Resources Program

KUBOTA Jumpei | Program Director

The Resources Program examines global environmental issues related to the use and conservation of natural resources. Human beings have always made use of and changed the environments in which they live. Such change occurs as people appraise the qualities of the plants, animals, waters and soils that surround them, and develop the tools that allow them to make use of their surroundings. Perception and use of resources is therefore related to the individual or society's immediate needs for survival and their knowledge of the natural world. Resource use is also guided by cultural preferences originating from individual tastes and belief systems, as well as societal preferences resulting from a peoples' collective sense of its place and role within the larger world.

Human innovation in the natural world has led to the domestication of plants and animals and the control of water and energy. Paradoxically, humanity's great advances in environmental knowledge and resource control have led to environmental problems of unprecedented scale. Overall, humanity appears to be consuming many resources and taxing many ecosystems at a pace beyond their capacity of renewal or absorption.

Excessive resource use cannot simply be explained as a result of population or economic growth. Instead we must look to the roots of the interactions between humanity and nature. Identifying solutions to contemporary resource problems requires close attention to specific human-environmental interactions, for there are great disparities between and within individual societies that prevent equal access to the benefits of local and global environments. Projects in the Resources Program examine how human livelihoods are directly affected by natural resources and seek solutions that will positively affect communities and the global environment.

Completed Research	Leader	Title
R-03	KUBOTA Jumpei	Historical Interactions between Multi-Cultural Societies and the Natural Environment in a Semi-Arid Region in Central Eurasia
R-04	MOJI Kazuhiko	Environmental Change and Infectious Disease in Tropical Asia
Full Research	**Leader**	**Title**
R-05	NAWATA Hiroshi	A Study of Human Subsistence Ecosystems in Arab Societies
R-06	KADA Ryohei	Managing Environmental Risks to Food and Health Security in Asian Watersheds
R-07	TANAKA Ueru	Desertification and Livelihood in Semi-Arid Afro-Eurasia

Historical Interactions between Multi-Cultural Societies and the Natural Environment in a Semi-Arid Region in Central Eurasia

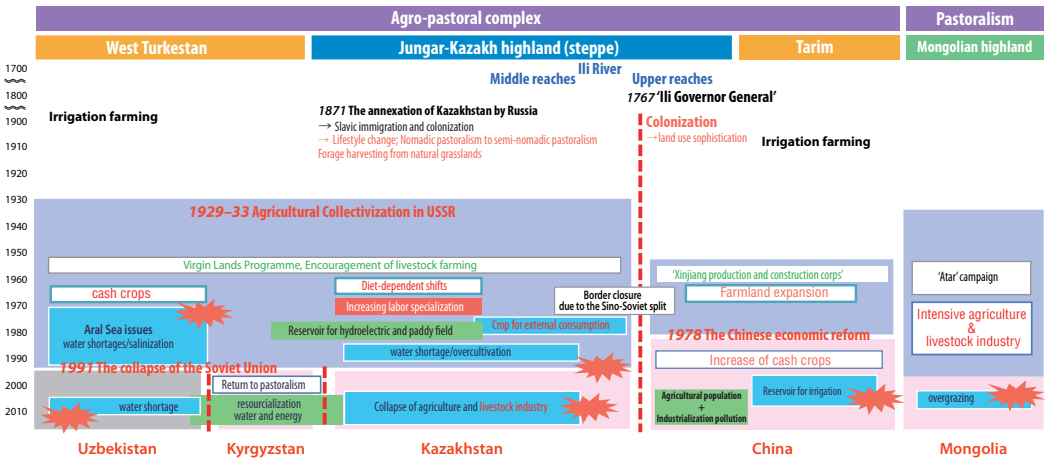
Project Leader **KUBOTA Jumpei** RIHN

Human beings have continually strived to adapt to changes in the environment. This project combined analysis of historical documents, archaeological remains and natural proxies such as ice cores, lake sediment samples, and tree rings in order to describe the history of adaptations by human beings to both environmental and societal changes in arid to semi-arid regions of Central Eurasia. Project research focused particularly on use of natural resources in order to provide some historical depth to contemporary discussion of global environmental problems.

The project reconstructed climate change in the area over the past one thousand years. Temperature and precipitation data indicated that the period from AD1000 to AD1500 was warm and dry, while the Little Ice Age (LIA), from 1500 to 1850 was cold and wet. We also estimated two important factors relating agriculture to nomadic activities, namely, river flow and distribution of grassland. The long-term trend of river flow corresponds well with the reconstructed lake level of Lake Balkhash, indicating that lake levels decreased from the 10th to 13th century. A chronological database describing the rise and fall of settlements indicates a clear change in the distribution pattern of agricultural settlements in the Syr Darya Delta from the 13th to 15th centuries. The change in settlement pattern is associated with shifting river courses which are also associated with severe decline of the Aral Sea lake level in the 13th to 15th centuries.

The warm and dry climate in early medieval times might have accelerated the development of agricultural and trading activities, and consequently contributed to the flourishing of the area, especially oasis cities in the Syr Darya basin of western Turkestan from the 7th to 13th centuries. The cold and wet climate in the LIA might be associated with the decline of oasis cities and increase of nomadic activities of the period, as nomadic population groups and place-names identified in historical documents show that nomadic groups expanded their activities in the new grasslands in the 17th and 18th centuries. Such cultural and ecological shifts demonstrate that ecosystems in Central Eurasia have wide range of natural variation, but also have fluctuated due to climate change. Social flexibility, such as high mobility and subsistence complex patterns were major ways of adaptation to this environment. Also, societal mobility sometimes reduced societal conflicts.

After a long transition marked by the rise and fall of various ethnic groups and countries, a secure and definite border divided the region between Russia and Qing in the 18th century. The people of the area experienced a great change in their lifestyle, caused by the introduction of modern agriculture. The settlement policy and collectivization of the agricultural sector from 1929 triggered social confusion in Kazakhstan, resulting in the loss of a large number of nomadic populations. Under the "transformation of nature" ideology of the Soviet Union, Kazakhstan was forced to become one of the major crop production areas in the Soviet Union, causing excessive development, which ignored environmental capacity and exerted significant impact on the area. In addition, these development policies were applied in a fashion that ignored and destroyed traditional social systems. In particular, the new production system, including the division of labor, together with the migration of skilled peoples from other countries as leaders for collective farms, prevented the accumulation of agricultural knowledge, and also caused the loss of traditional knowledge of nomadic pastoralism and its subsistence complex. Moreover, societal confusion caused by the collapse of the Soviet Union implies that societal flexibility in the area could be a very important factor in the resilience of society to both natural and societal impacts. This is one of the keys to understanding contemporary environmental issues in Central Eurasia.



Transition of social systems, subsistence and environmental conditions in Central Eurasia

http://www.chikyu.ac.jp/rihn_e/project/R-03.html

Environmental Change and Infectious Disease in Tropical Asia

Project Leader **MOJI Kazuhiko** RIHN

Today we may naturally think that environment and health are important in themselves and in relation to one another. We may know instinctively that they are positively linked, that good health is sustained by sound environments. This knowledge is not to be taken for granted, however. Human health and hygiene improved dramatically in the 20th century, and so has the global environment deteriorated. Life expectancy has increased dramatically in the developed countries in particular, but so has the developed world's ecological footprint. According to the dominant 20th century model of health and development, development was described as the solution for ill-health and poor hygiene. As humanity now risks crossing important environmental thresholds, the limitation of this model is increasingly apparent. As we look into the 21st century, we need to develop a model of health and environment and/or ecosystem that is as valid at the global level as it is at the local. We even need to create a concept of health that can identify and address the full significance global environmental change.

The RIHN Ecohealth Project was conceived in order to improve understanding of the relation between endemic infectious diseases that significantly impact public health and the environments and ecosystems in which they are found. Project fieldwork was conducted in tropical monsoon Asia, especially Laos P.D.R., Vietnam, Bangladesh, and China in which project researchers established important collaborations with governmental and non-governmental organizations (Fig. 1).

This range of research partners allowed identification and examination of critical health/environment contexts and nexus in the region. In the lowland plains of Savannakhet Province, Laos, we studied liver fluke infection in relation to the recent development of wet rice fields and irrigation systems (Fig. 2). In the mountainous area of the same province, where ethnic minority people live by cultivating upland paddies, we examined malaria incidence in relation to forest degradation. A trans-border examination of malaria among villages along the Laos-Vietnam border documented a significant discrepancy in the incidence of malaria, which seems to be linked to forest cover of each country. The project established two Health and Demographic Surveillance Systems (HDSS) and one mobile-phone network for rural health workers in the province. These systems will continue to produce the prospective ecohealth data necessary to elucidate the relation between ongoing social-ecological transformations and the health profile in Laos.

Project findings were published in numerous academic fora, just as they were communicated to appropriate offices of public health policy and practice. If we are to synthesize a single key finding, it is that the health profile of a human population is a product of the social-ecological system; it can more helpfully and accurately be understood as *ecohealth*. Human health should therefore not be studied in isolation from its environmental and social contexts. From this viewpoint, one can see that ecohealth in each social-ecological system is unique and that strategies adopted to promote it should be designed specifically for each locality. The concept of ecohealth therefore differs significantly from the conventional, medical-oriented, universal view of health, which relies on universally-defined goals and strategies rather than those designed for individual peoples and settings. The concept of ecohealth should allow health workers at all levels of practice and policy to better define their goals and conceive of their interventions. It should improve quality of life in the diverse and complex social-ecological settings of tropical Monsoon Asia just as it helps us to pursue the universal goal of sustainable health for all.

Lao P.D.R.
National Institute of Public Health (NIOPH)
Savannakhet Provincial Health Department

Vietnam
JSPS AA Science platform program for forest malaria
Khanh Phu Malaria Research Project (MCNV)

Bangladesh
International Centre for Diarrheal Disease Research, Bangladesh (ICDDR, B)
Bangladesh Ministry of Health and Family Welfare
Institute of Allergy and Clinical Immunology, Bangladesh (IACIB)

Yunnan, China
Yunnan Health and Development Research Association (YHDRA)
Yunnan University
Chinese Center for Disease Control and Prevention (CDC)

Figure 1 International Counterparts of the RIHN Ecohealth Project

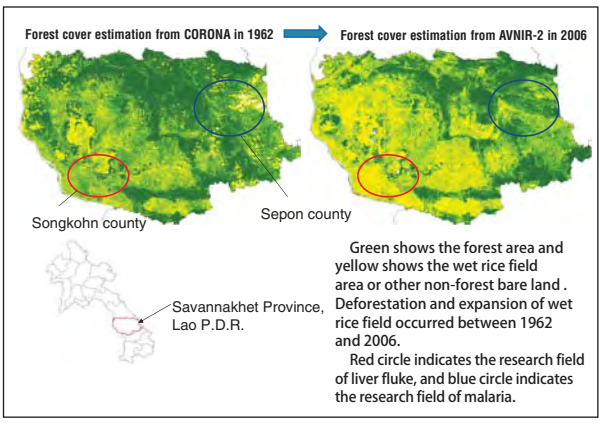


Figure 2 Land Cover Change of Savannakhet Province, Lao P.D.R. between 1962 and 2006.
Deforestation accelerated as lands have been converted to paddy fields.

A Study of Human Subsistence Ecosystems in Arab Societies: To Combat Livelihood Degradation for the Post-oil Era

Project Leader **NAWATA Hiroshi** RIHN

Hiroshi NAWATA received his Ph.D. in Human and Environmental Studies (Cultural Anthropology) at Kyoto University (2003). He was assistant professor at the Division of Comprehensive Measures to Combat Desertification, Arid Land Research Center, Tottori University (2004-2007). His major fields of interests are camel pastoral systems, Muslim trading networks, and indigenous (traditional) knowledge for rural development in the Middle East and Africa.

This project examines life support mechanisms and self-sufficient modes of production among Arab peoples who have survived in dryland environments for more than a millennium. Using the research results, we will propose a scientific framework to strengthen subsistence productivity and combat livelihood degradation in local Arab communities in preparation for the post-oil era.

Background and Objectives

Japan and the oil-rich countries of the Middle East have put excessive pressures on the earth's energy, water, and food resources. In prioritizing economic prosperity, these countries have exploited irreplaceable resources, such as fossil fuel and fossil water. Schemes to plant alien species have also placed stress on local ecosystems. This pattern of development has increased social and economic differences within the Middle East just as the region faces a turning point in modern oil-based industrial development. Fossil fuel–based interdependencies must now be transformed into new relations that can support viable future societies.

This project focuses on human subsistence ecosystems of the region: low energy-intensity life-support mechanisms and modes of production, such as hunting, gathering, fishing, herding, farming, and forestry. In doing so it also reflects on the role of advanced technologies in economic development, and measures adopted thus far to combat desertification. Field research investigates keystone species, ecotones, and traditional knowledge and examines the sustainability of subsistence economies under site-specific conditions.

Research Methods and Organization

Field surveys are conducted in semi-arid lands between the Nile River and the Red Sea in Sudan, with the Red Sea coast, Butana area, and Nile River areas as the main survey areas. Additional surveys will be conducted at the Sinai Peninsula in Egypt, the Red Sea coast in Saudi Arabia, and a Saharan oasis in Algeria. We will compare keystone species, ecotones, and traditional knowledge and examine differences in the sustainability of subsistence economies under site-specific conditions (Fig. 1).

Figure 1 Field survey areas and research themes

We will develop and implement our study of human subsistence ecosystems around three main areas: 1) comprehensive measures to control the alien invasive species mesquite; 2) assessment of the environmental effects of development programs in coastal zones of the arid tropics to prevent the emergence of new environmental problems; and 3) sharing of research results to support local decision making.

Our research method combines two main approaches: (1) analysis of subsistence ecosystems, focusing on keystone species such as camels, date palm, dugong, mangrove, and coral reefs; and (2) examination of the sustainability and fragility of Arab societies, focusing on the ecotones such as wadi beds, riverbanks, mountainsides, and seashores.

The members of this project include social and natural scientists, members of local NGOs and project managers, who are divided into four study groups: 1) Alien invasive species control group, 2) Coastal zone environmental impact assessment group, 3) Support for local decision making group, and 4) Local ecosystems comparative studies group (Fig. 2).

Major Achievements

Suggestions for resource management in Marine Protected Areas (MPAs) through studies on fishing culture and behavioral characteristics of dugongs

The local people have historically depended on sea products (fish, shellfish, dugong, dolphin, and sea turtles) for their diet in unique coastal ecosystem of the arid tropics: coexistence of mangrove forests (dominant species: *Avicennia marina*) and coral reefs and complex relationship of the both. On the other hand, the coastal zones presents a large development frontier, therefore, it may also lead to environmental degradation such as destruction of mangrove forests, coral reefs, and seagrass beds and releasing highly concentrated saline water into the sea. In order to suggest frameworks for a new environmental assessment with community participating for prevention of global environmental problems, we have conducted multi-principal studies focusing on mangroves, coral reef, camels, dugongs, and fishing culture in the coastal areas of Sudan,

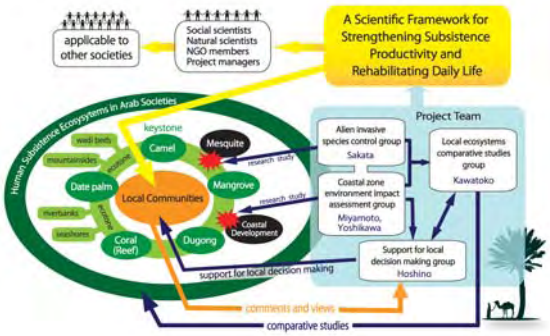


Figure 2 Research methods, approaches, and organization

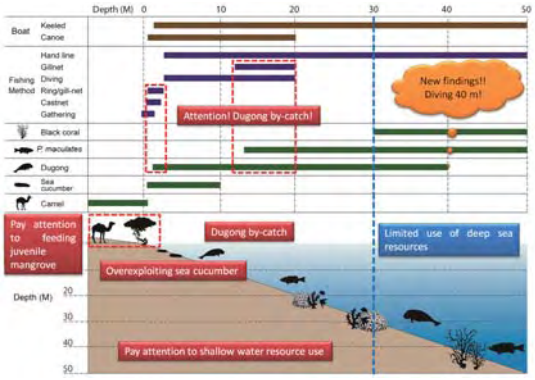


Figure 3 Actual situation of coastal resource use in Dungonab Bay in Sudan

Egypt, and Saudi Arabia, surrounding the Red Sea.

We have conducted surveys on fishing culture in Dungonab Bay in one of the MPAs in Sudan and have found that the local fishermen were catching fishes based on accurate recognition of their subsistence space and detailed understanding of ecology of the target fish. The fishermen find 77 fishing grounds accurately by using both maps and marine charts. Besides, it was suggested that fishing restriction due to harsh environmental conditions such as strong winds for half a year and hot temperature in summer may control over harvesting of the marine resources. On the other hand, there is a growing concern about over fishing of sea cucumbers which are coastal stationary species that inhabit shallow waters, because they are easily taken and traded at high price. It is also concerned that mangrove trees are used for processing the sea cucumbers.

Biologging studies of dugongs revealed behavioral characteristics of their space use. Dugongs stayed in the shallow waters less than 4 m for more than 96 % of their time, sometimes showing rapid dives down to 40 m. Strong site fidelity was also suggested because the animal repeatedly visited a specific feeding ground. Vocal communication is expected to be revealed by further analysis.

Most of the fishing grounds and the dugong habitats in Dungonab Bay did not overlap. It was shown that by catch of the dugongs in gill nets can be avoided by time-spatial segregation of fishermen and dugongs (Fig. 3).

We clarified precautions for development and resource management prior to waves of public projects and development. Accumulation of academic data by this project contributes to concrete input of framework and contents of management of MPA, and at the same time, it can be used ad reference for assessment of environmental impact in the whole area of Red Sea and also coastal areas of arid tropics.

Future Activities

Challenges for the last year of this project is to present a persuasive contention by connecting the particular factual data and integrate the result of analysis for "Human subsistence ecosystems in Arab societies". We will reveal human subsistence ecosystems in the seaside such as relationship between mangrove, coral reef, camels, dugongs, and fishing culture through our previous studies, and by comparing trees (wild species: A. *marina*, cultivated species: date palm, and alien invasive species: *Prosopis*), we will reevaluate them as new resources for energy and food. These research results will be exhibited as "Surviving in the desert (tentative)" at National Museum of Nature and Science. Last year, we have compiled a book "Human resource development and manufacturing in the post-oil era: Pursuit for a future vision of Japan and oil-producing countries" (RIHN book series, Showado) and volume 1 and 2 of multilingual books (in Arabic, English, French, and Swahili) as Arab Subsistence Monograph Series (Shoukadoh). We will also compile a series of books in Japanese "Human subsistence in Arab" (10 volumes, Rinsen Book Co.), and a book "Knowledge for sharing water in the desert (tentative)" (National Museum of Nature and Science, Tokai University Press) to conclude the study results and pass them on to the local society.

Photo1 Interview surveys with local fishermen (Sudan)

Photo2 Sea cucumbers are collected and dried in the sun (Sudan)

Photo3 A local fisherman and a dugong with biologging equipments (Sudan)

Sub Leader

ISHIYAMA Shun RIHN

Core Member

KAWATOKO Mutsuo Research Institute for Islamic Archaeology and Culture
MIYAMOTO Chiharu Action for Mangrove Reforestation
SAKATA Takashi Ishinomaki Senshu University
YOSHIKAWA Ken Okayama University
HOSHINO Buhe Rakuno Gakuen University
SHINODA Kenichi National Museum of Nature and Science
BABIKER, Abdel Gabar E. T. Sudan University of Science and Technology
ABU SIN, Abdalla M. A. Gezira University, Sudan
LAUREANO, Pietro Traditional Knowledge World Bank, Italy
BENKHALIFA, Abdrahmane Ecole Normal Supérieure, Algeria

Managing Environmental Risks to Food and Health Security in Asian Watersheds

Project Leader **KADA Ryohei** RIHN

Professor Kada joined RIHN as leader of the Food and Health Risk Project in July 2010. He also teaches at the Graduate School of Environment and Information Sciences, Yokohama National University since 2007. From 2001–2004 he served as Policy Research Coordinator at the Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries (PRIMAFF), Japan. For nearly 25 years he researched and taught agriculture and food policy at Kyoto University, and also held posts at Kasetsart University in Thailand and the University of Wisconsin–Madison. He received his Ph.D. from the University of Wisconsin–Madison in 1978.

The general objective of this research is to critically study how ecological risks such as floods, soil erosion and water pollution impact the sustainable linkage between agricultural & aquatic foods and public health, from social, natural, and medical science perspectives, in the watershed area of Southeast Asia. In particular, research has been conducted very intensively at Sta Rosa Watershed of the Laguna Lake region in the Philippines, a highly populated and variegated region in which rich ecological resources are threatened by rapid land use changes, urbanization and industrialization. This study site is expected to be representative of the challenges facing many other watersheds in Southeast Asia. Our major research framework is from upstream to downstream (Fig. 1).

There are four principal objectives: 1) to document the current levels and pathways of heavy metals and other chemical and organic pollution in the aquatic resources of Laguna Lake; 2) to investigate the health condition of local residents and their perception of food risks; 3) to analyze the impacts of varied land use changes in the Laguna Lake area on water and material cycles, including impacts on sedimentation, groundwater level and its quality; and 4) to prepare alternative policy options to improve environmental quality for sustainable development.

Research methods and organization

As shown in Fig. 2, the following five research teams are comprised mainly of researchers from RIHN, Yokohama National University and University of the Philippines; they work in collaboration with government agencies such as the Laguna Lake Development Authorities (LLDA) and local government units.

1) Environmental Risk Assessment Team identifies the exact sources of, and factors responsible for, particular pollutants in the food chain.
2) Terrestrial and Socio-Economic Evaluation Team explores how market- and non-market-based instruments can be used to improve water quality, food security and public health.
3) Health Risk Evaluation Team describes human nutrition, history of disease, and life expectancy in the region, especially in relation to socio-economic dynamics.
4) Payment for Ecosystem Services (PES) Team investigates the design of ecosystem service payment programs, including the potential support for regional agroecologies.
5) GIS-based Risk Mapping Team supports the entire research project by creating a spatially-explicit database of key variables associated with risk in the food chain.

Achievements in FR1-2 and the remaining research subjects:

The major research outcome in its first and second year of the Full Research can be summarized as follows:

Environmental Risk Assessment Team performed heavy metal analysis for multiple samples including water, sediment and plants collected from Laguna Lake and its watershed. Our data collectively suggest anthropogenic origins for heavy metals such as lead, but natural origin related to volcanic activity is also plausible especially for

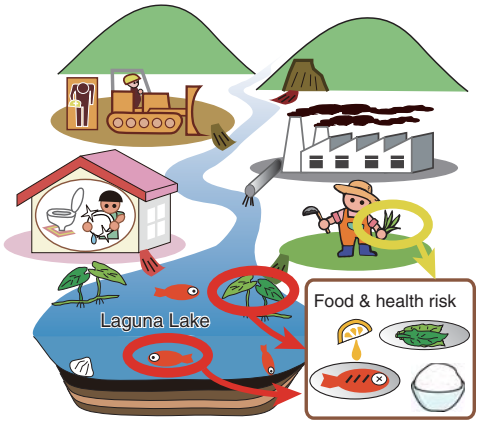


Figure 1 Working hypothesis: From upstream to downstream

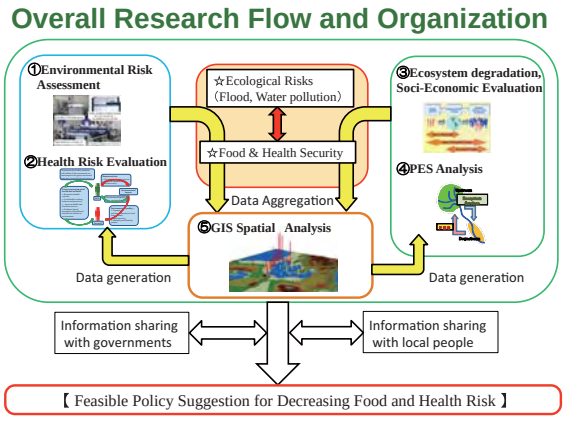


Figure 2 Overall research flow and organization

Photo1 Photo of flooding in the Laguna lakeshore region (August, 2012) local people used to repeated flooding.

Photo2 Field photo of lake survey using sediment sampler

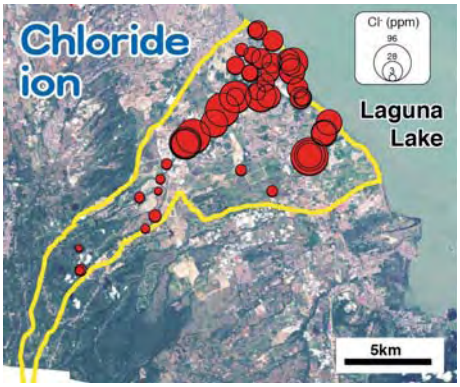


Figure 3 Chloride ion concentration map for river water in the Santa-Rosa sub-watershed. The concentration markedly increases in the mid-stream (industrial area).

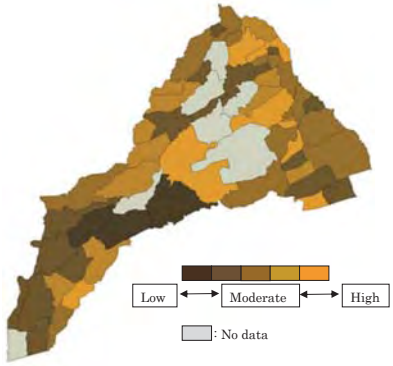


Figure 4 Flood Disaster Resiliency Barangay Map in Santa Rosa subwatershed by Built Environment Index;(calculated by Access to water, Waste disposal & sanitation, Electricity, Road network, Housing and land use).

arsenic. In the next step, the pathway of anthropogenic heavy metals from source though route to exposure would be traced by analyzing lead isotope compositions of the multiple samples (Fig. 3).

Terrestrial and Socio-Economic Evaluation Team computed diversity indices and revealed that plant and wildlife diversity in the sub-watershed was greatly reduced with land use change from forest to built-up and residential areas. The socio-economic team conducted the household survey across the study areas in the Silang-Sta. Rosa sub-watershed and found the wide-spread experience of food insecurity among the poor. This can be attributed to factors such as large family size, low income and nature of household income sources. Another field survey was conducted in the Langat River Basin, Malaysia, and examined the linkage of water pollution and food-health insecurity.

Health Risk Evaluation Team conducted a series of cross-sectional analytic studies to determine the relationship between specific exposures of interest (nutrition, exposure to environmental pollutants; water, sanitation, etc.) and certain health outcomes (acute and chronic disease, common medical complaints, levels of food security, general health and neurological status and cognitive development). Moreover, qualitative researches were conducted on such areas as dietary diversity, multi-stakeholder historical perspectives on changes in the variety, quantity and quality of lake produce.

Payment for Ecosystem Services (PES) Analysis Team started to investigate PES program to achieve sustainable watershed management by estimating the farmer's opportunity cost of participating in the PES and adopting agroforestry. There is a significant variation in farmers' opportunity cost of PES participation, which suggests that PES should have certain kind of flexible payment mechanism to ensure cost-effectiveness of the program.

GIS Risk Analysis Team have conducted the aggregation of sampling and questionnaire data to the spatial data map; and then created new analytical indices serving as a platform to be used by other research teams in order to complete the GIS risk analysis. Fig. 4 is one of such outcomes, showing the Barangay resilience profile in Santa Rosa subwatershed.

The project is now in the final year of 3 years' Full Research period. Combining the field work, laboratory experiments, interviews and discussions with stakeholders as well as household, farm, and biomedical surveys, each team's reseach results will be integrated for the discussion of watershed management. The Yamang ng Lawa (Blessing of the Lake) Project will promote and evaluate community-based watershed management. With the feedback from and discussion with the local stakeholders, this research project will challenge a real transdisciplinary approach.

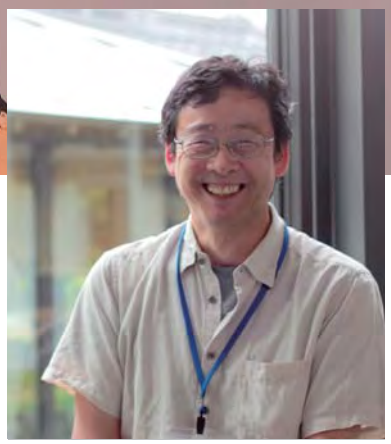
Sub Leader

MASUDA Tadayoshi RIHN

Core Member

YAOTA Kiyoyuki RIHN
ARIMA Makoto Yokohama National University
MASUNAGA Shigeki Yokohama National University
YUMOTO Takakazu Kyoto University
TANAKA Katsuya Shiga University
SAITO Satoshi Ehime University
RAZAFINDRABE, Bam H. N University of the Ryukyus
GALVEZ-TAN, J. University of the Philippines, Manila /RIHN
MOLINA, Victorio B. University of the Philippines, Manila
RANOLA, Roberto Jr. University of the Philippines, Los Baños /RIHN
CONCEPCION, Rogelio N. University of the Philippines, Los Baños
SANTOS-BORJA, A. C Laguna Lake Development Authority

Desertification and Livelihood in Semi-Arid Afro-Eurasia



Project Leader **TANAKA Ueru** RIHN

Ueru TANAKA obtained a Doctorate in Agriculture from Kyoto University (1997). He has previously worked as lecturer of Jomo Kenyatta Collage of Agriculture and Technology, Kenya (1983–1987), assistant professor in the Faculty of Agriculture, Kyoto University (1990–1999), associate professor in the Graduate School of Agriculture, Kyoto University (1999–2002), associate professor in the Graduate School of Global Environmental Studies, Kyoto University (2002–2011), and honorary professor of Hue University (Vietnam, 2012 -). His major fields of interests are agronomy, indigenous livelihood systems, desertification, and rural development assistance in West Africa, Southern Africa, India and Southeast Asia.

Research backgrounds, objectives and study areas

Desertification is a complex phenomena related to land degradation and poverty in sub-humid, semiarid and arid areas. Semi-arid Afro-Eurasia is recognized as one of the front-line of desertification, a problem related both to climatic conditions and basic human survival and daily livelihood activities, such as cropping, animal husbandry, and gathering of fuel woods. Desertification remains a serious problem in the region despite commitments from the international community, including the United Nations Convention to Combat Desertification (1994), to address it. This project identifies the socio-ecological characteristics of, and adaptation strategies related to, desertification in several study areas, re-examines techniques and approaches to desertification control and rural development assistance, and seeks feasible and practical integrative or holistic solutions to encourage improved livelihood security for people living in such uncertain and fragile environments.

Project research takes place mainly in the Sahel of West Africa (mainly Burkina Faso and Niger), Southern Africa (Namibia and Zambia), and Northwest India (Fig. 1), where socio-ecological condition and land resources are degraded due to demographic pressure and uncertain socio-economic conditions and rainfall. With progress, several additional study areas, perhaps in the other parts of West Africa (Senegal), Northeast Africa (Sudan) and East Asia (China and Mongolia), will be considered.

In the 2013 prospectus, we highlight some progress obtained through the studies in West Africa.

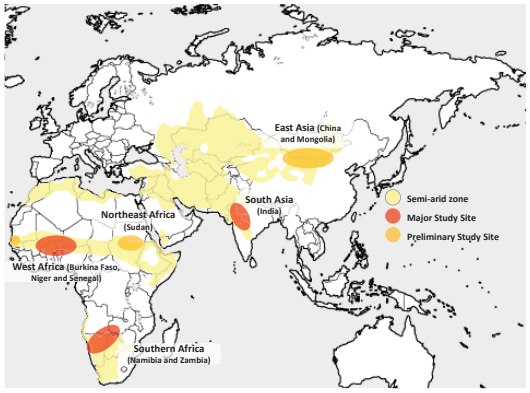


Figure 1 Targeted study areas in the project

Progress to date

Modification of extension method

Project researchers developed the 'fallow-band system', a unique practical technique to reduce wind erosion and improve crop yield (Fig. 2). This technique was endorsed by the JICA Grassroots Project "Formation and dissemination of practical techniques for mitigation of desertification and improvement of household income in Niger" (April 2010–March 2013). As of December 2012, the technique has been practiced by 439 households in 75 villages, 23 districts and 4 regions in Niger. It appears to be effective. Our survey in a selected village, however, revealed that the distribution of households practicing this technique were limited to the area closer to the village chief. This was explained by the intensity of social relations among villagers as showed in Fig. 3. If a new idea or technique is introduced to a village through a local chief as a contact point, as is commonly advocated in "participatory" approaches for rural development, the range of diffusion may be limited by the networking with and distance to this contact person. A social network survey may clear this black-box in conventional rural development approaches. We also identified some opinion leaders located in key nodes of the network, as indicated by the arrows in Figure 3. These individuals may be additional access points for introduced ideas and techniques.

Design of practical technique affordable for local people

Many techniques have been introduced to control desertification to date, but most are, unfortunately, not adopted by local people. New techniques, however scientifically sound and rational, may not match the needs and situation of local people, e.g. in relation to cost or time and labor requirement. Some techniques are highly dependent on materials and machinery from outside that may not be affordable locally or normally available. Together with volunteer villagers in Niger, we designed one technique using local materials and indigenous technique to control soil erosion by water. Figure 4 shows an on-farm experiment. We set a line of local wild perennial grass (Andropogon gayanus Kunth) with indigenous planting technique and allocated a stone band along the contour line in a cultivated field. Participating villagers said that the grass line and stone band may be effective for erosion control but the latter is not attractive as it is hard work to

http://www.chikyu.ac.jp/rihn_e/project/R-07.html
http://www.kazehitotsuchi.com/ (in Japanese)

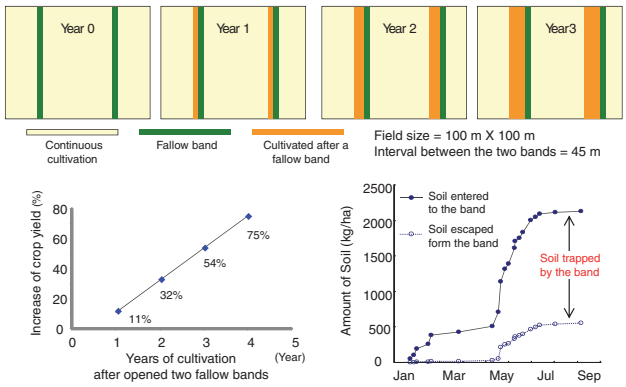


Figure 2 Fallow-band system for soil erosion control and yield increase

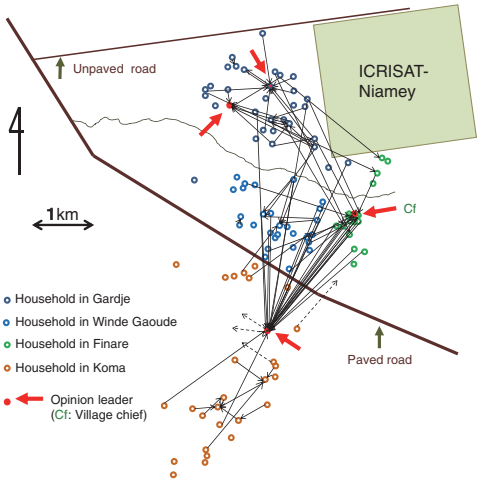
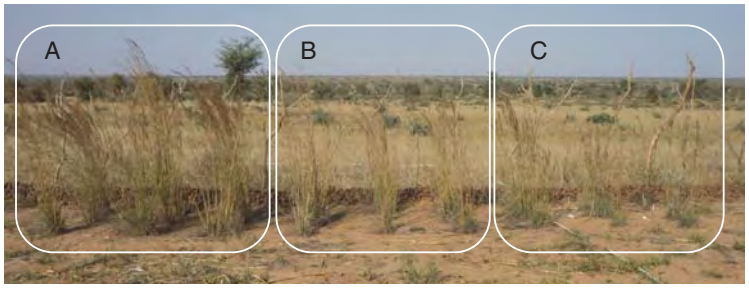


Figure 3 Network of consultation and opinion leaders in a selected village



A: *Diguette* (stone band), Andropogon (wild grass) planted in *Zai* (pit) with manure

B: *Diguette* (stone band), Andropogon (wild grass) planted in *Zai* (pit) without manure

C: *Diguette* (stone band), Andropogon (wild grass) planted without *Zai* (pit) and manure

Figure 4 On-farm experiment to control soil erosion using local materials and indigenous technique

carry such a number of stones. The harvested wild grass is used for a granary material and sold in local market, which becomes an alternative source of income. The result shows the possibility of establishing a practical technique with locally available material that contributes both to household income and erosion control.

Future tasks

Through several field studies we have recognized particularly vulnerable people in a community. The survey of social network visibly indicates the location of households of widow, divorced, disabled and elder persons (Fig.5). Some of these peoples' lives and livelihoods are particularly vulnerable to desertification. Our study focuses on these vulnerabilities in both rural and urban communities, since we believe such multi-dimensional problems are one of the challenging issues for humanistic environmental studies.

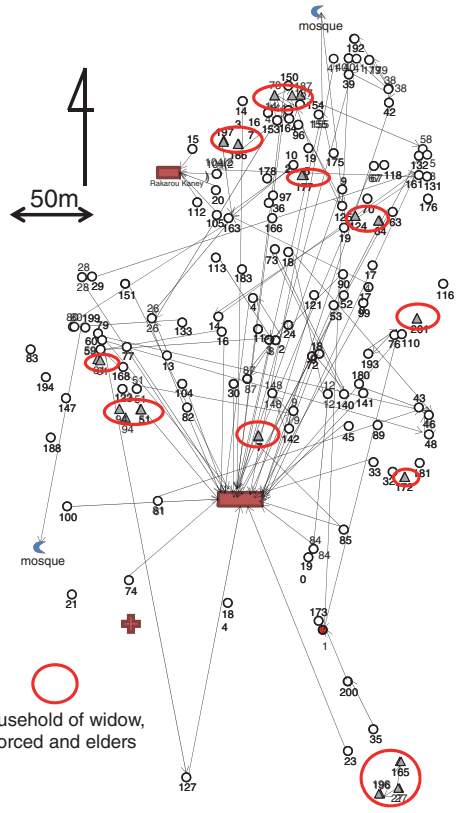


Figure 5 Information network and vulnerable households identified in a selected village

Sub Leader

ISHIMOTO Yudai RIHN

Core Member

SHINJO Hitoshi Kyoto University
IKAZAKI Kenta Tokyo Metropolitan University
KOBAYASHI Hirohide Kyoto University
NAKAMURA Hiroshi Global Environmental Forum
MIURA Rei-ichi Kyoto University
UCHIDA Satoshi Japan International Research Center for Agricultural Sciences
DEORA, K. P. Singh Institute of Rajasthan Studies, India
MIYAZAKI Hidetoshi RIHN
SHIMIZU Takao RIHN
SASAKI Yuko RINH
TESHIROGI Koki RIHN
ENDO Hitoshi RIHN