Endemic Areas of Filariasis Study in Empat Village, Simpang Empat District, Bnjar Regency in 2004. Journal of Environmental Health, 2(1): 85-96.

WEPSTER, J. B. and SWELLENGREBEL, N. H. 1953. The Anopheline Mosquito of The Indo-Australian Region, 504 pp., De Bussy, Amsterdam, Netherlands.

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Insularity in the Literary Imagination of SHIMAO Toshio

UDO Satoshi

Faculty of Law, Economics and Humanities, Kagoshima University

Abstract

One of the most original authors in post-war Japanese literature, SHIMAO Toshio (1917-1986) is known not only for his military career (he was an officer on a 'suicide boat' at the end of the WWII) but also for his insightful ideas regarding the Japanese archipelago, which he named '*Japonesia*' in the 1960s. His idea, which was to situate Japan on the edge of the chained islands loosely extending from Polynesia via Indonesia, the Philippines, and Taiwan, is now recognized as essential to East Asian cross-border area studies. However, the question of how 'archipelagianess' functions in SHIMAO's literary writings has not been studied satisfactorily in the current body of literature. In my paper, I try to identify some insular imagery in his novels and further discuss the metaphors and meanings that the imagery suggests to the reader.

Keywords: insularity, islandology, Japanese literature, SHIMAO Toshio

A radical overhaul of Japanese literature began soon after WWII. In the latter half of the 1940s, a number of young authors began to publish their works: these successive groups of writers are called 'the first post-war school' and 'the second post-war school'. The latter is especially known for its European-style novels, which won high appreciation abroad; this group includes the writers MISHIMA Yukio and ABE Kôbô. SHIMAO Toshio is sometimes considered as one of these post-war authors, although he is often also regarded as an important figure of the following generation, called 'the third freshmen, who became prominent in the first half of the 1950s. The lightness of this name implies the tendency of these authors to describe their daily lives and personal stories without revealing an explicit political consciousness. However, their literary freshness has gradually won popularity and high regard, and they are now recognized as among the most important authors in modern Japanese literature.

SHIMAO Toshio was born in Yokohama and grew up in Kôbe and Nagasaki. In 1944, having graduated from Kyûshû Imperial University, he was immediately drafted into the navy as a 'student on a torpedo boat' — that is, a naval bomb boat. After a short period of training, he was sent to Amami archipelago in the Kagoshima Prefecture as an officer in a naval suicide-attack squadron. On a small island called Kakeroma, he received an order to prepare

himself for departure, but he was never given the final order to attack. The war ended, and, miraculously, he survived. These wartime experiences later became major themes in his literary works.

After the war, SHIMAO married a woman whom he had met on the island and returned to mainland Japan. Shortly thereafter, he began to publish his auto-fictive short stories. In 1954, his wife, Miho, became mentally ill, another event which became a major preoccupation in SHIMAO's writings. In 1955, SHIMAO moved with his family to the island of Amami-Oshima, where he lived for around twenty years.

During the time he spent in the Amami archipelago, SHIMAO developed a new vision of Japan as part of the long archipelago which leads to Taiwan through the Amami and Ryukyu islands. He named it '*Japonesia*', situating the Japanese archipelago on the edge of the chained islands extending loosely from Polynesia through Indonesia. The idea to decentralize Japan and to deconstruct its uniformity has been re-evaluated extensively, especially since the 1990s, in the East Asian cross-border area studies. However, how 'archipelagianess' or 'islandness' works in SHIMAO's literary writings has received very little attention.

The common characteristics of all of SHIMAO's auto-fictions on his wartime experiences is the protagonist's conviction that he is doomed and destined for an imminent death as a result of the suicide attack he will be ordered to commit. He only lives while the death order is suspended.

As the title of the short story *Shima no Hate* (The Farthest Edge of the Islands) suggests, Kakeroma Island, where the protagonist was sent at the end of the war, is conceived of as the edge of his world, the edge of his imagination. Situated just next to Amami-Oshima Island, Kakeroma Island is not really a lonely island: however, the protagonist does feel lonely and separated from the rest of the world. Beyond this edge, only death awaits him. SHIMAO's last novel, *Gyoraitei Gakusei* (A Student on the Torpedo Boat), describes his gradual journey towards the actual southern edge of the Japanese Empire: the protagonist is trained first in Yokosuka, then in Nagasaki, and finally sent to Amami archipelago. This approach to the edge implies also his approach towards the death (Fig. 1).

As the protagonist arrives at the edge, the island becomes a place which paralyses his sense of being alive. It is described as an isolated, closed space with a complicated contour. A typical example of such a description is already found in one of SHIMAO's earliest stories, *Shutsu-kotô-ki* (A Tale of Leaving a Lonely Island, 1949).

As the title indicates, the place is a 'lonely island', which means that the protagonist and his squadron can neither move ahead nor turn back. They are trapped and have a limited supply of food, so they have to cultivate food to eat. They continue to live a peculiar daily life, eating and excreting, able to determine nothing by themselves. Here they remain, waiting for the order to attack, the moment of their death. Their condition of being is in every sense absurd. The narrator keeps expressing his anxiety and apathy:

I'm now a soldier! How is this incompatible!? What could I know about this war? My will was lost, my hands got dirty, I was running down on an inclination. (...) Blown off by the bloody starvation from the south, I was destined to jump off, not only by myself but also leading 48 suicide boats, the cliff of the frozen sea beyond the world.

(SHIMAO 1992, p.138)

We have finally come to this point only to wait for the order to depart.

Strangely, I have lost my ability to persist in this world. The minute-by-minute delay planted in me a seed of impatience. It was painful to retain, constantly, the mental readiness to immediately depart. Now is the chance. Now is the best time. If it is now, I can go out without hesitation.

(*Ibid*., p.176)

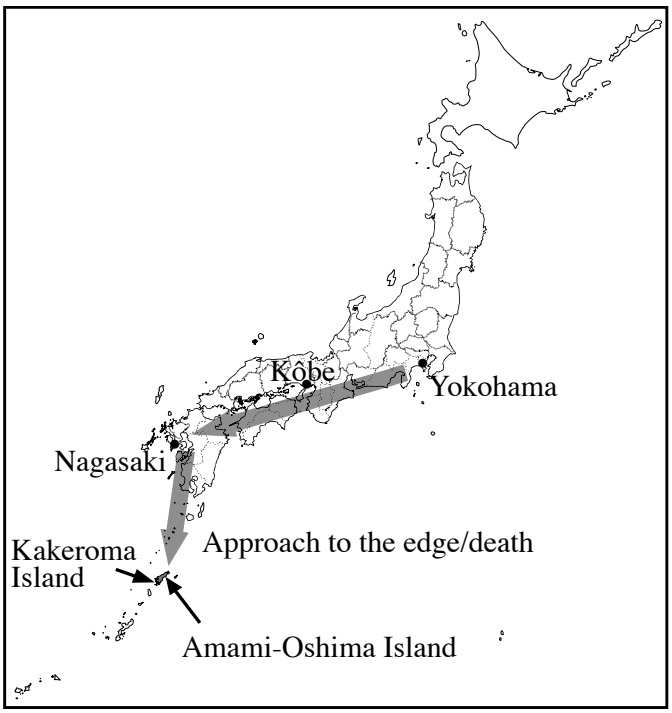


Fig. 1. *Gyoraitei Gakusei* (A Student on the Torpedo Boat) describing his gradual journey towards the actual southern edge of the Japanese Empire, which implies also his approach towards the death.

The scenery repeatedly described in the story is the inlet of the island, called '*Nomino-ura*'. In this hidden, enclosed space, the protagonist prepares his suicide boat squadron, using the cliff and its caves to conceal the boats. The protagonist often wanders along the inlet and the cape, observing the tide coming in and going out. The eventless days and nights begin to wear on his nerves, and he is continually perplexed by the loss of his will to live. At last, he receives the order to prepare for attack, but the story ends without him receiving the final order. The main theme, the eternal delay of a nevertheless impending death, is metaphorically represented by the repeated, cyclic nature of his natural surroundings in the inlet.

I close this short paper with a quotation related to the inlet, which indicates a presentiment of rebirth.

> In the freshness of the dawn, every inch of my body was liberated, flexible, absorbed in the enthralling relief that my fulfilled flesh still belonged to myself.
>
> It is probably that our action will be delayed while the sun shines.
>
> Then, the morning came naturally in the inlet, and its fresh impression soon, along with the sunrise, began to repeat its daytime routine.
>
> Nothing happened.
>
> (*Ibid.*, pp.186-7)

References

SHIMAO, T. 1992. Shimao Toshio (Chikuma Nihon Bungaku Zenshû 32), 477 pp., Chikuma-Shobô, Tokyo, Japan (in Japanese).

SHIMAO, T. 2011. *Gyoraitei Gakusei* [A Student on the Torpedo Boat], 205 pp., Shinchô-Sha, Tokyo, Japan (in Japanese).

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Territorial Organization by Bupolo People in Buru Island

PATTINAMA Marcus Jozef

Faculty of Agriculture, Pattimura University

Abstract

To understand Bupolo people in Buru Island, I should start from how I understand the way they divide their life space in association with the environment, namely by understanding the territorial organization of the Bupolo. This understanding will then give a good direction to the understanding of their social organization. Complex division of space in Bupolo people's lives is something interesting to study. Ethnobotany approach is one of the most suitable methods to be used to describe to complexity. This paper attempts to describe how the Bupolo people in Buru Island, Maluku Province, organize their territory and life spaces.

Keywords: Bupolo, Buru Island, territorial organization, ethnobotany

Introduction

Buru Island is known for being the place of internment of communist prisoners after the establishment of the President Suharto political regime, the "New Order", following the fall of President Soekarno. Buru is the island that is known to produce the essence oil of kayu putih from the "white tree" (*Melaleuca leucadendron*, Myrtaceae).

This island is in the southwest of the Moluccas, where its coastal regions are considered unwelcoming and dry. People living in the mountains of Buru Island make the essence oil of kayu putih and go to sell it on the coast. They avoid contact with the outside world and were always on the move and rarely stay in their homes.

Between 1969 (the year of the arrival of political prisoners) and 1979 (the year of their liberation), the entrance to the island was tightly controlled by the military and no research was allowed. People from the outside only knew that the prisoners were housed in a plain, north-east part of the island, where they had to work in irrigated rice fields and gardens which they had to do to make a living. In addition, in the northern part of the region the military developed a system of forced labor to exploit the forest, where many prisoners died. In the 1980s, military elements established a plywood factory and opened private forest concessions in the southern part of the region.

After the liberation of prisoners and the opening of the island to the outsiders, the civil administration began to have interest in the island and its inhabitants. Thus, at the end of 1980s, a settlement project in order to facilitate their participation in the overall development of Indonesia was launched. The objective of this project was to bring these people to reside permanently in the villages for easy access by the officials. Thus, dozens of settlement areas consisting of wooden houses with thin iron roofs were built on the coast.

In this paper, I discuss the description of Geba Bupolo community, especially on their territorial relationships. After describing about the general lifestyle of Geba Bupolo and some information about their language as an introduction, I begin this description with the ideas about the origin of the island and its people by constructing the story of some fragments of myths that I have collected. Then, I will explain the conception of how Geba Bupolo is being in their island and how it represents it as the body of a human being that is necessary to protect its center that contains the vital parts. I will next embark on how to organize the island's territories by assigning each social group a role in protecting the central part of the island where Mount Date and Lake Rana Waekolo are located. I will elucidate how this central part is designed as 'a dwelling' place. I address the structuring of different lineage groups, *noro*, and sub-groups, *bialahin,* which development is analogous to the development of a sago (*Metroxylon sagu*) cluster, where the suckers get nourishment from the main trunk and then are released. The *bialahin* term is indeed the term appellation of sago. I will explain how each *noro* has its place in the territory; it consists of the catchment area of a river and the mountain that is its origin and corresponds to the origin of its first ancestors.

Buru Island in the Moluccas, Indonesia

Indonesia is located in the tropics and is very rich in natural resources. Despite the cultures and languages of the people composing this country, the feeling of unity is generally strong despite some regional exceptions. There are about 530 languages and dialects in Indonesia. To overcome this linguistic multiplicity the government decided since independence to impose a single language: Indonesian. The language chosen by the anti-colonial opposition since 1928 is derived from the Malay lingua long used in the archipelago. Although Indonesia was a Dutch colony for centuries, the Dutch as a language is not, and has never been used in the daily lives of Indonesians. However, English is now of great importance in technical and scientific language.

The Maluku archipelago or the Mollucas is located in eastern Indonesia. According to the administrative division, it is divided into two provinces since 1999, i.e. North Maluku with Ternate as the capital city and Maluku with Ambon the capital city. The Maluku archipelago has the distinction of being made up of about a thousand islands whose layout is

reminiscent of Indonesia on a reduced scale. This is why this archipelago is also called “the thousand islands”.

Hundreds of islands of this archipelago remain anonymous. The population of 1,533,506 inhabitants is essentially distributed in the principal islands and archipelagos: Ambon, Ambon Lease, Seram, Banda, Wetar, Tanimbar, Kei, Aru, and Buru.

In floristic point of view, Maluku is one of the region where limited research has been done, so that accurate data is still lacking. This area has a high geographical diversity that affects the variation of the vegetation (PATTINAMA 1998).

We have little information about the colonial period of Buru Island. Clove and nutmeg were absent in this island, that the Dutch had little interests in this island. On the other hand, there is the kayu putih in the island, so inhabitants have extracted its aromatic essential oil (PATTINAMA 1998).

The surface area of the island of Buru is about 10,000 km^2, and has 135,500 inhabitants. In the south and west, it is bordered with the Banda Sea; and the north by the Seram Sea. Administratively the island of Buru has, since 1999, two districts (*kabupaten* in Indonesian), i.e. the District of Buru with Namlea as the capital city and is divided into five regencies or *kecamatan*, and the District of South Buru Namrole as the capital city and is divided into five regencies.

Methods and Approaches

This study is based on field research for two years. The initial phase of this research started to learn the local language, the language of Buru, to understand all the expressions and symbols in their lives.

My efforts to learn the local language helped me to get accepted as a researcher by local people. In fact, due to the lack of schools, many mountaineers only speak the local language. In addition, the knowledge of the language was essential to me to fully grasp their conceptions about how the world is. However, for sometimes they remained reluctant to provide me with information about everything, they seemed to keep secrets and not disclose them to a stranger, especially anything related to their relationship to the ancestors. I must add that even among themselves mountaineers often use metaphorical language to talk about what is most sacred.

My first concern was to understand the organization of space according to the topography, hydrography, and distribution of ecosystem. Then, I analyzed the relationship between the visually perceptible organization with the use and exploitation of land resources and their distribution among different social groups. For that I had to study the organization of the territory as a function of social organization. My intention was interested in it to the extent

of its relationship with the rights to use, the different forms of management and land exploitation, and vis-à-vis sacred places.

General Information on the Human Environment

Among the inhabitants of the island of Buru, I must distinguish the native (*autochtone*) population lives mainly in the mountains, and a non-native (*allochtone*) population who are now most numerous, and live on the coast and coastal plains.

The *allochtone* population has several origins. Some people of foreign origin has been there for a long time. They are descendants of Arab and Chinese traders who mostly stayed in Buru for centuries and married there. The other non-native people are from more recent immigrations.

The coasts of Buru island, like those of other islands in the Indonesian archipelago, are not regularly monitored by national marine guards, because Indonesia is composed of many thousand islands spread over 5,000 km. Buru has been the subject of a spontaneous transmigration more or less regularly of mostly poor people coming from elsewhere of the country in the hope of improving their life.

Since the 1980s an official transmigration was organized by the government. Also, as was mentioned in the introduction, after 1965 and the fall of President Soekarno, the island was chosen as a place of banishment for communist prisoners, many of whom chose to stay there after liberation. It is especially in the northeastern part of the island that Javanese transmigrants were settled under the national transmigration program. In this region, new roads, as well as public transport have been developed.

In general, the development in this island is very slow because all decisions are taken without consultation by the central government. These decisions do not take sufficient account of the island's capacity to contribute to national income from its natural resources.

While the *autochtone* population, as I have just described, will call themselves Geba Bupolo, they have been named with various terms by the colonial and Indonesian administrations or administration of the Maluku Province (PATTINAMA 2005), described as follows:

- Alifuru, that is to say, the people living in the dense forest. The word Alifuru comes from the language of the northern Halmahera: *halefoeroe*, that is to say "place in the dense forest". The North Halmahera people, including Tobelo people, often speak of « *o halefoeroeka ma nyawa* » that is to say, people from the forest. The word Alifuru was also used for indigenous people living in the island of Seram.

- Orang Kafir (*orang* = people, *kafir* = infidel) that is to refer to people who do not belong to one of the great religions.
- Suku Terasing (*suku* = people, *terasing* = isolated) that is to refer to the "isolated people", term used by the Departemen Sosial (Social Department) to refer to all isolated groups who continue to practice their local customs.
- Orang Pemalas (*pemalas* = lazy) that is to say "lazy people".
- Orang Belakang (*belakang* = back) that is to say, "backward".

All these expressions indicate the determination of Bupolo Geba to stay in their mountains and their refusal to participate in government programs, as long the government has not talked to them about the programs.

When I asked them the reason for their reluctance, they said that they live in this island with their ancestors and that if they did not faithful, one day the ancestors will be angry and send the disease and death. "Always be faithful to them". "We do not want to leave our villages because we have our gardens and protected places where our ancestors have lived". But the government wanted them to move to the coasts and forced them to choose one of the major religions. Indeed in Indonesia during the General Suharto (Orde Baru, 'the new order'), people were forced to convert to one of five religions: Islam, Catholicism, Protestantism, Hinduism, and Buddhism.

The Territorial Organization in Relation to the Social Organization

The conception of Geba Bupolo to their island

Most of the Geba Bupolo's conception of how the world is in their representation of Buru island, is like a bisexual human being, lying, with the central bodies - sexual organ of male, stomach and uterus of female – consisting of Mount Date as the male essence and Lake Rana Waekolo as the female essence.

All this reflects the image of the island as a living being (see Fig. 1), with the head (*olon*) representing the highest mountain in the west (*kakupalatmada*), spine (*kakunrohin*) representing the peaks covered by the sacred Garan forest, left foot (*kadanwana*) on the side of the coastal plain in the northeast (*waeyapo*) and the right foot (*kadanbali*) on the side of mount Batakbual in the southeast. The arms on each side, with the left hand (*fahanwana*) on the north coast (Waenibe river) and right hand (*fahanbali*) on the south coast (Waemala river). In the middle, the abdoment (*fukan*) with Mount Date represented by a male organ and Lake Rana Waekolo in its center represented by the belly containing both the bowels and uterus (female organ). This is the central part that the Geba Bupolo are responsible to preserve and protect from external attacks. This central area is irrigated by rivers flowing into the lake

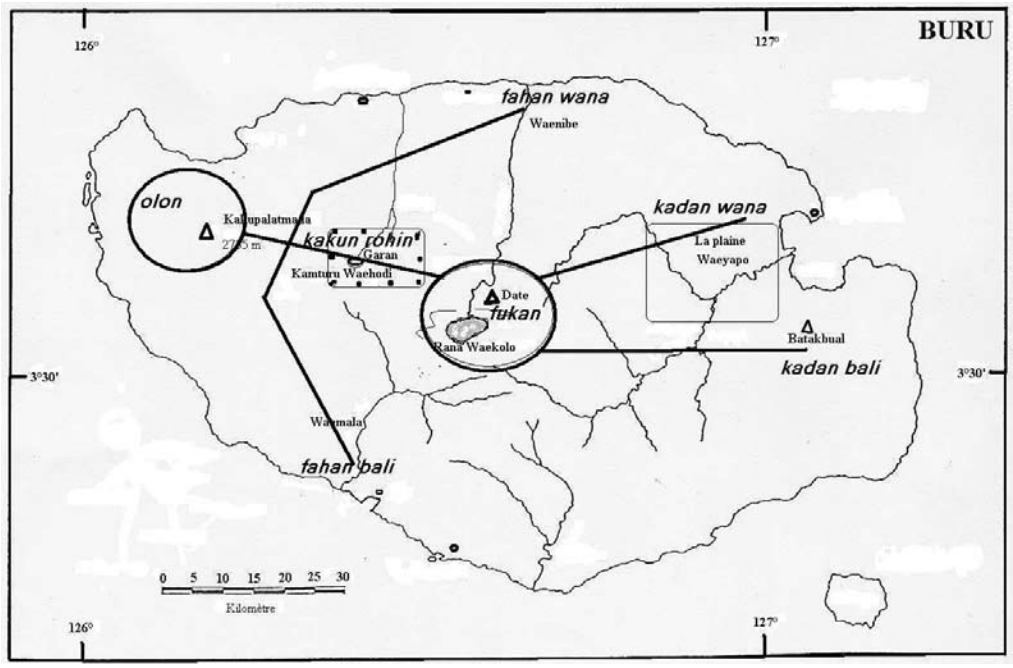


Fig. 1. The conception of the island of Buru according to Geba Bupolo.

Rana Waekolo and the water flows into Waenibe river which further flows to the north coast, as represented by the side of the left arm (PATTINAMA 2005).

In this expression are synthetically gathered several concepts and essential elements in the lives of Geba Bupolo. Some of which are presented here: the daily staple food that is made from sago starch and also cassava, ritual staple food, rice and millet, the elements of the reproduction of human beings, attention to wear in the sense of fluid flow.

The division of Buru island between two *fena*

According to the Geba Bupolo and as indicated by their myth, their dispersion started from *fenafafan*, the main village on Lake Rana Waekolo. *Fena* refers to both the group of inhabitants and the territory they occupy. It corresponds to different levels of territorial organization. *Fafan* means "superior", "first" or "flank". A first partition is made between two *fenas* who do not have the same importance geographically and each corresponds to a part of the body, according to the representation that the Geba Bupolo perceives about their island. The two *fenas* are *fena* Lisaboli Lisela and *fena* Masa Meserete.

The *fena* Lisaboli Lisela in the north is dominated by Mount Kakupalatmada (head), and in the center are Mount Date (males) and Lake Rana Waekolo (females). The Waenibe River (left arm), the sacred Garan forest (spine) and Waeyapo plain (left foot). The Geba Bupolo of

fena Lisaboli Lisela whose role is very important to protect the center from the external influence is considered as cadets.

The *fena* Masa Meserete, in the south, includes Mount Batakbual (right foot) and Waemala river (right arm). The Geba Bupolo of this *fena* is considered to be an elder brother.

Each *fena* possesses two *Matguguls* initially installed in the center. The term *Matgugul* is a contraction of *matlea* "head" and *gugul* "sit". This term, as we have seen, was used at the time of the Sultanate of Ternate. Indonesian calls the *Matgugul* of the Geba Bupolo as the "king of the land".

Two *Matguguls* of *fena* Masa Meserete left the center to go to the south coast and embrace the Protestant religion. The Dutch designated them as Raja Masarete.

The word Lisaboli consists of two words: *lisa* which is the name of *Terminalia* sp. tree, and *boli* "surround". Therefore, 'Lisaboli' literally means "surrounded by *Terminalia* sp. trees". The word Lisela, in my opinion, is an abbreviation of two words *lisa* and *ela*. *Lisa* "*Terminalia* sp." and *ela* means "try". It is difficult to know exactly why the *fena* facing the north use that name. It can be seen that *Terminalia* sp. trees are numerous on the hills around the lake. In addition, the different stages of the cycle of traditional agricultural practices are fixed according to the observation of the phenological stages of this tree, i.e. the fall and regrowth of the leaves, and the appearance and color of the latter stage.

The Geba Bupolo considers *fena* as a shared house with three parts: the room (*humalalen*), the entrance hall (*humanelan*), and the door (*sufen*).

For *fena* Masa Meserete in the south, the terms that designates this *fena* consists of *masa* "mature", the abbreviation of *mese* "*Artocarpus indicus*" tree and *farete* "superior". For the Geba Bupolo, *Artocarpus indicus* is a tree linked to the mythical story of the spillway of Lake Rana Waekolo to the Waenibe river which flows to the north. The water could get in that direction because a woman ancestor, who lived in Fenafafan, cut a trunk of *Artocarpus indicus* in the spillway area. The Geba Bupolo says when looking at the topography, the north shore of the lake is surrounded by high mountains, especially Mount Date, but not on the south shore, and therefore the water should flow to the south. The lake water in fact flew to the north and south is that the members of the Geba Bupolo went to *fena* Masa Meserete.

From their perspective, the relationship with the living world corresponds the horizontal links, meanwhile the relationship with the ancestors corresponds the vertical link (BARRAUD and FRIEDBERG 1996). For Geba Bupolo, in the center for horizontal links are marriages, in which negotiations and ceremonies are conducted during agricultural activities that may involve lineage subgroups (*bialahin*) spouses.

Each nuclear family has its own home. The houses are grouped into three to five, in hamlets, *humalolin*, which are formed by the members of a lineage subgroup (*bialahin*). It is noted that this notion of *bialahin* is used to designate that the lineage subgroups correspond to the way the suckers of sago occur in nature, where a main (the biggest) tree forms several

suckers around it. The hamlet, *humalolin*, consists of three to five equivalent *bialahin* houses, which is, to the eyes of Geba Bupolo, analogous to how a sago cluster develops (PATTINAMA 2005). This tree species grows as a group or cluster or *boliboli*, in Buru language. That is why the Geba Bupolo often use an expression *bialahinmsiandefobabo- liboliotohumalolinmsian* that is to say "a lineage subgroup (*bialahin*) establishes a group in a hamlet (*humalolin*)".

The interesting point is that the characteristics of the sago tree represent Geba Bupolo's life. An informant told me that a traditional chief among the Geba Bupolo takes power after his predecessor disappears but not before. It is like the growth of a sago sucker around the main tree. Fig. 2 illustrates the role of lineage subgroup (*bialahin*) in the Geba Bupolo in a hamlet (*humalolin*) or in a village (*fenalalen*), where *Gebakuasan* or the main tree is labeled "1" and the members, *bialahin*, or the other trees around it are labeled "2", "3", "4", and "5". The *Gebakuasan* considers himself as the main tree "1" and around him there are members of equivalent *bialahin*, as trees "2", "3", "4", and "5" that do not exceed the main tree "1". The tree "2" will be considered as a successor, but it must wait for permission from the tree "1". Based on LOUHENAPESSY (1992), sago like other species of the same family Arecaceae will die, started from the youngest leaves, the petioles become dry and gradually the trunk and the roots will die. In the process of replacing the principal body, it is considered that there is energy transfer from one to the other, like what happen inside the *bialahin* formed by the people.

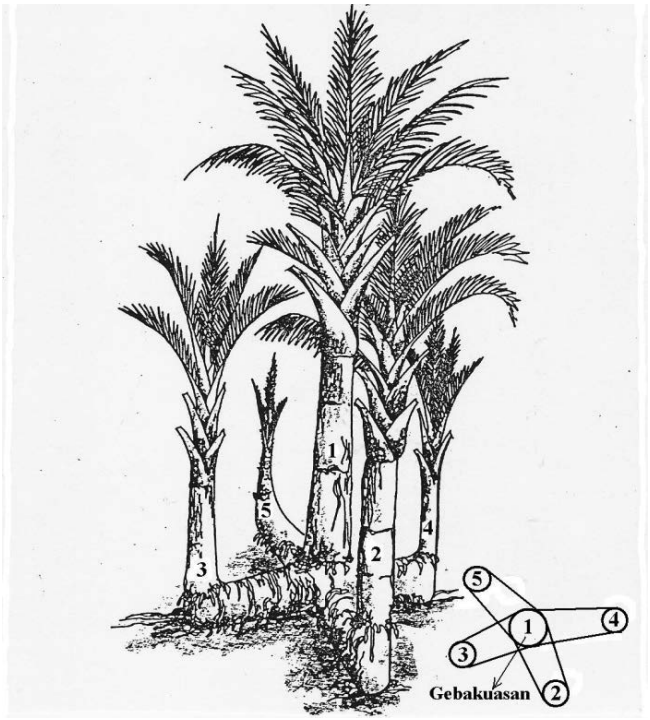


Fig. 2. The bouquet of sago, *bialahin* (*Metroxylon sagu*, Arecaceae)

Conclusion

This research on an Indonesian society describes the Geba Bupolo who live in the island of Buru in the Moluccas. Although the data are limited, however, it can provide an idea of our approach to that society, its place in the world, the relationship between the living and the dead and with the environment in general.

To think about their relationship to the territory, the Geba Bupolo appeals simultaneously to several models. Buru Island is considered to be represented by the body of a human being, with the center of the island, for the Geba Bupolo, represented by both the locations of the organs in the abdomen and the sexual organs. The center of the island is also thought as a dwelling place, in which the most private part where the hosts dwell and produce their children, is the most hidden and therefore the most sacred. In the mind of the Geba Bupolo, being sacred and being secret are associated.

References

BARRAUD, C. and FRIEDBERG, C. 1996. Life-Giving Relationships in Bunaq and Kei Societies. In: For the Sake of Our Future (Sacrificing in Eastern Indonesia) (HOWELL, S. ed.), 374-383, Research School CNWS, Leiden, Netherlands.

LOUHENAPESSY, J. E. 1992. *Sagu di Maluku (Potensi, Kondisi Lahan dan Permasalahannya)* [Sago in Maluku (Potentials, Field Conditions and Problems)]. In: *Prosiding Simposium Sagu Nasional 12-13 Oktober, 1992* [National Sago Symposium, 12-13 October, 1992], 135-149 pp., *Fakultas Pertanian, Universitas Pattimura, Ambon, Indonesia* [Faculty of Agriculture, Pattimura University, Ambon, Indonesia] (in Indonesian).

PATTINAMA, M. J. 1998. *Les Bumi Lale de l'île de Buru Moluques Indonésie: Mode de Subsistanceet Exploitation du Melaleuca leucadendron* [The *Bumi Lale* of Buru Island, Maluku, Indonesia: Subsistence Exploitation Mode of *Melaleuca leucadendron*], 100 pp., *Mémoire de Stage DEA Environnement, Temps, Espaces, Sociétés (ETES) Universitéd' Orléans, Orléans* [Memory of the DEA Internship on the Environment, Time, Space, Society, University of Orléans] (in French).

PATTINAMA, M. J. 2005. *Les Geba Bupoloetleur milieu, Population de l'île de Buru, Moluques, Indonésie. Liwitlalenhafaklalensnafatlahinbutemen "Vannerie virile, sarong féminin et émulsion qui flue"* [The Environment of Geba Bupolo People, the Population Buru Island, Maluku, Indonesia. Liwitlalenhafaklalensnafatlahinbutemen "Basketry masculine, sarong feminine and emulsion that flows"], 354 pp., Doctorate Thesis of Graduate School, the National Museum of Natural History, Paris (in French).

南太平洋海域調査研究報告　No.54（2014年12月）
OCCASIONAL PAPERS　No.54（December 2014）

Other Papers Presented at the Workshop (Abstract Only)

Marine Resources in Maluku

LIMMON Gino V.
Faculty of Fisheries and Marine Science, Pattimura University

Abstract

Maluku is an archipelago province that comprises 92.4% (658.294.69 km^2) of ocean and only 7.5% (54.185 km^2) of land. The unique geographical position of Maluku gives some oceanography advantage that reflected in the richness of marine natural resources, especially in fisheries. The potential of fisheries in Maluku is estimated 1.6 ton/year. Furthermore, the 1340 islands in Maluku that their shoreline represents 13% of Indonesian shoreline harbor main marine ecosystems such as coral reef, mangrove, and sea grass that significantly support the sustainability of fisheries in Maluku. Coral reefs in Maluku cover an area of 1.323,44 km^2 and estimated to have economic value that reach billions of dollars per year, with services including storm protection, tourism, pharmaceutical and an important source of food. However, so far only several commodities such as fish and sea cucumber have been furiously exploited, that leads to overfishing, whereas other invertebrates such as great potential for pharmaceuticals such as sponges and soft coral have been left untouched. Furthermore, the marine resources in Maluku have been exploited disregard of their sustainability. Therefore, comprehensive, integrated and interdisciplinary research involving all stake holders is necessary to build a robust database and development plan that can ensure the sustainability of marine resources in Maluku.

Common Local Fruits in '*Dusun*' System in Leitimur, Ambon Island

REHATTA H. and RAHARJO S. H. T.
Faculty of Agriculture, Pattimura University

Abstract

Ambon Island is a hilly island with limited flat areas that are suitable for medium to large orchards of fruit trees. Fruit cultivations are usually conducted in a mixed agriculture-agroforestry system, called '*dusun*' that is more suitable with such geographic conditions. Fruit trees are among the most important plants grown in the '*dusun*' system in Leitimur, in addition to multipurpose trees, perennial and annual food crops, as well as other horticultural, spice, and medicinal plants. Many local fruit species can be found in the '*dusun*', among others that are most popular in Ambon: durian (*Durio zibethinus*), gandaria (*Boueo mocrophyllo*), mangosteen (*Garcinia mangostana*), snake fruit ("*salak*", *Salacca zalacca*), "*langsat*" (*Lansium domesticum*), jackfruit (*Artocarpus heterophyllus*), and litchi (*Litchi chinensis*). These fruits are described in details in this presentation, and their prospects and problems of cultivation are discussed.

Workshop Organizing Committee:
S. H. T. Raharjo (Head)
J. A. Leatemia (Secretary)
Irma Kesaulya (Finance)

Members:
Rohny S. Maail
Gino V. Limmon
Maria Nindatu
Wardis Girsang
Erin Moniharapon
John M. S. Tetelepta
A. Y. Pattinasarany
Victor O. Lawalata
C. E. Latupeirissa
Audrey Puturuhu
Helena Lesimanuaya
Hatasuci Tuankotta

KAGOSHIMA UNIVERSITY RESEARFCH CENTER
FOR THE PACIFIC ISLANDS
OCCASIONAL PAPERS (BACK NUMBER)

鹿児島大学国際島嶼教育研究センター
南太平洋海域調査研究報告（バックナンバー）

No. 26 The Progress Report of the 1994 Survey of the Research Project, “Man and the Environment in Micronesia” (English)

No. 27 Studies of Nautilus Belauensis in Palau (English)

No. 28 Tropical Fisheries (Japanese)

No. 29 Modern Japan’s “Nanpo Kan’yo” (Participation towards the South) (Japanese)

No. 30 The Progress Report of the 1995 Survey of the Research Project, “Man and the Environment in Micronesia” (English)

No. 31 Invitation to the South Pacific: Selected Lecture Notes from the Kagoshima University Research Center for the South Pacific Public Lecture Series 1994-1997 (Japanese)

No. 32 Foraminifera as Indicators of Marine Environments in the Present and Past (Japanese)

No. 33 Islands and Information Society (Japanese/English)

No. 34 The Progress Report of the 1999 Survey of the Research Project “Social Homeostasis of Small Islands in an Island-Zone” Yap Proper, Micronesia and Islands in Southern Japan (Japanese/English)

No. 35 “The Power of Place” of the Areas at the Boundary between Land and Sea: The Viewpoint from Southern Kyushu and the Southerly Islands (Japanese)

No. 36 Health and Medical Issues in Island Areas (Japanese/English)

No. 37 Researching Eruption Clouds of Volcanic Island Chains (Japanese/English)

No. 38 The Progress Report of the 2000 and 2001 Survey of the Research Project “Social Homeostasis of Small Island in an Island-Zone” Islands in Southern Japan (Japanese/English)

No. 39 The Progress Report of the 2000 and 2001 Survey of the Research Project “Social Homeostasis of Small Island in an Island-Zone” Yap Proper and Ulithi Atoll, Micronesia (English)

No. 40 Institutions in the Making: An Interdisciplinary Study on Social Life and Economy of the Philippine Local (Japanese)

No. 41 “Symbiosis” of Human Being and Nature in the South Pacific Islands (English)

No. 42 The Progress Report of the 2002-2004 Survey of the Research Project “Social Homeostasis of Small Island in an Island-Zone”: Interdisciplinary Approach to Satsunan Islands Focussing on Yoron Island (Japanese/English)

No. 43 Islam in Contemporary Southeast Asia (Japanese)

No. 44 The Future of Shimauta (Japanese)

No. 45 Innovation of Education in Remote Islands to Affect a Request of the Present Age (Japanese)

No. 46 A Research Project for Sensor Zone Setting on Kagoshima Chain Islands from South to North for Cultural & Environmental Transition (Japanese)

No. 47 Global Warming and Pacific Islands (English/Japanese)

No. 48 Climate Changes and Globalization: Environment and People’s Life in the Pacific Islands (English)

No. 49 Strategy on the Asian-Pacific Islands and Kagoshima: Center-Periphery, Interdisciplinary and International Contribution (Japanese)

No. 50 Re-Opening as “The Center for Island Studies Education and Research”, Symposium: “Nesia empowerment” Developing Island Futures (Japanese/English)

No. 51 Interdisciplinary Research in the Small Islands, Subtropical Zone (Japanese)

No. 52 The Development towards Affluent and Homeostatic Kagoshima Islands (Japanese)

No. 53 Research on the Influence of Globalization and Global Warming on Life in Chuuk Atoll (English)

鹿児島大学国際島嶼教育研究センター
南太平洋海域調査研究報告　No.54（2014）

KAGOSHIMA UNIVERSITY RESEARCH CENTER
FOR THE PACIFIC ISLANDS
OCCASIONAL PAPERS No.54（2014）

鹿児島大学国際島嶼教育研究センター
南太平洋海域調査研究報告 No.54(2014)

PUBLISHED BY
KAGOSHIMA UNIVERSITY RESEARCH CENTER
FOR THE PACIFIC ISLANDS
Korimoto 1-21-24, Kagoshima 890-8580, Japan
Tel. : +81-99-285-7394
Fax. : +81-99-285-6197
E-mail : shimaken@cpi.kagoshima-u.ac.jp
December 31, 2014
www http://cpi.kagoshima-u.ac.jp/index-j.html

鹿児島大学国際島嶼教育研究センター
郵便番号　890-8580
鹿児島市郡元一丁目21番24号
電　　話　099(285)7394
ファックス　099(285)6197
平成26年12月31日発行