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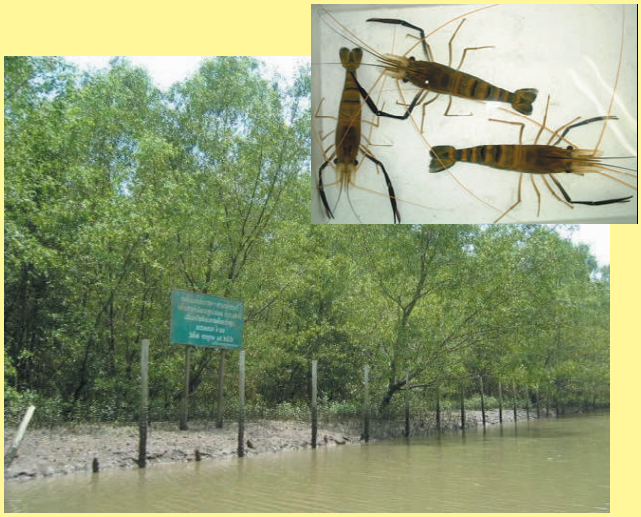
Agriculture, Forestry and Fisheries Research Council
Ministry of Agriculture, Forestry and Fishery

The International Researches of Agriculture, Forestry and Fishery for the Solution of Global Food and Environmental Issues



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1. Introduction

In An Essay on the Principle of Population, the 18th century English economist Malthus stated, "Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio," warning us that we would face a serious food shortage as the world population grows. Fortunately, we human beings have overcome that estimation by means of improvements in agricultural productivity. However, many agree that Malthus' principle is basically true and the time will come, though we don't exactly know when, that population growth will overwhelm productivity growth.

At the beginning of the 20th century, there were 1.6 billion people on the Earth. World population leaped to 2.5 billion by 1950 and now stands at 6.3 billion. It is still growing at a very rapid pace, increasing by about 90 million people every year. If population growth continues at this rate, the world population will reach 8.9 billion by 2050. (UN World Population prospect2002) (Fig1) The estimated number of new people on the planet by 2050, 2.85 billion people, exceeds the entire 1950 world population. The current growth rate is especially high in developing countries, and the estimated increase is anticipated to mostly affect developing countries. 49 countries classified as developing are expected to add a billion more people to their existing population of 668 million. With this rapid pace, we do not hesitate to call this a "population explosion."

Will this population explosion lead to world hunger?

Even today 800 million people, 15% of world population, suffer from malnutrition. These people take in only 2,000 Kcal a day and most of them are the residents of developing countries. The population explosion will certainly increase their number and worsen the condition.

We also have serious ongoing environmental crises that we have never experienced before: climate fluctuation caused by global greenhouse effects, and widening barren lands caused by soil erosion. The worldwide food crisis always looms, ready to happen in reality, and is likely to strike the developing areas first and critically.

http://www.census.gov/ipc/www/world.html
http://www.unic.or.jp/new/pr03-010.htm

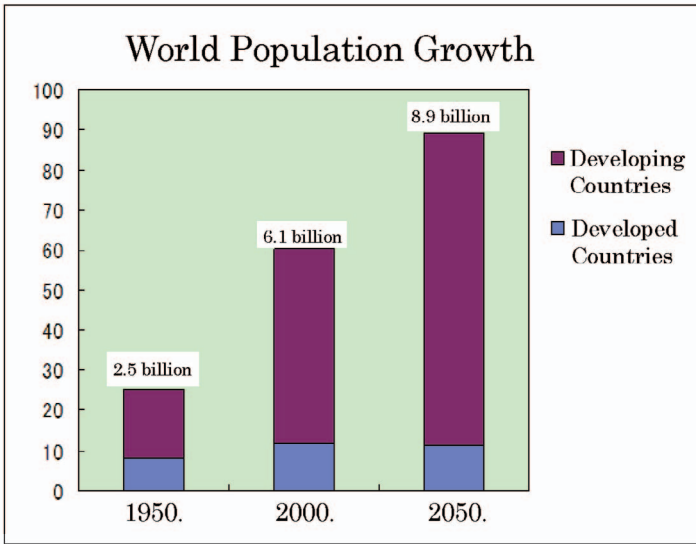


Fig.1 The World's Population Transition (UN World Population prospect 2002)
http://www.census.gov/ipc/www/world.html

2. Fluctuation in world's food production

From 1960 to 2000, the world's supply of wheat, corn and rice had had a cycle of abundant and lean harvests over the long term. This caused the excess and shortages cycles in the market, too. Nonetheless, overall food production during this period achieved remarkable growth. The success in the common agricultural policy conducted in the EU and the progress in farm plant breeding, as well as the increased application of agricultural chemicals fertilizers and pesticides brought great growth in the yields per unit.

However, since the year 2000, food consumption has exceeded production, and the stock-to-sales ratio is staying in a low level. Wheat stock had been in continuous drop from 2000 to 2003, though it is expected to recover in 2004. Corn and rice stock rates are expected to decrease again in 2004 after four downward years (Overseas food survey report 2004).

The present food supplies do not allow us to be optimistic. So as the population increases in developing countries, it will create more demand for grains, and the currently growing needs for livestock products also will generate an increase in grain demand. As a result, we will see a strained market situation in coming years. (Fig2)

Food production yields depend largely on farm acreage, which increased until the middle of the 1970s. From then, the harvesting area has decreased and together with the growing world population, farm acreage per individual is half of its area 40 years ago. (Fig.3)

In addition, growth in productivity per area is slowing down. Food production per individual hit its peak in the year 1984 and has dropped since then. (The Annual Report on the Trends on the Agriculture and the Farming Communities 2001) (Fig.4)

The production per area increased through enlargement of irrigated areas but it is getting harder to secure new sources of water. Some areas report they are already running out of water: rivers are drying up and undergrounds water levels are falling. There are other areas of increasing concern: irresponsible irrigation management, overuse of chemical fertilizers, and soil deterioration or desertification caused by overgrazing. Droughts and floods caused by climatic aberration also disturb the stabilization of food supplies.

http://www.hakusyo.maff.go.jp/books_b/WN01H140/html/index.htm
http://www.fao-kyokai.or.jp/world/index.html
http://www.fas.usda.gov/wap/circular/2002/02-05/Key_briefs.htm

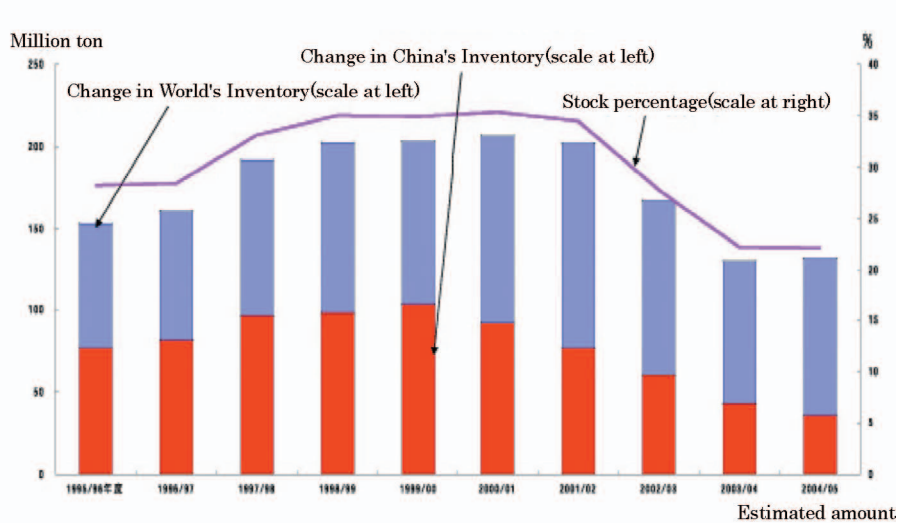
3. Global greenhouse effects on agriculture

According to a report by the Intergovernmental Panel on Climate Change, IPCC, the largest climactic change in the last thousand years happened in the 20th century: the global average ground temperature increased 0.6C. This rapidly rising temperature affects every aspect of the world's agriculture. The most prominent results of greenhouse warming are the following three:

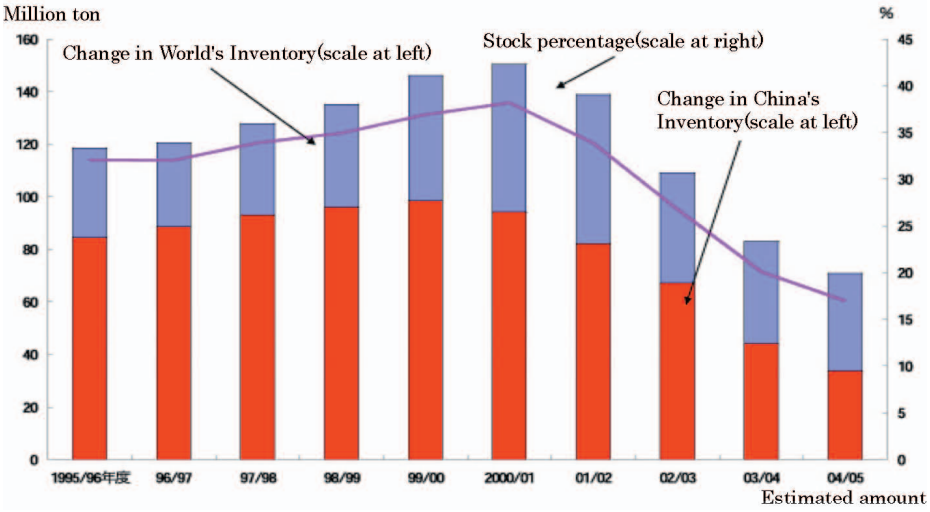
1. Decrease in production

The effects of rising global temperatures have already been observed in actual phenomena. For example, the flowering season in Europe starts much earlier now than traditionally. IPCC estimates that the rise in global temperature from 1990 to 2100 will be 5.8C at the maximum. This will result critical damages in food production in developing countries located in tropical and sub-tropical climates. (Refer to "The Report on the Effect of Global Warming to Japan 2001")

Wheat



Corn



Rice

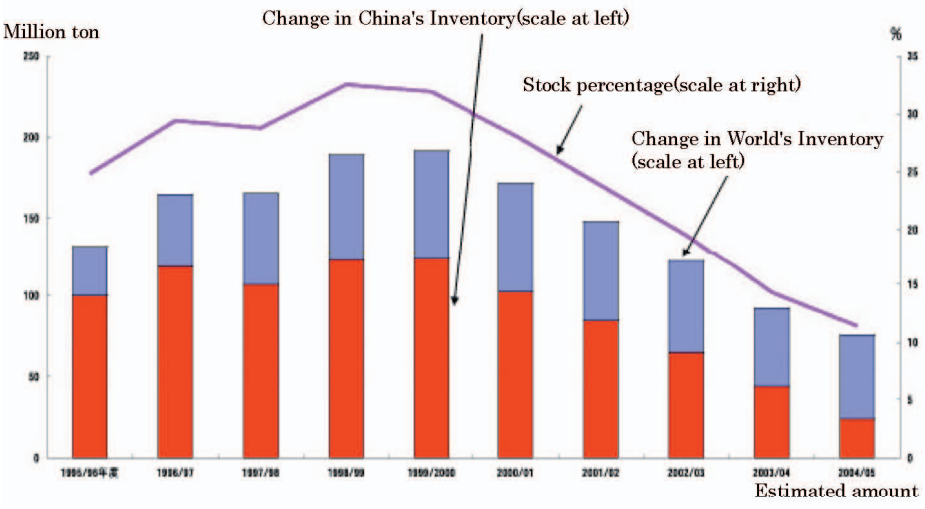


Fig.2　World's grain stock at the end of period and stock rate transition
(Top: Wheat, Middle: Corn, Bottom: Rice)
http://www.kanbou.maff.go.jp/www/jki/rep/2004kaigai-rep.pdf

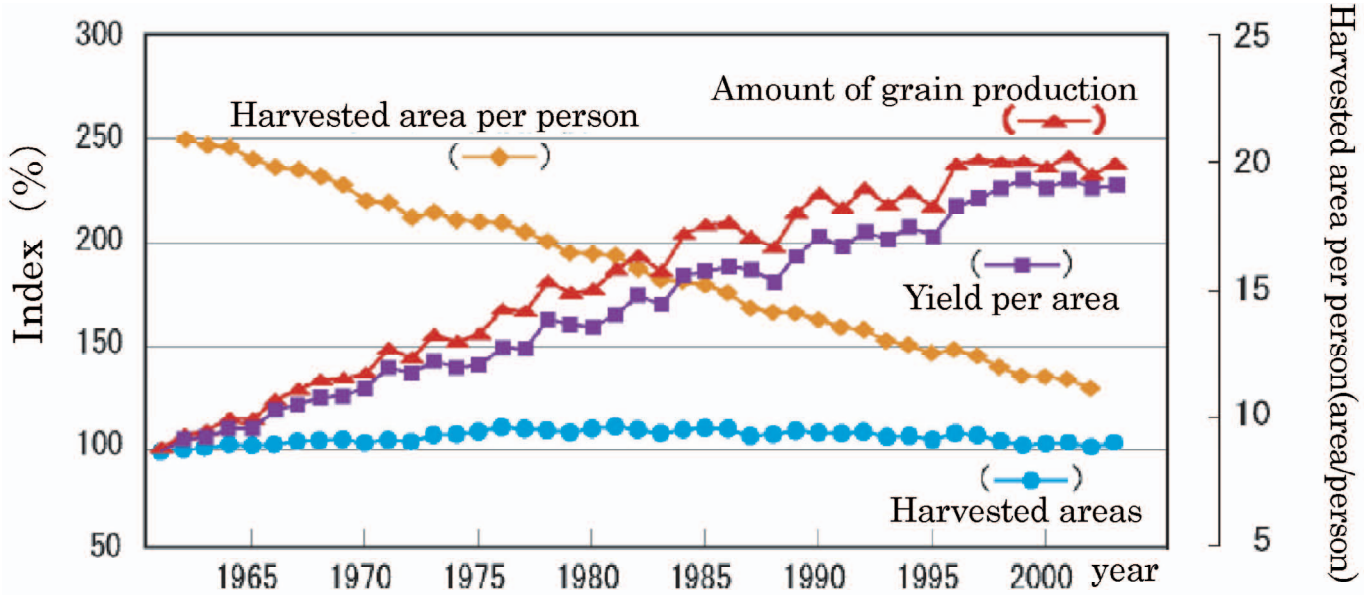


Fig.3　World’s grain production, yield per unit and harvested areas transition

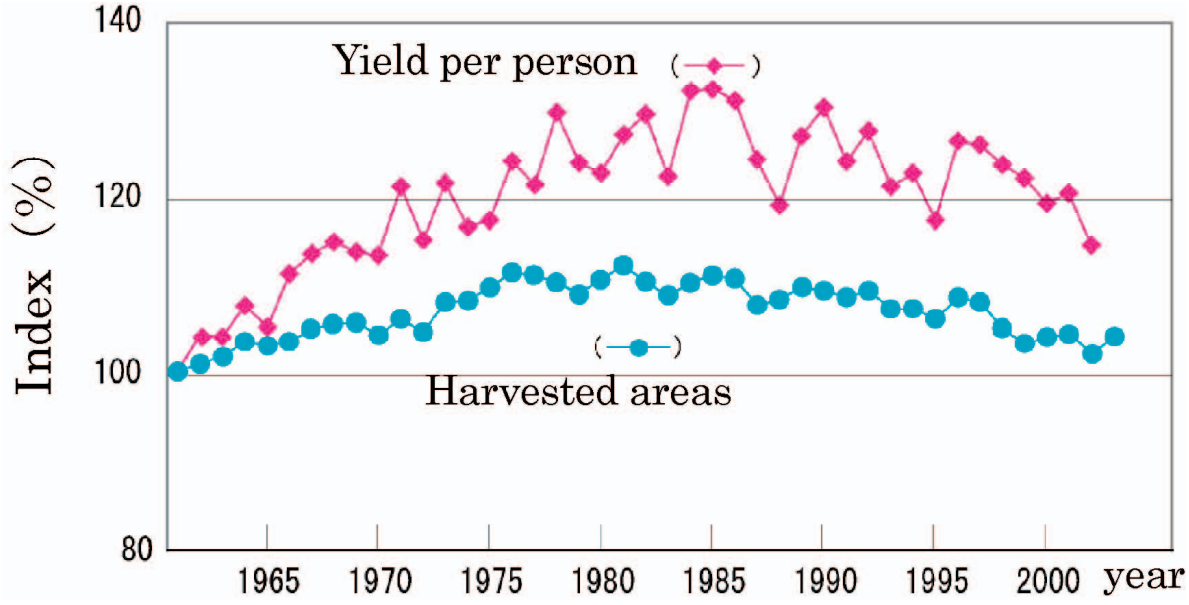


Fig.4　World’s grain harvested area and yield per person transition（1961is100）

http://www.hakusyo.maff.go.jp/books_b/WN01H140/html/index.htm

If climate alteration stays in the range of 2 to 3C, and we carefully plan and adapt to a warmer environment, we can expect some increase in the mid-latitude agricultural production. However, in the tropical low-latitudes, total agricultural yields will decrease because the higher temperature will increase aborted pollination and other processes inhibiting the harvest.

2. Decrease of accessible fresh water resources

Water is the natural resource most affected by the climate alteration. Fresh water is not an abundant resource on our planet. 97% of Earth's water is sea water. Much of the remaining 3% of fresh water is frozen ice in the polar areas. The accessible fresh water in rivers, lakes and swamps totals only a tenth of a percent (0.01%) of all the water on the Earth.

Even now, we see increasing demands for water resources. Innovations in water supply technology, particularly pumping techniques able to leach the underground water situated in deeper strata, lead to over-pumping and cause subsidence and lower underground water levels all over the world. In the North China Plain where 40% of Chinese grains are produced, the underground water level is falling at the rate of 1 to 1.5 meters per year. If the underground usage in Saudi Arabia continues at present rate, it could possibly vanish completely by 2040. (Refer to "The Third World Water Forum")

As shown in figure 5, both China and Saudi Arabia achieved over 250% increase in grain yield in three decades starting in the middle of 1960s. Climatology research models that global warming will bring more droughts to these areas and result in serious damage to the world's food production. (Fig.5)

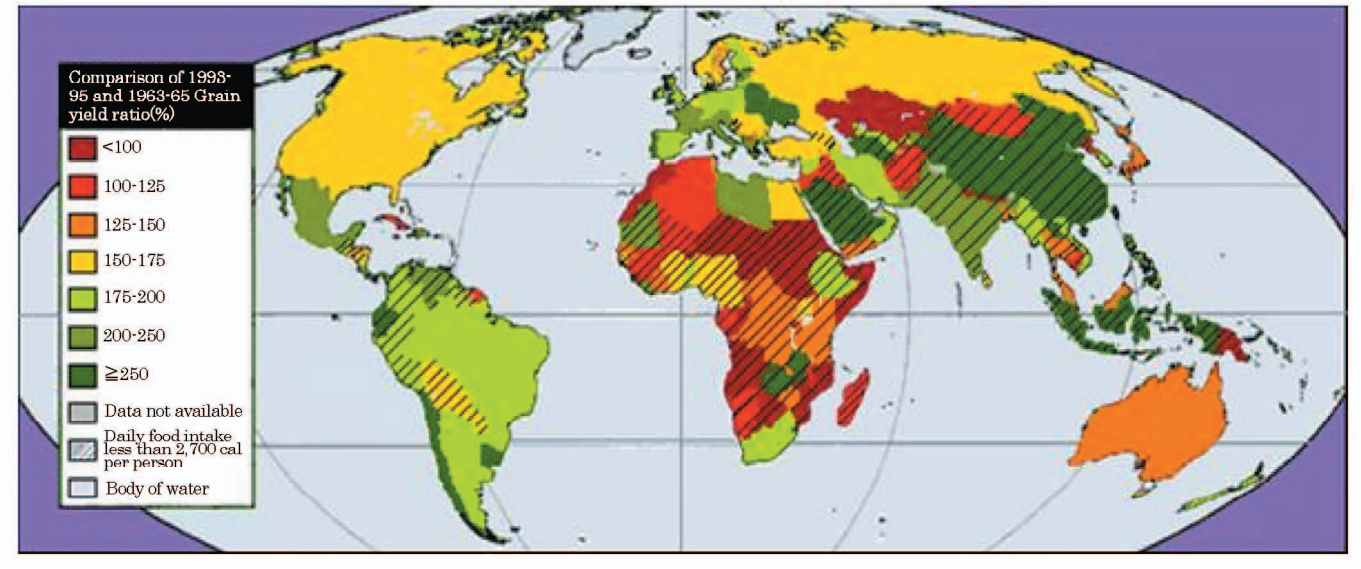


Fig.5 1993-95 Grain yields ratio to 1963-65 yields (%)
http://www.fao-kyokai.or.jp/world/index.html

3. Increase of sea level

Global warming will cause water stored in glaciers and polar ice to melt, leading to a rise in sea level. Submergence, erosion of seashores, and saltwater contamination of fresh water are the most worrying results. IPCC estimates a rise of the sea level in the next 100 years between 9 cm and 88 cm, which will affect nations located on flat islands or lowland deltas; land areas could disappear under the sea water and more damage would occur at the time of typhoon, high tide and tsunami.

http://www.mlit.go.jp/tochimizushigen/mizsei/wwf3/index.html

Changes in the global environment mean all the nations on Earth face the same problems to solve. A crisis in one country affects the whole region it belongs and thus affects the entire world. International research on the issues of food production and the environment is the one of the most urgent projects carried out by developed countries including Japan.

<Column ① : World's Forest Area and Its transition>

Forests absorb and fix CO2 in the atmosphere. Therefore forests are considered an important resource to control CO2 increases, which are seen as the main cause of the global greenhouse effect. Forest resources now cover 30% of the Earth surface but forest area as large as 1/4 of Japan is lost every year. (Average of 1990s)

Region	National area (1,000 ha) 1999	Forest area (1,000 ha)		Forest rate (%)	Yearly Transition in area (1,000 ha)	Yearly transition rate (%)
		1990	2000	2000	1990-2000	1990-2000
Africa	2,978,394	702,502	649,866	21.8	-5,262	-0.8
Asia	3,084,746	551,448	547,793	17.8	-364	-0.1
Oceania	849,096	201,271	197,623	23.3	-365	-0.2
Europe	2,259,957	1,030,475	1,039,251	46.0	881	0.1
North and Middle America	2,136,966	555,002	549,304	25.7	-570	-0.1
South America	1,754,741	922,731	885,618	50.5	-3,711	-0.4
Total	13,063,900	3,963,429	3,869,455	29.6	-9,391	-0.2

Reference : FAO State of the World's Forests 2001

4. The international effort

November 1966, the United Nation Food Agriculture Organization, FAO, organized the first “World Food Summit” in Rome. Representatives from 185 countries and the European Community attended the meeting. The international communities shared the awareness that the food supply problem will be one of the most important issues facing world leaders in the new millennium, together with issues on the population, the natural environment and the energy. "The Rome Declaration on World Food Safety" made by the summit stated that the governments and international organizations will cooperate and exert on going efforts to accomplish two main aims: achieve world food security; halve the number of undernourished people by 2015. "The World Food Summit Plan of Action" presented a blueprint for actual policies. The UN Millennium Declaration of September 2000 also included a 50% reduction of the world's undernourished population by 2015 as one of the millennium development goals for the international community.

Despite of all efforts made after the summit, the undernourished population of the world is decreasing in very slow rate. The condition is getting better in East Asia but the number of people suffering in Africa and South Asia is increasing. If we leave the situation as it is, we will never achieve the goal by 2015. Worse than that, the food supply rate in developing countries is estimated to drop to 86%, 10% lower than the 96% rate achieved during 1974 to 1976.

To accelerate the achievements of the Rome Declaration, "World Food Summit: Five Years Later" held in Rome in June 2002, called for the international efforts towards the goal. "International Alliance Against Hunger" set a target for developed countries.
http://www.fao.or.jp/international_conference/detail.html

In a world where 75 percent of poor people live on agriculture, investments in agriculture directly contribute to reducing the undernourished population. The scientific and technological improvements in the international agricultural sector are imperative to achieving the goals of the Rome Declaration. For this purpose, international research organizations will play important rolls.

Consultative Group on International Agriculture Research (CGIAR), established in 1971, is the world's largest organization for agricultural research. Their aims are to resolve the food and poverty issues in developing countries, as well as promoting appropriate management and protection of natural resources. CGIAR supports 15 international agricultural centers, where they research food productivity, management of natural resources and saving biodiversity, as well as providing support on policy and human resource development. (Fig 6) CGIAR is also known as an organization that led the "Green Revolution" to success in 1970s. They are expected to be a core organization to lead the second Green Revolution to reduce the malnourished population.

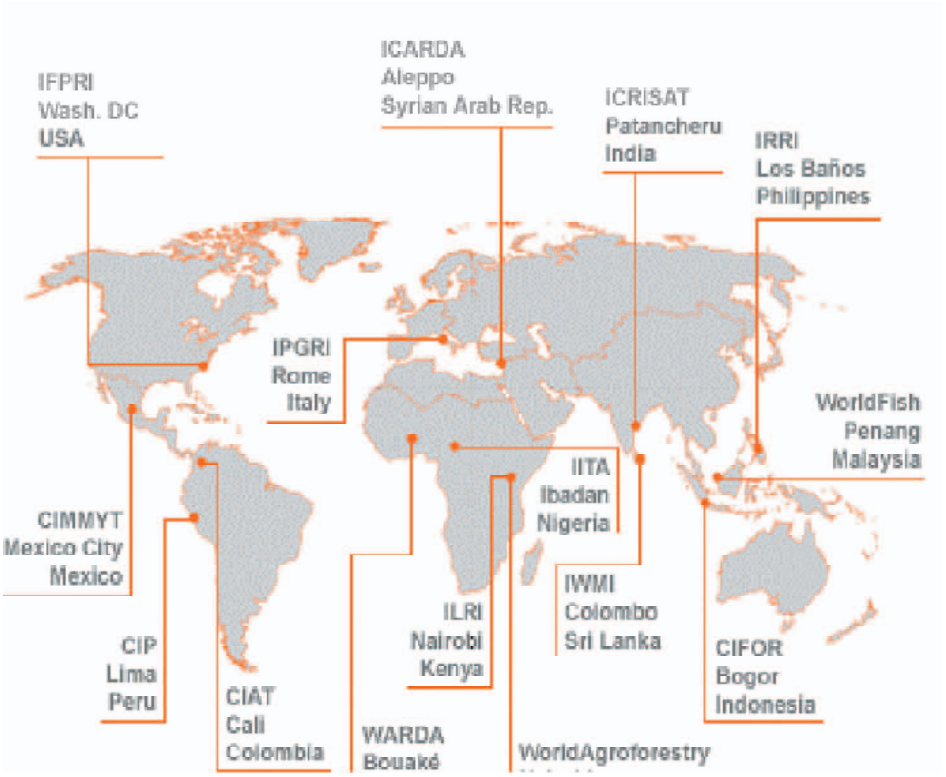


Fig. 6　15 organization of CRIAR (Present, september, 2004)

<Column ②: The Green Revolution>

The serious famines that took place in India during 1960s warned the world about theexpected food shortage in future and highlighted the necessity to increase food production on a large scale. This was when Mexico, then largely dependent on imported wheat, started to breed semi-dwarf wheat varieties by introducing Norin 10 wheat of Japan. Norin 10 wheat, developed in 1935 has shorter stems, is resistant to over-fertilized conditions and brings better yields. By cross breeding the semi-dwarf gene of Norin 10 with Mexican spring wheat, a series of improved varieties were created; e.g.Lerma Rojo and Sonara 64. This improved wheat made Mexico into a wheat exporter. The new varieties were introduced to India, Pakistan, Nepal and the countries in Mediterranean regions, and resulted in significant increases in grain production, thus known as the "Green Revolution." The role that genes of Norin 10 played in this achievement cannot be underestimated.

<Column ③: The International Year of Rice>

The UN declared 2004 as the International Year of Rice.

Rice supports the lives of half the world's population and several tens of millions of people work in rice-related industries. The rice cultivation is deeply related to the world's natural environment. Rice production is, as a single industry, the most important economic activity in the world.

The Ministry of Agriculture, Forestry and Fishery of Japan will host the World Rice Research Conference from November 4 - 7, 2004, to find resolutions for numerous challenges faced by the world's rice-related industries. The opening ceremony and keynote speech will take place in Tokyo with a research symposium in Tsukuba.

The World Rice Research Conference is the most important research event during the International Year of Rice. Scientists from all over the world will gather to share their research results concerning rice's role in the world's food security, fight against poverty, and the global environment. The participants will discuss ideas based on the up-to-date results to bring more profits and a healthier life to millions of rice cultivators and consumers.

Many poor people in the world depend on rice, not only as food but also for their living. The result of this conference will be imperative for international society to achieve the UN goals for the millennium. Through the World Rice Research Conference, the Ministry of Agriculture, Forestry and Fishery of Japan will bring together the latest rice study with domestic agricultural research facilities and the International Rice Research Center.

5. Japan's effort to support international issues on agriculture, forestry and fishery

Since 1984, Japan is the largest net importer on the agricultural field. On a monetary base, we import 10.2% of the world's agricultural products, which makes us the world's third largest importing nation, but the Japanese population is only 2% of the world. The import ratio is more than five times the population ratio, and the net agricultural import amount (import export) continues to increase. The Japanese self-efficiency in food and energy is extremely low and we largely depend on the other nations of the world for food and resources. Therefore, the world's food circumstances directly affect Japan.

Japan has accumulated technology and knowledge and we should eagerly engage in activities to find resolutions to the world's food and environmental issues. This is not only to fulfill our obligation as a developed country, but to sustain our own security and prosperity. Participating in collaborative studies with developing countries is one possible way to contribute, but points out certain limits on effectiveness and range of influence, mainly because of insufficiencies in research systems and sources in developing countries. This leads us to conclude that collaborating with CGIAR would bring better results. By enhancing relations with them, sharing our knowledge and experiences to build an organic combination, and promoting research and development, we can devise solutions to food and environment problems that are important for Japan, CGIAR and the World.

Japan became a member of CGIAR in 1972 is one of the top financial contributors. Japan has sent 70 board members, at least one for each of 15 centers and two for the International Rice Research Center, as well as 169 researchers in total. In 2002, Dr. Masaru Iwanaga was the first Japanese appointed director general of CIMMYT; Centro International de Mejoramiento de Maizy Trigo. Dr. Keiji Kainuma was selected as one of the seven-member Science Council, CGIAR, formally founded in 2003. Dr. Kainuma is also a committee member of the Agriculture, Forestry and Fisheries Research Council. By these accomplishments, Japan and CGIAR will develop further ties to corporate with each

other.

Japan carries out joint works with other international organizations. For Food and Agriculture Organization (FAO) founded in1945, we have assigned professionals in both short- and long-term projects. ESCAP-CGPRT: Regional Coordination Center for Research and Development of Coarse Grain, Pulses, Root and Tuber Crops in the Humid Tropics of Asia and the Pacific is another organization Japan is deeply involved in. We have participated in their managing council since their establishment in 1981, and all of the director generals were selected from Japan. We also have sent a number of professionals to the organization. United Nation University founded in 1972 has their head office in Tokyo, and our National Food Research Institute (Incorporated Administrative Agency) has accepted 38 trainees from UNU since 1996.

In carrying the collaborative work with CGIAR, we need to create schemes to enhance our co-relation for better results. For example:

1. *Upgrade the domestic arrangement to support CGIAR systems.*
Japan established "Japan Forum on International Agricultural Research for Sustainable Development" in July 2004.

2. *Send research personnel to CGIAR centers with flexible and well-planned intentions*
Japan has sent researchers as cited previously.

3. *Develop education and training program for young Japanese researchers in cooperation with CGIAR*
Universities are the key organization promoting this item. There are 10 major universities in Japan (7 national and 3 private) with international research departments in agricultural areas. Their graduates are expected to be core researchers for international projects in the future. We launched "International Research Career Network" project to support these young researchers.

4. Provide information to CGIAR centers on potential Japanese competitive funds

5. Support CGIAR centers in research areas involving our domestic study projects
6. Encourage domestic research organizations to cooperate with CGIAR centers

Japan International Research Center for Agricultural Sciences (JIRCAS) is an important organization bringing well-organized results. JIRCAS is the one and only public institute established for international collaborative studies with developing countries and international organizations to promote and achieve the sustainable food supply and environmental friendly agriculture and fishery.

Japanese	CGIAR	Date of conclusion	Subjects
JIRCAS	ICRISAT	1994. 5.20	Sustainable cultivation of inland crops in semi-arid tropics; development of sustainable land use systems
JIRCAS	ILRI	1995. 5.22	Study on the mechanism of the trypanosomiasis development and trypano-tolerance
JIRCAS	ILRI	1995. 5.22	Study on the mechanism of trypanosomiasis infection and development in gene defect mice
JIRCAS	ILRI	1995. 5.22	Study on the roll of TNA alpha on trypanosomiasis

JIRCAS	IRRI	1995. 8.24	Genetic study of rice blast resistance: Stabilization of rice production under tropical water stresses
JIRCAS	IRRI	1995. 8.24	Developing stabilization technique on rice production under the tropic water stress by enlargement of genetic resource
JIRCAS	IIMI	1997. 2.17	Developing effective water utilization technique in growing inland crops in dry season rice paddies
JIRCAS	IIMI	1997. 2.17	Developing MI technique to estimate salt accumulation in semi-arid land
JIRCAS	IIMI	1997. 2.17	Developing the optimum water management technique under the water shortage to diversify the crop varieties
JIRCAS	ICRAF	1997. 5.25	Study on the roll of local residents for the forest dissertation and rehabilitation
JIRCAS	CIMMYT	1998. 1.14	Establishing effective method assisted by DNA marker and haploid breeding for the disease resistant selection and high disease resistant wheat breeding
JIRCAS	CIMMYT	1998. 1.14	Establishing effective breeding method for wheat by haploid maize method
JIRCAS	CIMMYT	1998. 1.14	Breeding technique for disease resistant wheat utilizing the biotechnology
JIRCAS	WARDA	1998. 3. 3	Study on use of cross bred rice varieties for increasing rice yield in West Africa
JIRCAS	WARDA	1998. 3. 3	Genetic and physiological ecologic study on environmental adaptability of cross bred rice between Asian and African rice plant
JIRCAS	WARDA	1998. 3. 3	Study of social economical issue concerning the promotion of rice cultivation technique in West Africa
NIAS	IPGRI	2001.12.10	Analysis of genetic variety in Ceratotropis plants
JIRCAS	IRRI	2002. 3. 7	Physiological study on yield decision factor and environmental adaptation for developing environmentally sustainable method for rice cultivation

6. The research systems of JIRCAS

JIRCAS was established in 1993, by reorganizing the Tropical Agriculture Research Center (TARC). TARC had mainly worked with developing countries, fulfilling their request by sending researchers for certain areas of study. These bilateral research projects realized difficulties because the research levels and political instabilities of the partner nations largely affected the projects. JIRCAS, in contrast, carries out international collaborative studies by following well-discussed plans made by the governments and the research organizations, and by sending researchers for long and short terms. JIRCAS also develops domestic research projects to support these projects, to which JIRCAS invites overseas researchers to join Japanese organizations. Other collaborative studies with international research institutes provide support to the overseas projects. While the institutions still carry on bilateral projects, they now emphasize collaborative works with international institutes supported by CGIAR to facilitate the processes and to bring results more effectively.

The following 7 items are JIRCAS's recent major projects; unlike existing research projects that were carried out in the individual areas of researchers' interests, these are the comprehensive studies targeting on the key subjects in the strategically important regions for the world's food supply. These employ multi-disciplinary professionals including social and economic majors to tackle the issues multilaterally and systematically.

1. International collaborative projects
As of 2004, JIRCAS leads 8 projects in cooperation with CGIAR centers. The projects are planed in 5 to 10 year terms. Most of them are in Asia, but recently Africa was added as an important strategic region.

2. Domestic projects
Some important research studies on food and agricultures of developing counties and regions require facilities with high-tech environments and knowledge that is not available in the overseas centers. Worldwide information references in relation to developing countries and their analyses are also carried out in Japan.

3. Invitation of researchers
Researchers and research project managers are invited to Japan for further study and/or to obtain further education training to enhance human resources.

4. Information references, analyses and public relation works
Accumulation, references and analyses on information on agriculture and their trends, as well as demands for collaborative works in major developing countries are carried out on an international basis.

5. International symposiums, workshops and seminars
JIRCAS hosts events to draw out major issues on agriculture in developing countries and regions, thus clarifying the issues to be treated in future research. The events also provide chances to use JIRCAS activities and research results to promote internationally collaborated works.

6. Technical assistance for developing countries
JIRCAS provides support and assistance to other international cooperation organizations such as JICA by sharing its knowledge and experience accumulated through research work. For example, JICA established a technology transfer project based on the technology developed by the collaboration work of JIRCAS.

7. Think-tank function
JIRCAS is one of the most well informed organization on the subjects of agriculture, horticulture, forestry and fishery as well as social and economic issues in developing countries. Answering requests

from domestic and overseas administration bodies, NGO aid organizations and citizens, JIRCAS provides suggestions, advice and results of researches.
http://ss.jircas.affrc.go.jp/index.sjis.html

7. University research facilities

Japanese universities not only promote international agriculture researches, but also contribute to educating and training the people who will play important roles in the international community. Major universities equipped with international agricultural facilities are listed below.

University of Tsukuba http://www.tsukuba.ac.jp/
Alliance of Research on North Africa is carrying out research on North Africa. Their major area of activity is Tunisia. ARENA aim to carry collaborated studies with North African countries in their four major areas of studies: language and culture; the arid area environment; biotechnology; and information and communication.

The University of Tokyo http://www.ga.a.u-tokyo.ac.jp/
The University has launched an International Agriculture major at the Graduate School of Agriculture and Life Sciences. Their intention is to accumulate achievements in research and education area incorporating international view points which were not possible in the existing range of majors and they also expect to encourage collaborative works.

Tokyo University of Agriculture and Technology http://www.tuat.ac.jp/~ieas/
The University offers an International Environmental and Agricultural Science major in the Masters program. The major includes following three fields: International Environmental Rehabilitation and Conservation; International Biological Production and Resource Science; and International Development in Rural Areas. Their aim is to develop sophisticated technological systems for agricultural production that achieve environmental purifying, rehabilitation and conservation. The research is carried out in the long term under comprehensive perspectives to create the basis for this aim. The students are expected to be "leaders in the field" equipped with pragmatic agriculture technology, and to organize and carry out the regional development projects.

Tokyo University of Agriculture http://www.nodai.ac.jp/
The University provides the Faculty of International Agriculture and Food Studies composed of following three departments: International Agricultural Development aims to turn out pioneering engineers who will play an active part in the world in international aid; Food Environment Economics trains environmentalist economists with expertise in global food economic systems; Bio-Business Management and Information develops experts in bio-business capable of planning global information strategies.

Nihon University http://www.brs.nihon-u.ac.jp/gs/navy.html
At the Graduate School of Bio Resource Sciences, the University provides two majors: International Food Economics Studies; and International Development Studies. Both contend with the global issues on food and development of resource allocation.

Nagoya University http://www.agr.nagoya-u.ac.jp/%7eiccae/index-j.html
International Cooperation Center for Agricultural Education (ICCAE) was founded in 1999, and is carrying out its own development projects; e.g. "The agricultural influences brought by seawater resistant rice plant introduced in Macon Delta areas" and "The structure and function of agriculture promotion in China."

Tottori University http://www.tottori-u.ac.jp/main/flash_submenu/index_da.htm
Located near the Tottori dune, the university own the Arid Land Research Center founded in 1990,

serving as the center of arid land research in Japan. The center conducts basic research for the prevention of desertification and the development and usage of arid lands.

Kyushu University http://bbs1.agr.kyushu-u.ac.jp/tropic/
The Institute of Tropical Agriculture has two sectors: water control and environmental reservation; and crop production. The crop production sector deals with farming systems in tropical and sub-tropical climate and they are creating a database of disease and pest information. The water control and environmental reservation sector carries out studies on the ecology and physiology of forest trees, environmental conservation of tropical forest, climatic damage in tropical and sub-tropical areas, water environmental mechanism shift caused by environmental changes as well as the land use in watershed areas affection over water quality of river and underground water source.

University of the Ryukyu http://www.u-ryukyu.ac.jp/en/for_student/jointuse/jointuse_index.html
The Tropical Biosphere Center is carrying out research related to the environment and living things in the tropical biosphere.

8. Private Organizations

NGO and other private organizations do not conduct international collaborative research, but regardless of their sizes, they have accumulated experiences and know-how through their activities, and are expected to provide effective information to figure out the true demand of people.

The Asian Rural Institute http://www.ari.edu/
Founded in 1973, the Institute provides training courses for rural leaders who will head activities in Asian and African local communities. Their achievements are highly evaluated in the international community, and in 1996, founder Dr. Toshihiro Takamami was granted the Ramon Magsaysay Award.

ICA Japan http://www.icajapan.org/
The Institute of Cultural Affairs has a long history of activities since their founding in the US in 1953. ICA Japan was launched in 1982 as volunteer organization and provides support for agriculture projects in the Philippines, Vietnam and Kenya. The Kitui Integrated Rural Development Program in Kenya, conducted with JICA, should be noted for their approach to collaborate with NGO and ODA for more effective results.

OISCA http://oisca.org/indexj.htm
Oisca was founded in 1961 as International Organization for Cultivating Universal Human Spirit. They now carry out a range of agricultural projects in Papua New Guinea, the Philippines, Malaysia and other developing countries.

LIFE: Live with Friends on the Earth http://www.ne.jp/asahi/life/home/
LIFE developed from volunteer organization The Tokyo Branch of the Japan-Asia Friendship Society (JAFS) founded in 1986. Their main activities are water well projects and tree planting projects in India and Indonesia.

Japan International Volunteer Center http://www1.jca.apc.org/jvc/
The organization was founded in 1980 to aid refugees in Thailand. They conduct various aid activities to make "villages that would not create anymore refugees," focusing on community-based development and life-improving activities in rural areas, specifically, water supply, agriculture, tree planting, healthcare and vocational training.

Action for Greening Sahel http://www.jca.apc.org/~sahel/
The organization was founded in 1991. It is conducting activities in the fields of forestry, agriculture and fresh water fish cultivation in Chad and Burkina Faso.

9. The Result of International Collaboration Research Works

Of International collaboration research works carried out by research bodies and Universities, the JIRCAS projects are the largest in the scale. Listed below are some examples of results from ongoing projects.

"Development of Agro-forestry Technology for the Rehabilitation of Tropical Forests" (2000 to 2006) aims to establish a technical system that enables us to recreate tropical forest consisting of a variety of organisms. In tropical regions, artificial and planted forests, mono-cultured oil palm and rubber tree forests created by plantation farming, and devastated secondary forests are increasing at a rapid rate and the diverseness characterizing tropical environment is endangered.

In this project, JIRCAS developed a technique to produce cellulose from the empty fruit bunches of oil palms otherwise abandoned as industrial waste. Oil palm is a useful crop. The per unit area amount of vegetable oil produced from oil palms is significantly high compared to other plants. (Fig.7) The oil is also rich in vitamin A and E. It has been drawing public attentions as a supplement food for patients of vitamin A deficiency and as an anti-aging and anti-cancer food and as a result, its production is increasing. (Fig.8) On the other hand, the woody parts like empty fruit bunches are currently thrown away without any use. We developed an environmentally friendly technique to draw out cellulose pulp from these EFB. (Fig.9) Cellulose pulp is used as the starting material for cellulose derivatives and regenerated cellulose production, and for tropical nations where a large amount of unused tropical lignocellulose resources exist, this will be a key technique to create a domestic and integrated production system to manufacture industrial products from the raw materials.
http://www.meti.go.jp/report/downloadfiles/g30922b41j.pdf

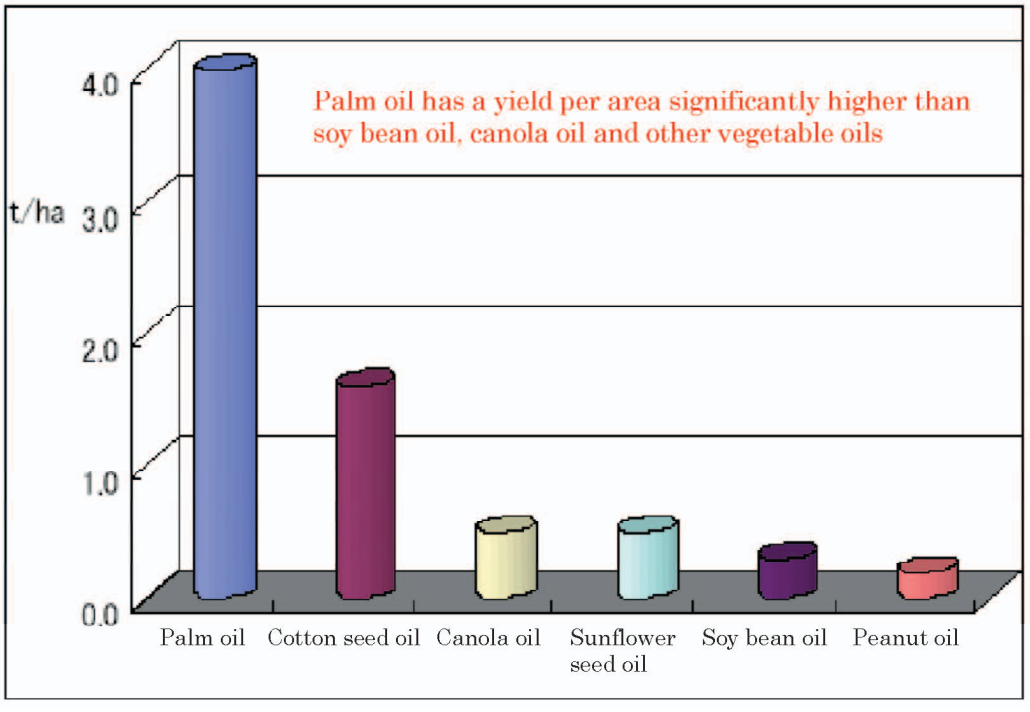


Fig. 7　Amount of oil produced per unit area（t/ha）
http://www.meti.go.jp/report/downloadfiles/g30922b41j.pdf

The majority of the world's palm oils are produced in Malaysia and Indonesia

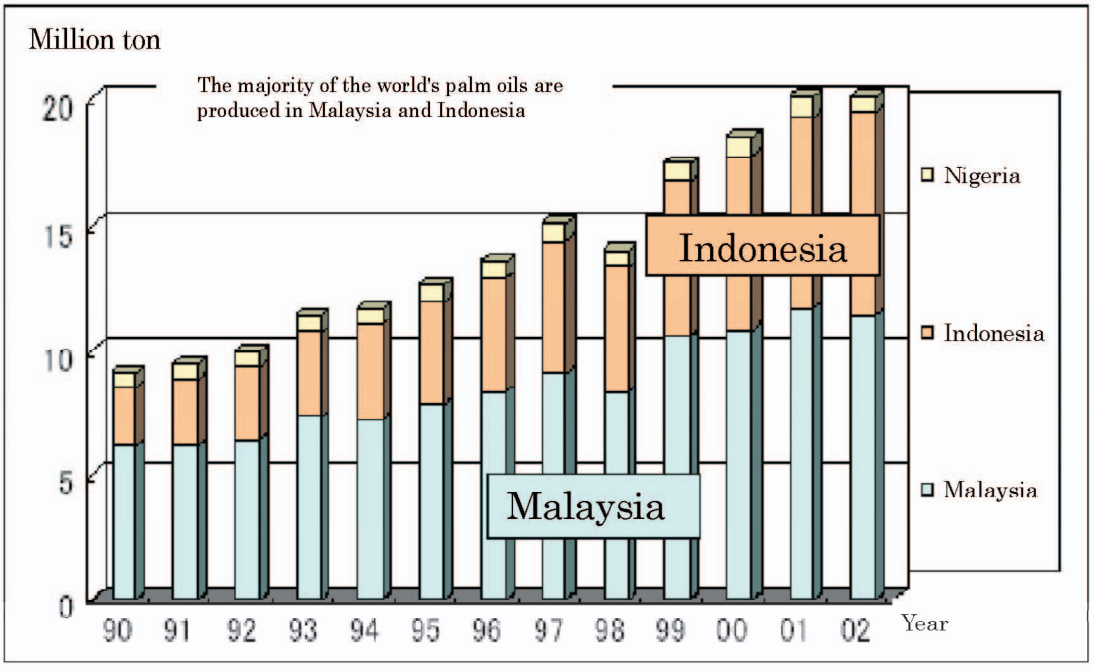


Fig.8 Amount of oil produced in major countries
http://www.meti.go.jp/report/downloadfiles/g30922b41j.pdf

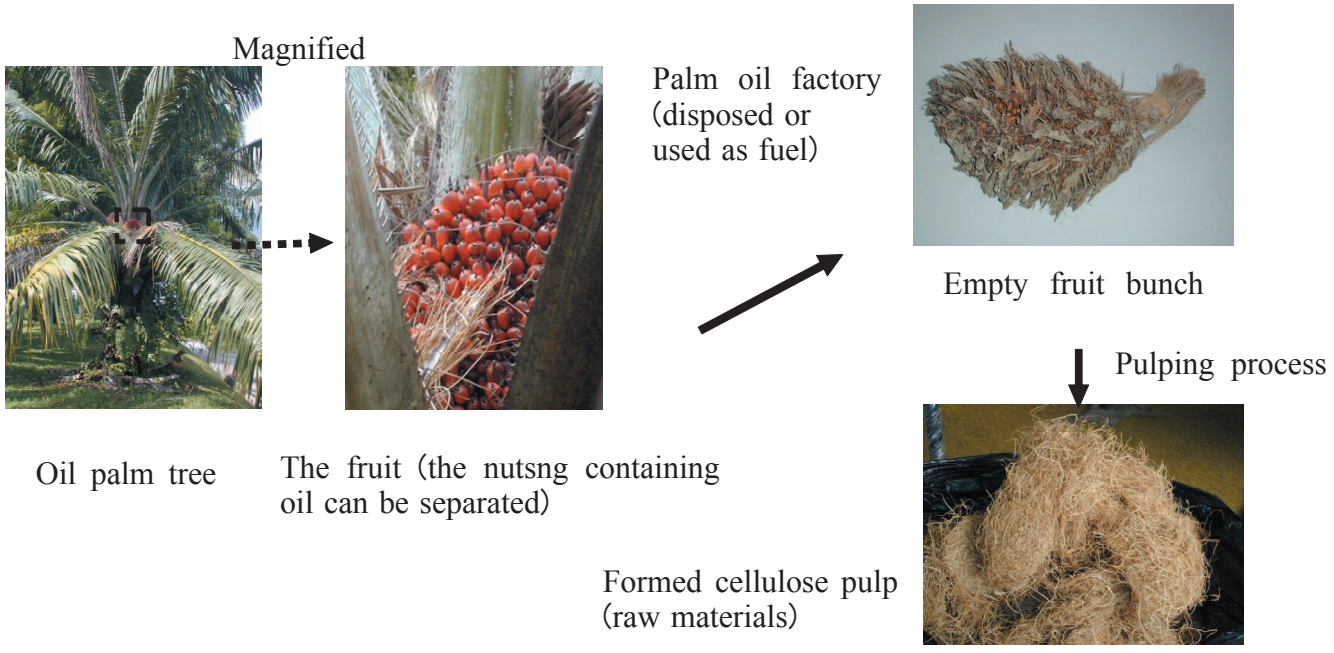


Fig.9 Extraction of cellulose from empty fruit bunches of oil palms
(Photo by Mr. Tanaka of JIRCAS at Malaysia in 2001)

"Productivity and Sustainable Utilization of Brackish Water Mangrove Ecosystems" (2001 to 2005) focuses on the coastal region where natural mangroves are deserted and deteriorating, and aims to develop a low input aquaculture system utilizing the natural water circulation that mangrove forests have.

In the Macon delta region of Vietnam, the giant fresh water prawn is expected to be an important target shellfish for aquaculture. The major problem here was the low survival rate of prawns during the early period of growth; after hatching until transformation to baby prawns. By introducing a more sophisticated aquaculture method, the survival rate improved significantly. The amount of baby prawns produced in Vietnam increased by 50 times compared to 1990 and has achieved a total yield of 50 million prawns.

The prawn and other aquacultures are conducted in the tropical coastal regions. The culture ponds are built along coasts including the mangrove-hinterland. A large amount of sewage water drains into the natural water system severely impacting the ecology by causing eutrophication and reduction of the biodiversity. We now are discussing development of a semi-closed system for managing sewage water. The idea is to conduct sewage through a mangrove planted pond that will function as a natural purification system and send water back to the culture pond again. The technological system is important to recreate the endangered mangrove forests. (Fig.10 to 12)

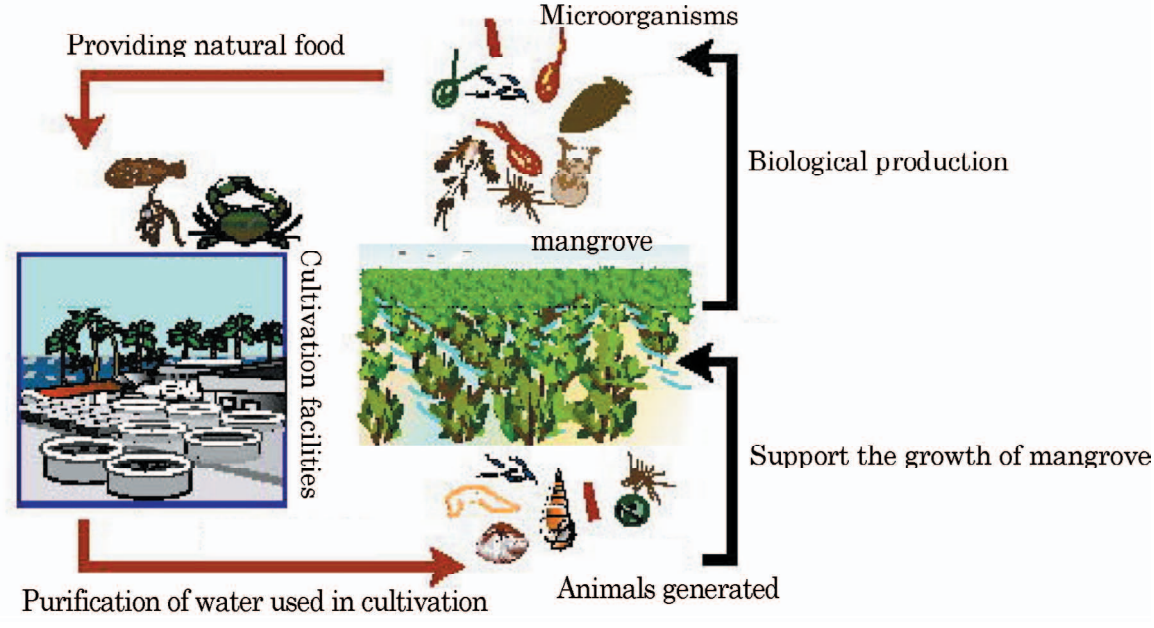


Fig.10 The water purifying system for culture pond sewage using mangroves

Fig.11 Purifying pond using window fans (mangrove will be planted to complete) Experimental aquaculture pond of Coastal Fishing Research Center, Kasetsart University, Thailand (Photo by Mr. Fujioka Yoshizo of IRCAS in May, 2004)

Fig.12 Mangrove purifying pond Experimental aquaculture pond of Coastal Fishing Research Center, Kasetsart University, Thailand (Photo by Mr. Fujioka Yoshizo of IRCAS in May, 2004)

"Development of soil fertilization management techniques in semi-arid tropic Africa" (2003 to 2007) is a project carried out in collaboration with ICRISAT Sahel center. Its purpose is to avoid soil depletion in the farmlands and to improve the productivity in savanna areas where the annual rainfall is minimal and less fertile sandy soils spread.

Africa suffers from chronic food shortages caused by stagnant agriculture and increasing population. At the same time, amount of rice consumed in Africa has increased rapidly since the 1970s, making them more dependent on imported rice.

With this background in mind, the effort to breed a new variety of rice started in Africa in the early 1990s. Overcoming periods of difficulty, NERICA -NEw RICe for Africa- was created in 1994 by WARDA, headquartered in Cote d'Ivoire, with financial and technical support from Japan and other developed nations. Japan provided support by sending out researchers and experts from MAFF, JIRCAS and JICA while MOFA offered financial support.

NERICA is a dry rice bred by crossing drought- and pest-resistant West African rice with high-yield Asian rice. To avoid confusion with hybrid rice, we call it NERICA. NERICA has a number of supreme qualities: e.g. high yield; fast ripening; drought-, pest- and weed-resistance. It is rich in protein, too, containing 9 to 10% protein compared to existing rice with only 6 to 8%). The UN expects this rice to play a role as a key crop in the solution of poverty and food security issues. The multilateral research and development proceeded significantly through collaborative study carried between WARDA and JIRCAS, e.g. "Study on utilization of cross bred rice varieties for increasing rice yield in West Africa" concluded in March 1998, breeding more than 3,000 lineages of NERICA. More than 200 varieties selected from those are now in the stage of extension in actual cultivation.
http://www.undp.or.jp/Publications/Nerica.pdf

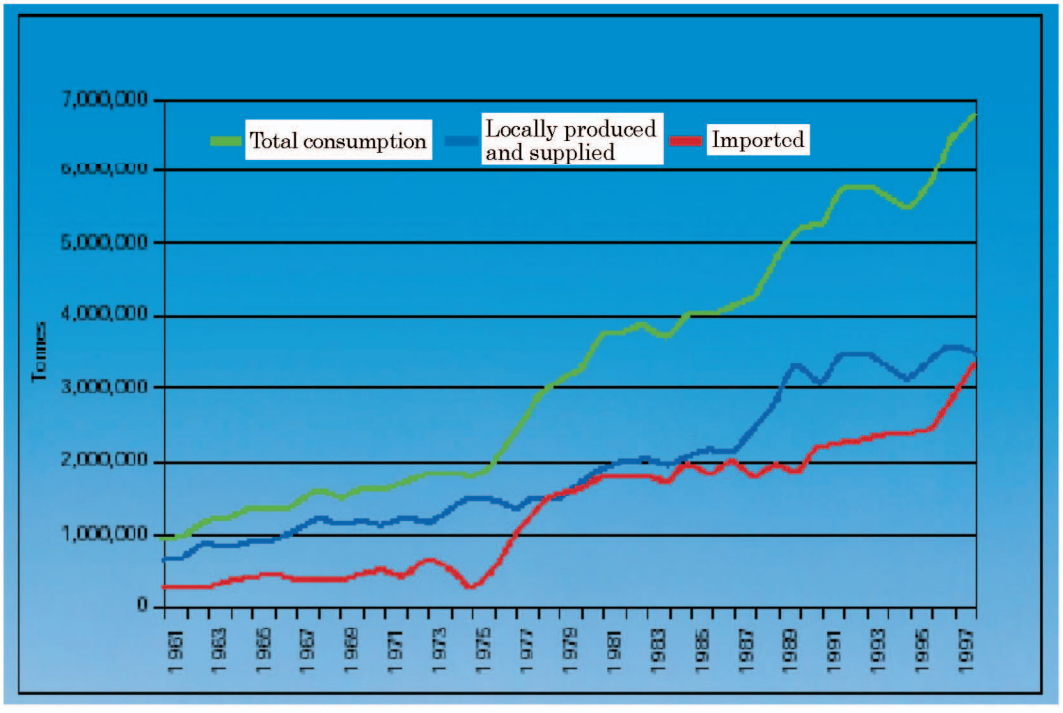


Fig.13 Transition of rice consumption in West Africa
http://www.undp.or.jp/Publications/Nerica.pdf

Fig.14　NERICA cultivated in the field
(Photo by Mr. Tobita of JIRCAS at a rice field of Cote d'Ivoire farmer, August 2000)

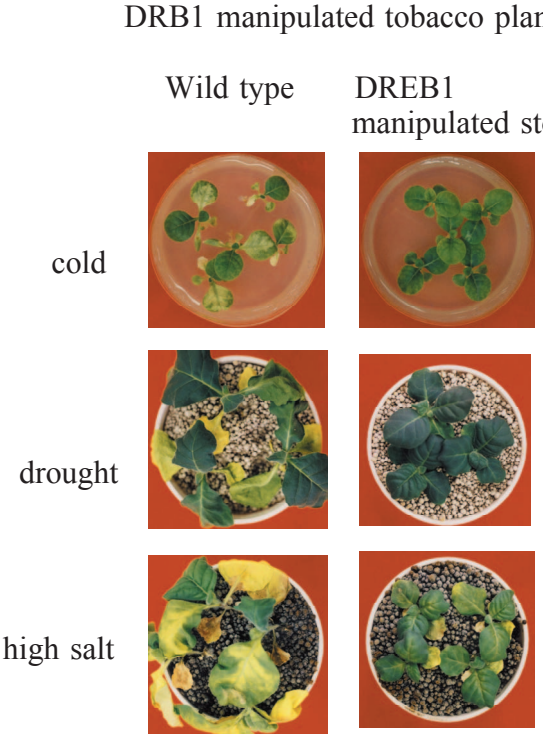
<Column ④: Developing hostile environment resistant crops>

Plants put in hostile surroundings develop various environment resistant genes to adopt themselves to the environment. We discovered DREBIA; a gene regulating these environmental resistant genes. By improving the DREBIA gene and introducing it to plants by genetic engineering techniques, we can create new plants highly resistant to drought, salt and freezing. The technology is expected to be applied to create crops and trees with the ability to adapt to global environment deterioration. JIRCAS is now conducting some collaborative research projects to apply DREBIA to rice with IRRI, to wheat with ICARDA, to wheat and corn with CIMMYT and to soybeans with EMBRAPA.

The drought resistance of genetically manipulated rice with DREB1

Wild type　DREB1 manipulated stock a　DREB1 manipulated stock b

DRB1 manipulated tobacco plant



(Photos provided by Shinozaki Kazuko of JIRCAS)

<Column ⑤: Stone mulching>

The agriculture lab of Tokyo University of Agriculture lead by Fukunaga Kenji has been working with a desert greening project in the Republic of Djibouti in northeastern Africa. Through their activities, a unique stone mulching method was developed.

The stone mulching works just as it literally means: place cobbles on the ground leaving some space in between. The space could be several cm to 10 cm. Cover them with a small amount of soil and place seeds in the soil between the stones. (Photo.1) In Djibouti, the ground surface temperature reaches 70 to 80 C in summer and even in winter, hovers around 50 C. Shaded by the stone, the surface temperature is as much as 20 C lower. Therefore, the stone mulching slows down the evaporation of water in the soil, and by doing so, prevents accumulation of salts caused by the evaporation and controls the surface temperature. The mulching provides water to the ground by stimulating dew formation and avoids soil erosion as well. Photo 2 shows a sprout in stone mulching. This is leguminous tree suited for desert greening. 5 years after, without any irrigation, the tree had grown as shown in photo 3.

Photo 1: Stone mulching applied to the ground surface

Photo 2: Sprout of leguminous plant (Leucaena) 1 week after seeding

Photo 3: 5 years after without any irrigation

<Column ⑥: Citrus Greening Disease>

Citrus greening disease is seen commonly in Southeast Asia. It was named so because once infected, the citrus fruits stops growing and turns green. (Photo 1) The disease was first reported in South China in 1919 and broke out in China in 1943. Then it started to spread to the adjacent areas of Asia; continental Southeast Asia to the Philippines and the Indonesian islands. It had reached New Guinea in 2001. As the symptoms worsen, all the leaves of infected trees fall and in 2 to 3 years, the trees start to die. (Photo 2) This plant disease is transmitted by a small insect named Asiatic citrus psyllid, whose body is only 2 mm long. The disease is attacking Japan, too. It first infected Okinawan plants in 1988 and is coming north along the Nansei Islands located in the south of Kyushu. In Tokunoshima Island, a notable number of trees died in 1 year after the first infected tree was reported.

The only measure to protect citrus crops against this disease is, currently, to cut down the infected tree and plant a new non-infected tree instead. Until today, most of the effort was made to develop a diagnostic method to identify the pathogenic germs to stop further infections. However it is almost impossible to cut down all the infected trees particularly the garden and wild plants and therefore we are powerless to stop the disease. We now must focus on the Asiatic citrus psyllid to develop new methods to avoid infection. By studying its ecology, new methods to prevent infection could be developed; e.g. physical way to prevent the bug by using fly-screen nets and windbreak trees and/or utilizing bug avoiding materials and attractant to trap and kill them.

Photo 1: Healthy fruit and infected fruit
(Photo taken by Mr. Imada of NIFTS
at Katmandu, Nepal)

Photo 2: abandoned fruit farm and dead trees
(Photo taken by Mr. Imada of NIFTS
at Cameron Highland, Malaysia)

Photo 3: Asiatic citrus psyllid sucking citrus tree sups
(Photo taken by Mr. Ashihara of NIFTS, 2003)

10. The development prospect of international agriculture, forestry and fishery research

In next 100 years, the Earth will experience a population explosion and global warming that we never have encountered before. Whether we can avoid the catastrophe largely depends on the improvement of agriculture technology and environmental conservation in all areas of the world. As globalization proceeds, it becomes impossible for any nation to set itself apart from these global crises. We must admit now that global benefits are national benefits and global problems are national problems. Japan must contribute to international agriculture more than ever.

We cannot solve every existing issue. To conduct international agricultural research projects using limited human and financial resources effectively, we need to build a strategy to focus on the distinct target of our own nation. To enable this, we must assess trends of overseas and domestic research, consider the effectiveness of the research and development, maintain knowledge of up-to-date achievements of research and development, and then must map out the research fields where Japan can contribute internationally. At the same time, to improve our ability to contribute to solving problems, we must establish a flexible research system by overcoming difficulties in exchanges among relevant organizations. To serve this purpose, Japan Forum on International Agricultural Research for Sustainable Development was established in July, naming JIRCAS as the secretariat. The forum is expected to play an important roll in promoting international research projects.

Asia and Africa are the two areas where most of the people suffering from malnutrition reside, and these are the areas Japan must focus on. The most important subjects for our research will be following three: balancing development and environmental conservation; decreasing poverty; and approaches for the global issues.

In making an effort to balance the development and environmental conservation, following subjects for research are most suited to Japan: maximize the yield capacity per unit area by using all potential biomass in the region; develop farming systems for areas of soil deterioration (agricultural methods combining tree plantation, vegetable and feed stuff cultivation and livestock breeding in multilayered and multifaceted ways), develop animal disease diagnosis methods in extensive areas and crop protection technology against hazardous insects and diseases. The development of cellulose extraction from oil palm fruit waste sited above is a good example of achievement in this field. For biomass research, we must bring into our view the clean development mechanism approved by the Kyoto protocol. (The clean development mechanism is a system that allows a developed country supporting developing countries in their effort to decrease CO2 and other greenhouse effect gases can count a part of that achievement in the developed country's effort of reduction.)

The largest problem in decreasing poverty is a range of inhibiting factors existing in the developing countries. Some of these factors do not belong to agricultural fields but hinder the solution of food problems: e.g. depletion of water resources; enlarging areas of hazardous environments; inadequacy in social infrastructure; non-effective public investments and low investment in production materials. We cannot solve these problems by research projects alone and therefore, must analyze each factor. For those that can be solved by science, we must conduct research and development projects to improve production technology. We also must encourage people to improve their agriculture and rural development policies, encouraging understanding of how these two areas must cooperate to achieve notable results. More precisely, we must conduct research and development to enlarge the self sufficiency of small scale farmers, e.g. developing environmentally adapted and sustainable production technology, avoidance of post-harvest loss and fresh water fish and shellfish culture, all suited for small scale farmers. Among the on-going projects, the development of sustainable fish and shellfish culture system in brackish mangrove areas is an example.

To approach global issues, internationally shared technology and knowledge creation is the key subject. In this category, the breeding project using the rice DNA database and genetic engineering techniques, as well as the creation of hazardous environment resistant plants, development of practical application technology for biomass, fresh water management technology and development of technology that prevents global warming are example of critical research.

The creation of new crops using gene manipulation techniques is very important, because it will provide a common solution to all problems listed above. The number of crops created at this point is not large and the range of genes is limited, too. However we should not underestimate it when we consider population increase, decreasing farmland areas and depletion of water resources. Gene manipulation technology is one solution with great potentiality.

Technology transfer conducted through research and development and technical aid achieves the improvements of developing countries. The relevant personnel of Japan must share their extensive accumulated scientific knowledge with international technological aid projects at the actual sites. This is Japan's obligation as a member of the world and is the duty as a developed country.

<Column ⑦: Japan Forum on International Agricultural Research for Sustainable Development>

On July 28, the Japan Forum on International Agricultural Research for Sustainable Development was established to cross boundaries among Japanese organizations, to achieve cooperation and coalition by building new partnerships between international research participants and organizations in agricultural fields, to solve global issues including the stable and sustainable development of developing countries which face serious starvation and poverty as well as the environmental issues related to these problems.

Photo: The organization meeting of Japan Forum on International Agricultural Research for Sustainable Development

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