

JIRCAS Newsletter

for
INTERNATIONAL COLLABORATION



Rural landscape in Vietnam (Photo by H. Chien)

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At the Inception of the Third Medium-Term Plan

The Great East Japan Earthquake, which happened on the 11th of March, 2011, was an unforgettable disaster for Japan. I was shocked and felt very sorry to hear the sad news and could only offer sympathy, not only to the victims but also to those who have been greatly affected by the aftermath of the earthquake itself. We, at Japan International Research Center for Agricultural Sciences (JIRCAS), have been trying to collect and present the necessary information to restore the agricultural, forestry and fishery industries of the stricken areas.

Although international food prices seemed to have stabilized amidst the economic recovery after the global financial crisis stemming from the collapse of the Lehman Brothers in September, 2008, they have reached a new ceiling since July after another surge that was triggered by the drought in Russia. The rise in food prices has hit the poor and increased the number of the population who can't afford enough food and suffer from starvation, hence social unrest has increased in many countries, such as Egypt etc. The fundamental problem regarding the world food supply has become clearer since now supply cannot keep up with the demand.

Consequently, intensified international and national efforts towards further reinforcement of agricultural research in developing countries were agreed upon at the United Nations Summit of the Millennium Development Goals in September, 2010. It would be difficult to achieve the first goal to halve the number of those who suffer from extreme poverty and hunger by 2015. The world food problem, which is now the biggest global issue, will be discussed at the G20 Summit in November 2011 in France.

Important research policy and targets for the next 10 years were set in March of last year by the Ministry of Agriculture, Forestry and Fisheries of Japan. The research carried out by JIRCAS is regarded to be of global importance in addressing world issues. And the governmental policy and targets will guide JIRCAS in its research direction and activities.

The government discussed the draft plan on budget screening of the Incorporated Administrative Agencies (IAAs) at the Government Revitalization Unit and the Administrative Reform Promotion Office, following the results of the review of budget screening of the IAAs. Likewise, an assessment policy at the end of the medium-term period was carried out, and organizational

and administrative structures were revised by the committee. Through a series of discussions and assessments by the different governmental mechanisms, it has become clear that JIRCAS has an important role to play to bolster research to enhance food security in our county by stabilizing the international food supply, and we re-affirmed our commitment that we need



to carry out intensive research that contributes to the improvement of the agricultural and fishery technologies in developing countries. We are resolute in our determination to accomplish this mission.

An international symposium titled, "A New Decade for International Agricultural Research for Sustainable Development" was held during the 40th anniversary of our predecessor organization, the Tropical Agriculture Research Center (TARC), in November last year. In that venue, we confirmed that JIRCAS plays a key role as a national focal center for enhancing international agricultural research collaboration, in response to the global food and agricultural challenges as mentioned previously. We will likewise continue making major contributions to the Coalition of African Research and Development for Rice (CARD) for the goal of doubling rice production in Africa by 2020.

In 2010, we focused intensively on examining the direction and framework of research to achieve the objectives of the Third Medium-Term period. Likewise, we spent a great deal of energy summarizing and releasing the results of all the research projects in the final year of the Second Medium-Term Plan that was launched in 2006. We believe that we have made substantial contribution towards the agricultural, forestry and fishery industries in developing countries, and that we have fully achieved the original targets as of the final year of the Second Medium-Term period. We will focus on two main targets in the future: continue to develop concrete results that can be widely disseminated, and strengthen JIRCAS' role as a national focal center for international agricultural research. We will all strive in unison towards these goals.

Masa Iwanaga
President, JIRCAS

Program-Project Research Framework

The Third Medium-Term Targets, which will guide research operations for the next five years (FY 2011-2015) were set by the government in March this year, and subsequently, the Medium-Term Plan for their implementation was approved. This article will describe how JIRCAS will carry out the major activities that have been identified in the new plan, and likewise briefly explain the differences between the old and new organizational structures, as well as the rationale for the introduction of this new system.

Significance of the programs

Japan International Research Center for Agricultural Sciences (JIRCAS) is an institute with unique missions. The law stipulates the purpose for its establishment which is to, "Contribute to the improvement of technology for agriculture, forestry and fisheries in developing regions by performing technical trials and researches." (Article 3, JIRCAS Act). However, this aim seems too broad in terms of research targets for our organization, relatively small with only about 180 staff members, to be able to render an explanation that is easy to grasp as to what the focus will be. In particular, we need a clear understanding of why and for whom the "Improved technologies for agriculture, forestry and fishery in the developing regions" are intended; and furthermore, what kind of impact we intend to bring to society with the advance technologies.

JIRCAS has been constantly reviewing this issue. The "Project system" was introduced to carry out both research budgeting and management under the responsibility of project leaders, based on the work schedule that was planned for each year, for all of the JIRCAS research activities at the beginning of the Second Medium-Term Plan in 2006. Through that, we were able to achieve certain enhancement in the transparency of the relationship between costs and outputs. However, detailing an explanation of what JIRCAS focused on was not easy as we had more than 30 research projects. In addition, there was a major problem as we had defined so many interlocking research subject layers such as two 'research fields', three 'large issues' and 21 'medium tasks' in the last Medium-Term Plan, and the responsibilities of these "issues and tasks" as well as for the specific projects themselves were complicated. Thus, it was difficult to find a direct correlation between the external evaluation and internal project evaluation.

Therefore, we studied ways to manage our research projects more effectively and efficiently by establishing a working group in JIRCAS in 2009. As a result, since it was concluded that it is necessary for us to stipulate the relationship between our overall goals (vision) or mission and our research projects, it was deemed an effective policy to introduce "programs" that could be used as units of external evaluation. The programs will enable us to clarify our overall goals that need to be contributed, and the manner in which we attempt to accomplish our research. Especially assigned Program Directors will be in charge of budgeting, staffing, management of achievement and evaluation support. Along this line, the personnel structure will be simplified to enable efficient administration.

Contents of the programs

What are the priority areas for the next five years? JIRCAS has bolstered work on these issues after becoming an incorporated administrative agency. It has endeavored to grasp an understanding of international agricultural, forestry and fishery trends, related research directions and needs for the local people since the launch of the Research Strategy Office in 2006. The Basic Plan for Agriculture, Forestry and Fisheries Research, which was determined by the Agriculture, Forestry and Fisheries Research Council in March 2009, indicated three research agendas for the improvement of technology in developing countries, based on the outcomes of JIRCAS' research strategy. As background for this basic plan, the Japanese researchers' expertise, JIRCAS' comparative advantage in the field and our accumulated research were duly considered.

The three research agendas are: 1) Development of agricultural technologies based on sustainable management of environment and natural resources in developing regions, 2) Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments, 3) Technology development for income and livelihood improvement of the rural population in developing regions. In addition, the overall goals "to secure stability of the world food supply/demand, to eradicate extreme poverty and hunger in Asia and Africa, and to solve global environmental problems" are likewise indicated.

The Medium-Term Targets and the Plan in the third period are following faithfully all the contents of the three agendas to carry out the Basic Plan for Agriculture, Forestry and Fisheries which is one of the key national policies. JIRCAS has set four programs, among them the three research programs mentioned above and another one to collect and disseminate information that will be discussed later. The three research programs are linked to contribute to the overall goals: 1) Sustainable resource management (Global issues) 2) Food security (Mainly in Africa) and 3) Improvement of income and livelihood (Mainly in Asia). The output targets are easily quantifiable numerically, such as: 1) Quantity and quality of resources, 2) Food productivity and 3) Income gain. A "flagship project" has been fixed to represent each research program, and for which priority has been allotted in the allocation of research resources. (See Fig. 1)

On the other hand, the number of subject-based

research divisions was reduced, and new divisions were dedicated toward the enhancement of the researchers' specialties and staff management. Researchers, based on their research expertise, will be placed in charge of their own research project/s that are designed to achieve JIRCAS' mission, under the direction of the Program Directors and Project Leaders. Such a matrix system has been adopted by many international agricultural research institutes, too.

Information Analysis Program

The law stipulates that JIRCAS must conduct two major tasks:

1. Carry out technical trials, research and investigation for agriculture, forestry and fisheries in developing regions
2. Collect, analyze and disseminate domestic and overseas data of the agricultural, forestry and fishery industries in developing regions

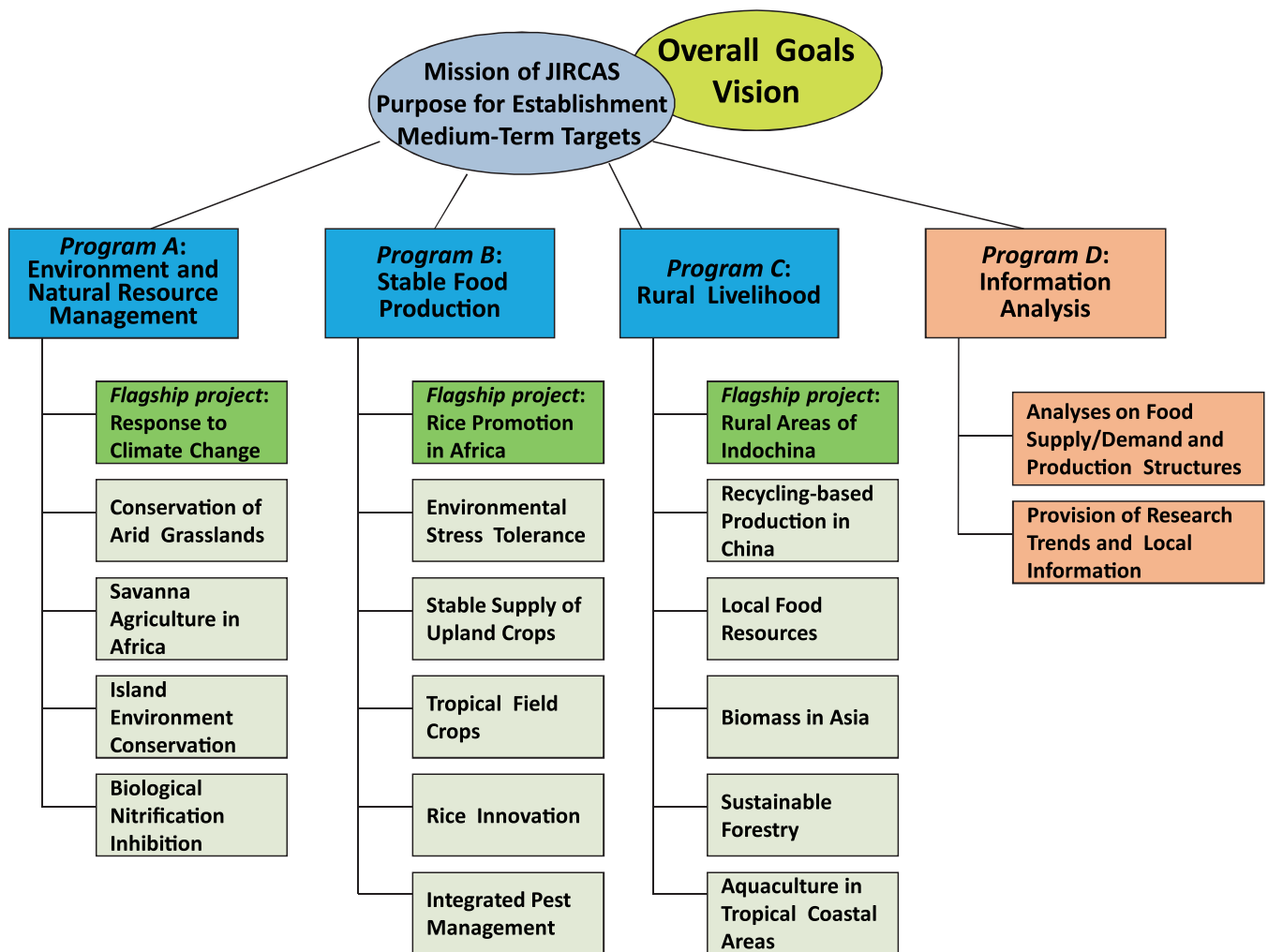


Fig. 1. Program-Project Research Framework

The second task is very essential in providing useful information to researchers inside and outside the country, or people concerned with the technological and economic development of agricultural, forestry and fishery industries. This activity was particularly requested to obtain an accurate picture of the international situation, when government bodies carried out the 'project/budget screening process' for independent administrative agencies (IAAs) last year. However, the problem was that the task was not clearly defined, due to the fact that those activities were mixed with the research and investigation projects, in the previous Medium-Term Targets and Plans.

Hence from now on, attempts will be made to clearly distinguish the activities of information collection, analyses and dissemination from the three research programs for the new Medium-Term Targets and Plan. Therefore, JIRCAS expects to set an effective implementation of this fourth program. To be specific, these shall be carried out:

1. Accurate analyses of the status quo and forecasts on food supply/demand and production structure for agricultural, forestry and fishery industries in foreign countries
2. Regular and systematic collection, analysis and dissemination of information on the international food

situation, agricultural, forestry and fishery industries, and rural villages

JIRCAS shall enhance the quality of this activity by increasing the originality of information, and shall also expand its homepage and seminars to improve user-friendliness for researchers, governmental organizations and corporations.

Output-oriented management

By introducing the program-project system, JIRCAS shall be able to depict more succinctly what it essentially does and for who, not only to the taxpayers and Japanese citizens but also to the people in developing countries. More efficient and accountable research promotion will further be feasible. However, it is important for every researcher, manager and support staff to work together collectively to produce well-considered outputs that will be deemed suitable, acceptable and adaptable for users. We will keep striving to take advantage of this new structure, with the undying passion of our 40 year-old 'research for development' tradition, hoping not to fall into the same trap portrayed by a Japanese proverb, "To create an image of Buddha but without a soul."

Osamu Koyama
Director, Research Strategy Office
JIRCAS

Environment and Natural Resource Management

A Third Medium-Term goal, "Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions", has been set as one of the research directions, towards which JIRCAS should endeavor. Recently, some global environmental problems have manifested themselves. Agricultural technology development based on sustainable resource management is required to maintain and expand the agricultural, forestry and fishery industries in developing countries which are susceptible to these types of problems. The Natural Resources and Environment Program will strive towards five projects to achieve this goal, as shown in Fig. 1. Henceforth shall be discussed the features of each project, focusing on our flagship project, the "Climate Change Response Project."

1. Climate Change Response Project

The Climate Change Project comprises of the development of climate adaptation countermeasures for rainfed and irrigated rice cultivation, advancement of GHG (Greenhouse gases) emission mitigation measures

by introducing water-saving irrigation technology and improvement of animal feeding, as well as the development of a sustainable rural community model with low GHG emission, and assessment of the impact of global warming on rice production by using the Supply and Demand model as a framework. (Fig. 2)

Regarding adaptation measures, we also have the Feasibility Study of irrigated agriculture in Vietnam and Sri Lanka, as well as the improvement of rainfed rice cultivation technology, which are jointly researched with the International Rice Research Institute (IRRI) and Japan Agency for Marine-Earth Science and Technology (JAMSTEC). There has been great collaboration between IRRI and JIRCAS through 25 years of joint research history. The coupled Atmosphere-Ocean model SINTEX-F developed by JAMSTEC will be utilized to develop a seasonal weather forecast model, as a major feature of the project of rainfed rice cultivation technology. We will focus on developing a more efficient nutrient management technology than a conventional one by adapting the said JAMSTEC coupled ocean-atmosphere model to develop a decision support system in addition

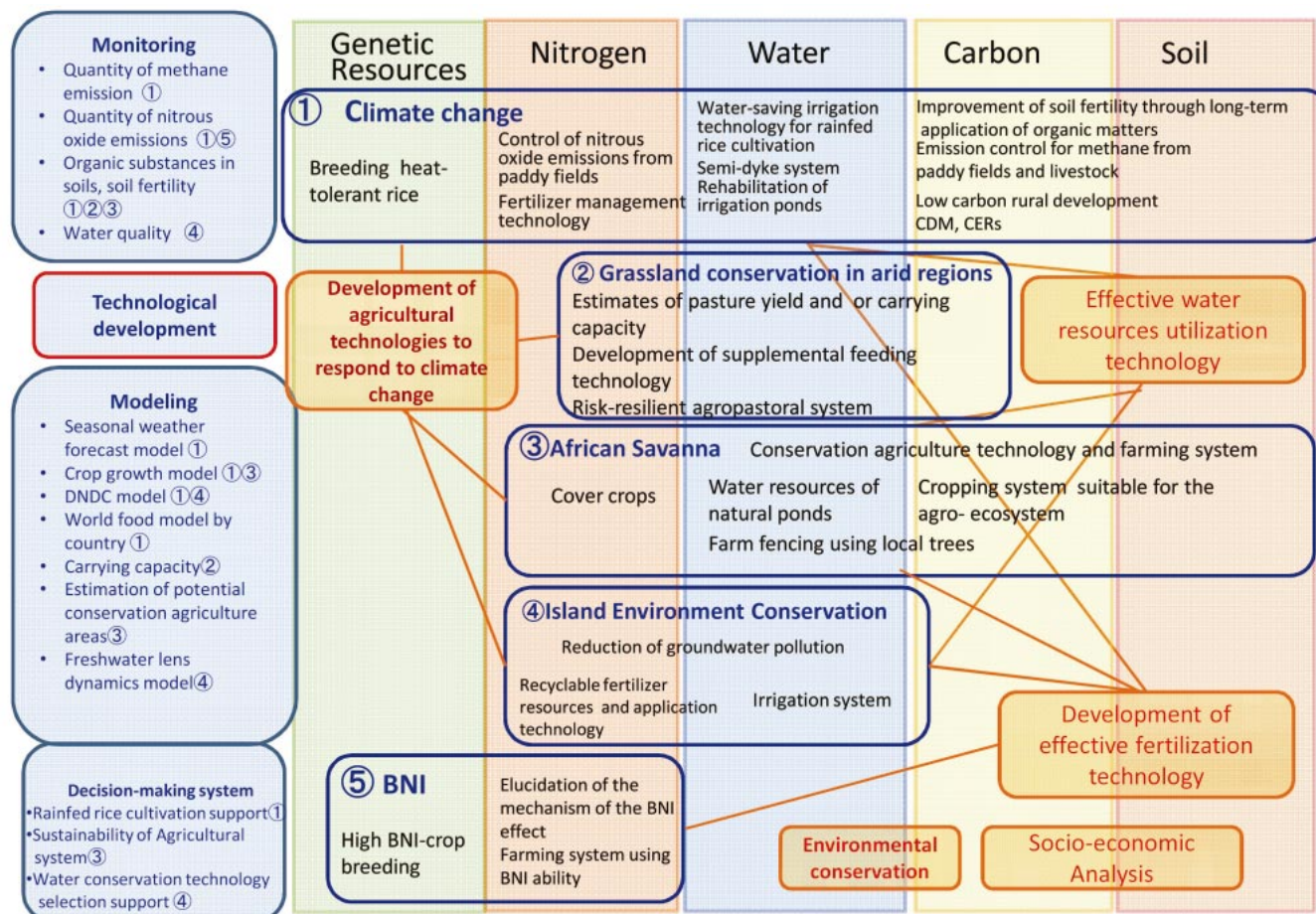


Fig. 1. Development of agricultural technologies based on sustainable management of natural resources and the environment in developing regions

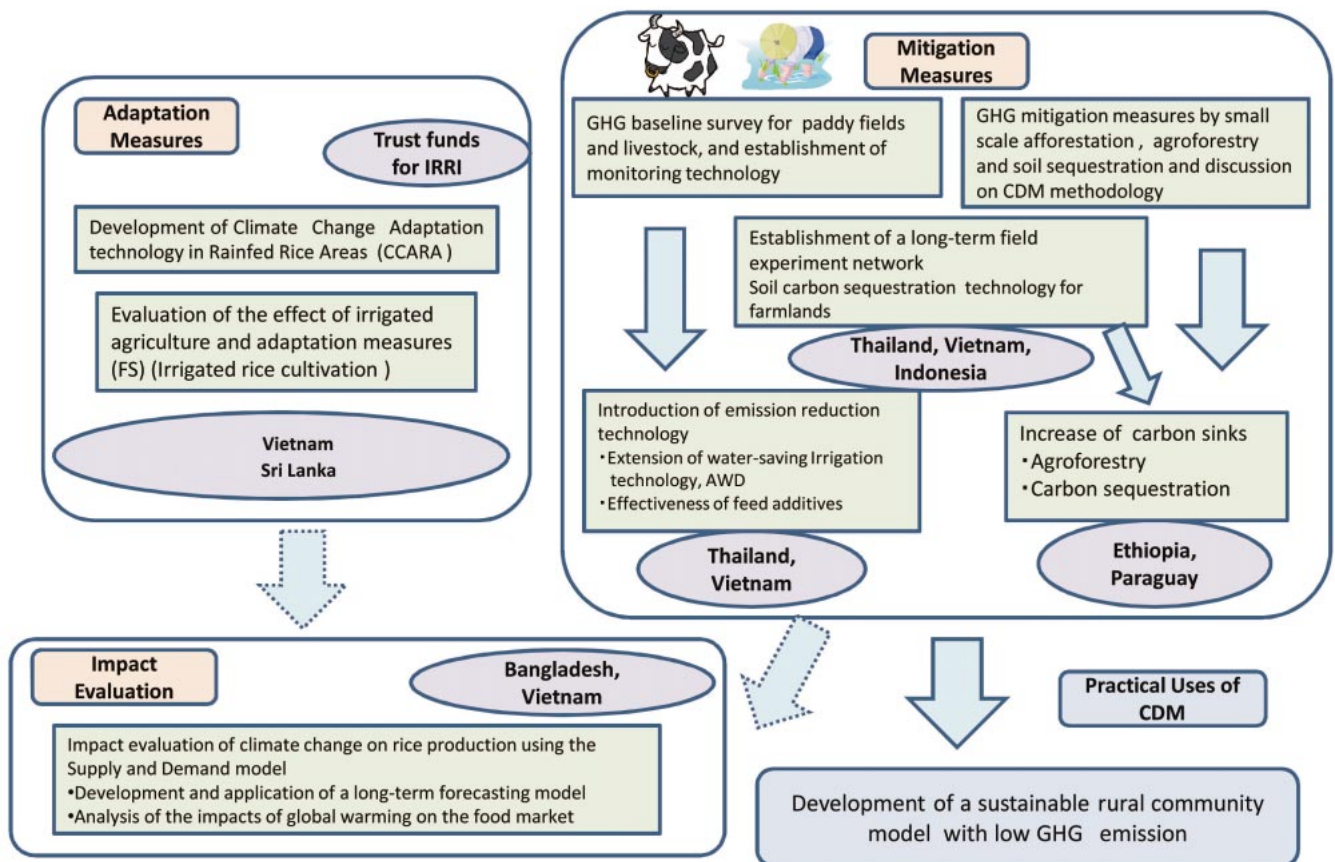


Fig. 2. Development of agricultural technologies that respond to climate change in developing countries (Climate Change Project) Note: AWD: Alternate Wetting and Drying, CDM: Clean Development Mechanism

to the seasonal weather predicting model. Developing a tolerant variety which can withstand global warming or climate change will also be a main focus, especially breeding of a heat-tolerant variety.

As one of the mitigation measures, the efficiency of the water-saving irrigation method for rice production that has been validated in a previous JIRCAS project will be demonstrated in the Mekong Delta. AWD stands for alternate wetting and drying, a water-saving method which enables farmers to cut down the use of pumps for irrigation. It can reduce methane emissions by leaving the paddy fields dry for some periods to allow the land to be aerated.

In the livestock industry, a monitoring method for methane gas emissions from ruminant livestock will be established and technology development for methane emission control will be carried out by improving feeding management technology.

Development of a model for sustainable rural communities with low GHG emission will be conducted in Vietnam, Ethiopia and Paraguay. Carbon sequestration through reforestation and agroforestry in degraded areas are the main activities in Ethiopia and Paraguay. Emission reduction of GHG by converting cooking fuel use from fossil gas and nonrenewable firewood to renewable biogas produced by the newly introduced biogas digester for pig farming by low income households will be achieved in Vietnam. The activities

of carbon sequestration and GHG emission reduction are aimed to formulate a CDM project in each country, and provide carbon credit for funding rural development after obtaining registration and verification by the Executive Board of CDM, UNFCCC.

Monitoring will be implemented to evaluate the impact of prolonged application of organic matters on carbon accumulation in the soil, via the research network for long-term field experiments on organic matters in Thailand and Vietnam. Evidence on the use of composting, minimum tillage cultivation and green manure crops have gradually shown results, as it was shown that increasing the organic contents of the soil is overall more beneficial for the farmers.

Changes in land suitability conditions of paddy fields are being analyzed under the research on the impact evaluation of climate change on rice production. Using the results of the analyses of land conditions, a land evaluation model for forecasting of land suitability under climate changes will be developed. Supply and demand models of rice in developing countries for the evaluation of climate change on agricultural markets will be developed by combining the land evaluation model and a crop model such as SERES-Rice to the econometric models. Furthermore, a world food model for long-term forecasting will be developed for the evaluation of climate changes on the world food market.

2. Grassland Conservation Project in arid and semi-arid regions

There were huge damages to Mongolia in the winter of 2010, in which 10 million livestock, almost a quarter of the nation's total, were lost. The loss could likely be attributed to overgrazing as well as extremely cold weather and excessive snowfall (Dzud). Therefore, a diversified risk management program and a grassland conservation system are now urgently required.

Three major approaches have been designed to establish a sustainable farming system that is resilient against risks, such as extreme weather events. Firstly, we will produce an up-to-date carrying capacity map for the effective use of pastures and develop an effective method to deliver such information. Secondly, we will stabilize farm management and economy by improving production technologies and feeding management using supplemental feeds. Lastly, through socioeconomic studies, we will determine and propose a farm management system that will be resilient against risks.



Fig. 3. Grazing sheep and goats in Mongolia (Photo by K. Toriyama)

3. African Savanna Project

This is a project to sustainably improve agricultural productivity in the African savanna, where the poverty rate is high. This project will look into two areas, which have two different sets of problems. Burkina Faso, Ghana and Niger in West Africa are areas of low soil fertility and severe soil erosion, as well as erratic rainfall. Therefore, they need the efficient use of water resources and soil conservation. The aim is to suggest a method for promoting vegetable production using existing water resources in Niger, and a research project focusing on conservation agriculture will be carried out in Burkina Faso and Ghana. On the other hand, another objective is to develop a commercial agricultural system which will make the best use of the potential of the savanna in the southern part of Africa that has a good deal of unutilized lands in spite of its high fertility. The potential of self-sufficient agriculture there is yet

untapped. A collaborative research project will be carried out using external funds, based on the JICA technical cooperation projects in Mozambique.



Fig. 4. The savanna in Southern Africa with vast stretches of cultivable land in the Nacala Corridor (Photo by Y. Tsujimoto)

4. Island Environment Conservation Project

Measures to safeguard water resources are urgently needed because islands are very susceptible to a rise in sea level and fluctuations of rainfall due to climatic changes. For research of islands made of raised plateaus of limestone coral reefs, we will focus on a deep underground stream which is flowing below a coral lime plateau in Negros in the Philippines. Focus shall also be on a freshwater environmental phenomenon called the freshwater lens, which floats mainly because of the density differential, at the top part of the aquifer which includes the island's underground seawater in Marshall Islands that serves as a low atoll island model in this research. The project will suggest a sustainable agricultural production system, develop techniques to use local recyclable fertilizers and propose a technology to manage the efficient use of the limited water resources. And then, we will develop a decision-making system for the government officials to use.



Fig. 5. The Laura district in Marshall Islands with an underground freshwater lens (Photo by K. Koda)

5. BNI Project

Nitrification, a key process in the global nitrogen cycle that generates nitrate through microbial activity, aggravates fertilizer nitrogen losses by leaching and denitrification. Nitrification and denitrification are the major biological processes for the generation and emission of N₂O and NO, the powerful greenhouse gases contributing to global warming. Agriculture contributes greater than 70% of global N₂O emissions. Certain plants can suppress soil nitrification by releasing inhibitors from the roots, a phenomenon termed as biological nitrification inhibition (BNI). Our ongoing research indicates that *Brachiaria humidicola* (i.e. creeping signal grass) has the highest BNI potential in its root systems and can effectively suppress soil nitrification and N₂O emissions.

Among major food crops, sorghum has some potential to suppress nitrification in its root systems. The BNI project is aimed at developing management strategies to exploit the BNI function of tropical pastures to control nitrification and N₂O emissions from agricultural systems, using a cropping systems approach. Likewise, in clarifying and quantifying the BNI capacity of sorghum under field conditions, its potential impact

on nitrogen use will be assessed. Advancing breeding tools such as genetic markers associated with the BNI ability, and identification of genetic stocks with different BNI capacities to facilitate breeding applications are other goals of this project.

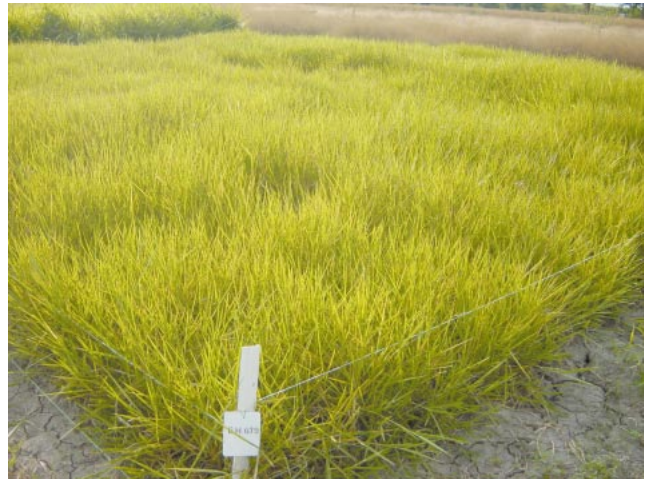


Fig. 6. Cultivating creeping signal grass in an experimental field (Photo by G.V.Subbarao)

*Tomoyuki Kawashima, Program Director
Natural Resources and Environment Program, JIRCAS*

Stable Food Production

The Stable Food Production Program corresponds to "Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments", as identified in JIRCAS' Third Medium-Term Plan. This will develop technologies to improve and sustain productivity through collaborative research with local institutions and international research centers in specific research fields wherein Japan has shown predominant comparative advantage, especially for areas in adverse environments such as those found in tropical regions. Likewise, reducing starvation and malnutrition which remain as serious problems in developing regions, and contributing to food security in the world and in Japan are also parts of its targets.

Hereunder is a summary of the flagship project of the program, "Development of rice production technologies in Africa" and other projects.

1. "Development of rice production technologies in Africa"

In Africa, delays in economic development and high population growth have given rise to poverty and food shortages. The volume of rice imports from Asia and North America has increased annually due to the rapid rise of consumption that exceeds production. Meanwhile, local farmers' techniques and knowledge of rice cultivation being deficient and the aid system and research to support such farmers' activities likewise insufficient, technological progress and increase in rice production are not yet assured.

The Yokohama Statement at the Tokyo International Conference on African Development in 2008 declared that, "African rice production will need to be doubled in the next decade." The "Coalition for African Rice Development (CARD)" was established to realize that statement and JIRCAS has participated as a member of the Steering Committee since its inception.

This project is composed of three research subjects; the content of each as follows:

1-1. A research will focus on offering new materials obtained by evaluating or improving the existing genetic resources of upland and lowland rice that are suitable for African field conditions. Efforts will be directed to reduce the losses caused by the lack of phosphate fertilizers or by rice blast, and to boost rice production.

- 1-2. The project will develop a low life cycle cost paddy infrastructure technology, an Asian-type rice cultivation system and a paddy field model suitable for African conditions. Likewise, support will be extended to enable local farmers to easily recreate Asian-type irrigated paddy fields that are banded, levelled and puddled, and carry out paddy rice cultivation (Fig. 1, 2).
- 1-3. To expand rice cultivation in areas which used to be flood plains, the project will develop a technology for effective rice production in river basins (Fig. 3).

Likewise, efforts are underway to build a framework of cooperation or launch a joint research project, so that the governments concerned or the international organizations can utilize the outputs of research with full confidence for their own projects, investigations and extension promotions. The goal of this project is to achieve the main target of CARD that endeavors to double rice production in Africa within ten years.



Fig. 1. Plowing by oxen (Ethiopia) (Photo by M. Hayata)



Fig. 2. Plowing using a power tiller (Ghana)
(Photo by N. Kawano)



Fig. 3. Rice in flood plains (The depth rises to about 1.0 meter in rainy season.) (Ghana) (Photo by J. Sakagami)

2. "Development of genetic engineering technologies of crops with environmental stress tolerance"

The project intends to establish genetic engineering technologies of crops for developing countries, aimed towards stable crop productivity in unstable environments caused by drought or poor conditions.

New useful genes and promoters shall be determined to produce environmental stress-tolerant crops such as maize and soybean. For use of adaptable genes such as the DREB genes that JIRCAS has already developed, researchers will select breeding lines for drought resistant-soybean in experimental fields in Brazil and likewise for rice, to be evaluated in several test fields in collaboration with other international research centers.

3. "Development of breeding technologies toward improved production and stable supply of upland crops"

Technologies and materials shall be developed for breeding of superior varieties to secure sustainable production against factors that inhibit the production of main upland crops such as soybean or wheat. This theme is related to food security in Japan as we rely greatly on the imports of those crops.

On biotic stress, this project seeks to develop varieties in Brazil, Argentina and Paraguay which are resistant to soybean rust, a big issue recently in South America. Regarding abiotic stress, there will be evaluation and selection of breeding materials for salinity tolerance in soybean and drought tolerance in wheat (Fig.4).

As a related research subject, it will carry out technological development to reduce salinization in farmlands and improve agricultural productivity in Central Asia (Uzbekistan).



Fig. 4. Salt-tolerant soybeans (right) (Photo by D.H. Xu)

4. "Evaluation and utilization of diverse genetic materials in tropical field crops"

Tropical field crops have a multi-faceted role to play in securing the local food supply and keeping the local agriculture diversified.

Marginal agricultural lands where crops' performance is limited are widely distributed in the tropics. To improve the supply of food and energy in such regions, the research will exploit breeding techniques and materials to generate new types of sugarcane with higher biomass yield and with wide adaptability to adverse environments, by using wild relatives.

Yam (*Dioscorea* spp.) is a tropical tuber crop which is a traditional staple in West Africa (Fig. 5). The genetics of yams is least understood due to several biological constraints and research neglect, hence the research will attempt to develop and utilize genomic information and molecular techniques to facilitate breeding for improved yam productivity in West Africa.



Fig. 5. Yam in Africa (Photo by H. Takagi)

Cowpea (*Vigna unguiculata*) is an African indigenous leguminous crop (Fig. 6), which is an important source of protein and micronutrients for the poor, and likewise augments the cash income of farmers.



Fig. 6. Cowpea in Africa (Photo by H. Takagi)

To develop high-value cowpea varieties with better nutritional values and quality to meet markets/consumers' preferences, research will delve deeper into genetic diversity and the effects of environmental factors to identify useful breeding materials and strategic breeding approaches.

5. "Rice innovation for environmentally sustainable production systems"

A low-input and environment-friendly strain of rice and cultivation technology in Asia that ensure stable productivity in poor environmental conditions will be advanced. Contribution to the promotion of the project, "Development of rice production technologies in Africa"

mentioned previously, shall be through "Improvement of Asian-style rice cultivation."

Development of breeding lines for practical usage through the Blast Research Network that was prior established will be undertaken. Regarding tolerance to phosphate deficiency, elucidation of the genetic factors and evaluation of breeding materials shall be pursued. The project will likewise establish a system of high-yielding technologies under low input conditions.

6. "Development of integrated pest management techniques for stabilization of agricultural and livestock production in developing areas"

Work will be performed on the enhancement of integrated pest management (IPM) techniques, combined with risk assessment of identified pests, individual pest control technology and economic evaluation of the developed technologies, to contribute to the stability of agricultural and livestock production. In particular, it aims to prevent diseases and insect pests, such as sugarcane white leaf disease, from inhibiting the shared cultivation technology, "ratooning", which is designed to improve the productivity of promising sugarcane breeding lines developed through the collaborative research between JIRCAS and Thailand.

Takeshi Kano
Program Director, Stable Food Production Program
JIRCAS

Rural Livelihood Improvement

We launched this new Rural Livelihood Improvement Program to achieve "Technology development for income and livelihood improvement of the rural population in developing regions", which is one of JIRCAS' Third Medium-Term Targets.

It aims to improve incomes in rural areas, and promote the practical uses of local resources, missions that JIRCAS will all tackle. We are also planning technological innovations for application to those areas. Indeed, it's likewise important to improve agricultural productivity and increase value-addition to agricultural products in order to generate more income. On advantageous uses for local resources, the goal is for recycling-oriented societies---based on sustainable productivity and diversity of both the environment and culture. The program consists of six projects geared to achieve these targets (Table 1). The core research project of the program is the "Establishment of Sustainable and Independent Farm Household Economy in the Rural Areas of Indochina", and the outlines of the other five projects are likewise indicated hereafter.

Sustainable and Independent Farm Household Economy in Indochina Project

ASEAN countries have strived towards the establishment of a regional community by 2015. But the regional development gap is a major constraint in this area. In short, there is an economic gap between the

original member countries such as Thailand and Malaysia, and the newly joined countries (Cambodia, Laos, Myanmar and Vietnam). Therefore, commercial development to promote income amelioration is urgently needed. However, it is regrettable that the original member countries have allowed their lands to deteriorate and have used excessive fertilizers due to single crop- or monocrop farming, which induced the losses of, not only agricultural productivity, but also the great diversity of their habitats.

In this project, we will develop a 'local resource management-type production technology' focused mainly on Laos. We will also suggest details of a system of agriculture, forestry and fisheries to assure both the farmers' financial independence and sustained productivity.

In the rural districts in Laos (Fig.1), self-sufficient agriculture, forestry, livestock breeding, hunting and fishing still remain together with various rice and crop cultivation practices and even the hunting of wild animals and fishing thanks to the diversity of its geographical environment (forests, open fields, rice fields and rivers). Their system seems very old fashioned and involves low inputs of fertilizer and machinery; but on the other hand, it has a first rate conservation mechanism. Because of that, Laos is often described as "the front-runner, but running a lap behind."

The project intends to learn the practical and ethical

Table 1. List of Rural Livelihood Improvement Research Program themes

1. Establishment of sustainable and independent farm household economy in the rural areas of Indochina
2. Design and evaluation of a recycling-based agricultural production system in upland farming areas of Northern China
3. Advanced application of local food resources in Asia
4. Development of biofuel and biomaterial production technologies using biomass resources in Southeast Asia
5. Development of forest management and conservation techniques through sustainable use in Southeast Asia
6. Development of aquaculture technologies for sustainable and equitable production of aquatic products in tropical coastal areas

uses of Laos' traditional local resource management practices to be able to develop a patrimonial and comprehensive production technology, and will suggest a technology package that the local farmers can introduce with ease, through broader field demonstrations in the local areas. One can expect from the project, the construction of a sustainable, stable and independent economic system for farmers, which include the preservation of the ecosystem and biodiversity in those areas. Likewise, its outcomes will be beneficial for other developed countries that have been impacted by issues of

resource exploitation and the manner that their methods have affected the ecosystem.

The specific research subjects have been set up based on the categorical structure of the domestic farm economy as follows (Fig. 2) :

1. Improvement of Stability and Sustainability for Self-Sufficient Production
Small scale irrigation, Low-input and sustainable rice cultivation, Small-scale fisheries, Forest management
2. Promotion of Sustainable Commercial Production
Dry season cropping in paddy fields, Sustainable upland crop production, Stable animal feeding, Sustainable fruit production, High-value aquatic animals
3. Socio-Economic Conditions for the Stability and Independence of Farm Household Economy
Evaluation of the new developed technologies and farming systems
4. Assessment of Biodiversity and its Conservation
Evaluation of biodiversity, Rural development methods to conserve biodiversity



Fig. 1. Laos rural Landscape (Photo by Taro Izumi)

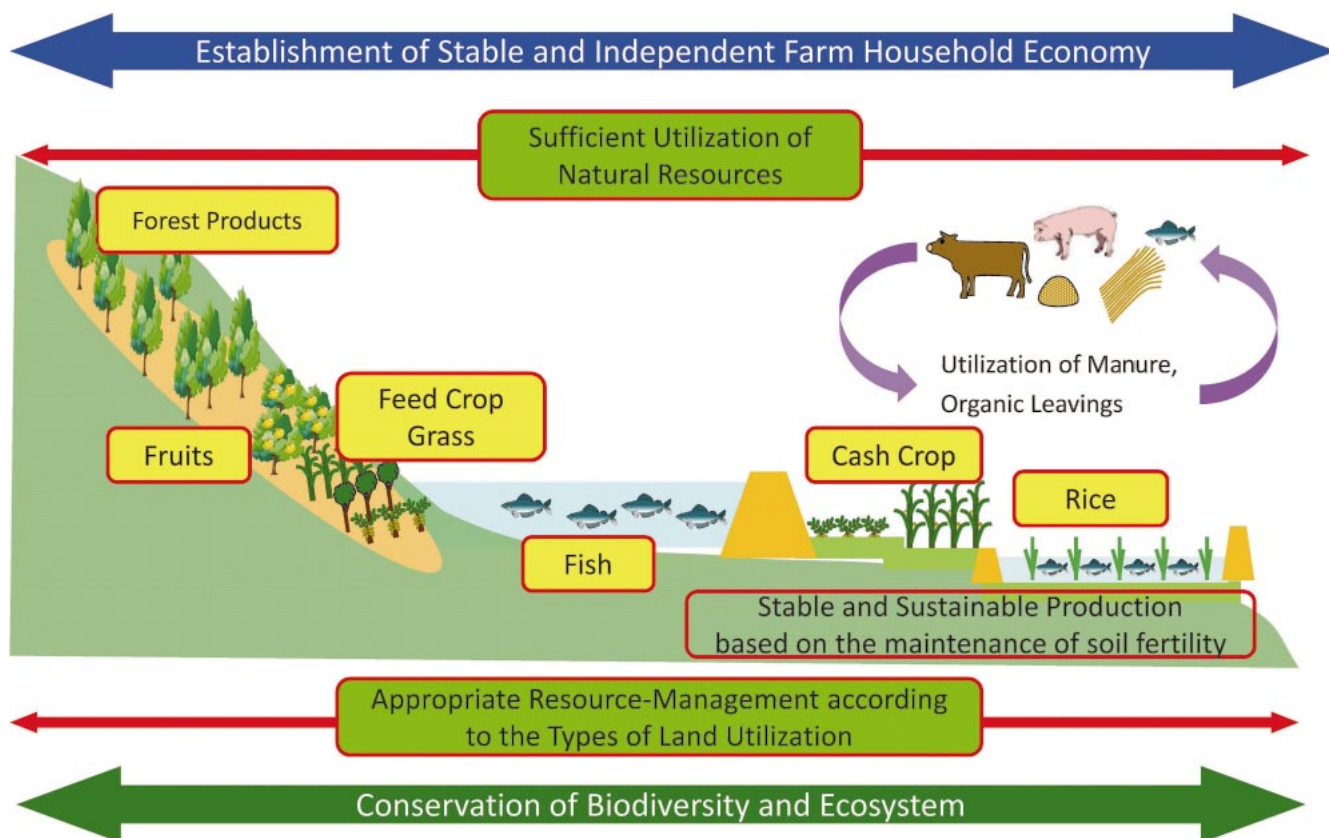


Fig. 2. Sustainable rural development based on the Integrated Research on Agriculture, Fishery and Forestry

Recycling-based Agricultural Production in China Project

The project will clarify the current situation and future prospects of environmental impacts according to the changes in the type of agricultural production in upland farming areas of northern China. Basic technologies shall be developed that will serve as the core of a recycling-based agricultural production system consisting of organic matter application technologies in intensive cereal farming areas, and high value-added cropping technologies in disadvantaged agricultural livestock regions. In addition, we will examine and suggest support countermeasures and systems, while taking into consideration the unique characteristics of a recycling-based agricultural production system in China.

Food Resources Utilization Project

The project intends to build a 'Food Resources Research Network' in Asia. The network shall include foreign and domestic companies as well as research institutes, and shall evaluate local food resources. New research themes will be sought at research organizations in Thailand and China as the base. Then, we will conduct an extensive project, re-evaluate previous results, bearing in mind that our research outputs will be used in the industries.

Regarding technology development, we will utilize these intensively, and also enhance high value-addition to the traditional agricultural products or processed foods, by enhancing their functionality or their macromolecular components.

Asia Biomass Project

The three issues enumerated below will be tackled, while aiming to understand the socioeconomic impacts of adopting biomass technology in society. Biofuels and biomaterial production technologies that do not compete with food production will be developed by using to advantage the unused biomass resources in Southeast Asia.

1. Development of efficient energy-saving ethanol production technology for fuel, using tropical crops residues, such as cassava or sugarcane bagasse residues
2. Establishment of ethanol and bio-plastic production technology for practical fuel uses from waste old oil palm trunks (Fig. 3).
3. Identification of the socioeconomic impacts of technology adoption on agriculture and rural villages and the technological requirements needed to promote coexistence between the increased use of biomass and food sustainability in Southeast Asia.



Fig. 3. Ethanol production from old oil palm trunks
Felled oil palm trunks (Upper 2 photos) contained large quantity of sap (Lower 2 photos). This sap with high glucose content can be used for ethanol fermentation.

Sustainable Forestry Production Project

The multiple functions of forests support the basis of long term and sustainable production for agriculture and fisheries, but recently, deforestation has caused impending deterioration to the livelihood of the local people. Forest management techniques are indispensable, depending on the conditions of the forest in each area due to the limited effects so far of ongoing efforts of the 'forest preservation/ restoration program'.

Therefore, we will tackle the three projects as follows:

1. In northeastern Thailand, we will try to enhance the functionality of a utilization technology and divert ecological resources in forests for the stabilization of local forestry.
2. In Malaysia, the project will establish a methodology on the sustainable use of forest resources through selective logging guidelines, while preserving genetic diversity in the Hill dipterocarp forests.
3. Development of the use of versatile technology for forest resources from plantations and artificial forests.

Tropical Coastal Aquaculture Project

The objective of our research project is to develop safe and sustainable aquaculture technologies based on environmental conservation and the carrying capacity while improving the aquaculture environment by utilizing local fishery resources in the areas. Furthermore, we aim to elucidate the physiological factors controlling reproduction in economically-important shrimp species in developing regions. The information obtained above will be applied to the establishment and adaptation of re-circulating production systems in developing areas.

In the mariculture activities of coastal areas, there occurred ecological problems, including water eutrophication and sludge accumulation at the bottom attributable to excess nutrient loading from residual diets and feces. To address these, an integrated aquaculture technology will be developed for improving the quality of water and sediments at aquaculture farms and their environs (Fig. 4). As a final goal, it will improve

livelihood prospects as well as increase employment for local small-scale farmers, by carrying out extension and promotion of technologies beneficially suitable to the characteristics of the local aquaculture.

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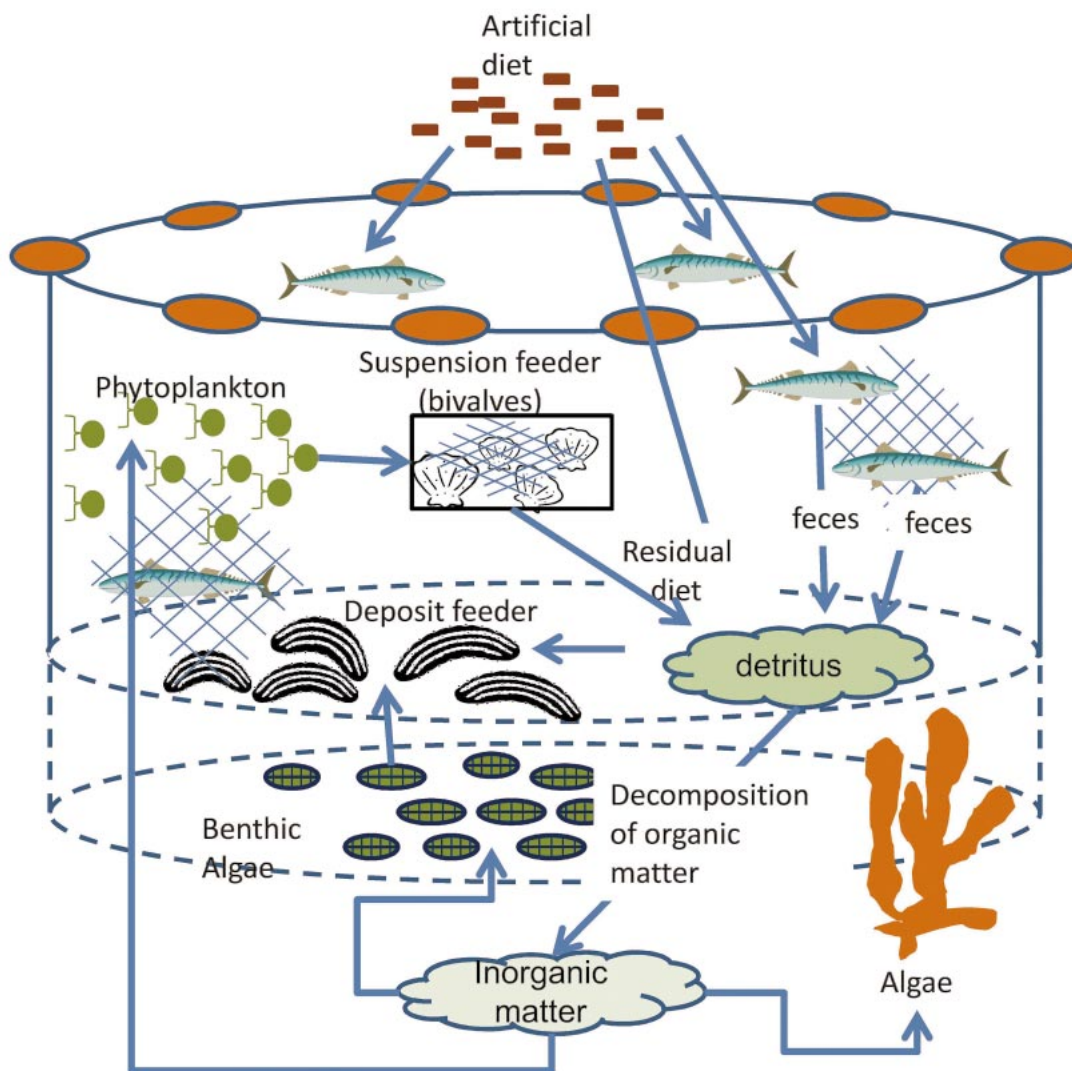


Fig. 4. Schema of Integrated Multi-trophic Aquaculture (IMTA)