Facets of International Agricultural Research :
JIRCAS workshop papers (1993 Fiscal Year)

AQUACULTURE : THE STATUS AND OUTLOOK OF INTERNATIONAL COOPERATIVE RESEARCH

This past October,the Tropical Agriculture Research Center (TARC) was reorganized into the Japan International Research Center for Agricultural Sciences (JIRCAS), with the creation of a new division in the area of fisheries. The newly-inaugurated Fisheries Division is expected to play a role in promoting continued and smooth fisheries research. Especially now, it is of utmost importance to have a precise grasp and understanding of the current situation regarding international cooperation and technical assistance; only the proper usage and analysis of such information will enable fruit-bearing research. In this regard, research activities and information analysis should be based on a thorough grounding in the realms of production, management and study. How this is being done is the theme of today's symposium, and the topics presented here should be of much significance to those involved in international cooperation. Fisheries encompasses many areas; however, propagation and aquaculture taken together are considered most necessary to target in subsequent cooperative research and will be the focus of today's program.

Held January 13, 1994 9:00-17:00 at JIRCAS, 1-2 Ohwashi, Tsukuba, Ibaraki Pref.

9:00- 9:10	Opening address, Dr. Keiji Kainuma, JIRCAS Director General
9:10- 9:50	Prospects for cooperative research in aquaculture, Dr. Masaru Fujiya, ICLARM, Councilor in Japan
9:50-10:30	Aquaculture and the FAO : Current project status and outlook, Dr. Toshihiko Matsusato, National Research Institute of Fisheries Science, Senior Researcher (previously FAO expert)
10:30-10:50	Break
10:50-11:30	JICA and current and future projects involving culture fisheries and aquaculture, Mr. Yasuo Tadokoro, JICA Fisheries Technical Cooperation Division Head
11:30-12:10	Establishment of aquaculture technology in consideration of preservation of the environment, Dr. Motoyuki Hara, JIRCAS Senior Researcher
12:10-13:30	Lunchtime
13:30-14:10	International collaborative research and the Japanese Ministry of Education, Science and Culture, Dr. Koichi Ohwada, Professor, Ocean Research Institute, University of Tokyo
14:10-14:50	Trends in technical assistance at the Fisheries Agency, MAFF, Mr. Ryozo Kaminokado, Head, Oceanic Fisheries Department, Office of Overseas Fisheries Cooperation
14:50-15:10	Break
15:10-17:00	General Discussion
17:00-19:00	Reception

Prospects for cooperative research in culture fisheries (Dr. Fujiya)

Over many years, efforts to promote the development of the coastal regions of Japan have taken various forms. For example, in order to better utilize existing fishing grounds, artificial coral reefs have been set up in many locations to attract fishes and encourage breeding. Past research efforts and previously developed technology are finally coming together; new ways of thinking about fisheries development are taking place. With the promotion of ocean ranching and the construction of many new facilities, much success is being achieved. However, it is important not to lose sight of the establishment of a more rational and scientific means of fisheries resource management, and indeed many attempts are being made, spanning all areas of fisheries science.

Up until the present, Japan has been a world leader in fisheries technology. Our obligations remain large and in particular, much is expected of Japan by developing countries. Ocean resources have been greatly affected by over-harvesting over many years, and especially luxury fisheries species have greatly dwindled. As early as the beginning of the 1960's, "not fisheries resources for the taking, but fisheries resource making" became a motto here, and the concept of creating and enhancing resources took hold not only in the realm of fisheries but also in many other fields of specialization. Existing technologies were put to new practical use. Returning the discussion of fisheries, of particular notice were innovations in the regulation of coastal fisheries, fish farming, and ocean ranching.

In the case of coastal fisheries management, areas which were considered fishing grounds were targeted, with the objective of their improvement and expansion. Many operations, such as for the construction of breeding reefs and seed production and aquaculture facilities, were implemented to protect existing populations of important fishery plants and animals or to promote their propagation. This was a form of alteration of the surrounding ecological systems.

In culture fisheries, juvenile fish, or "seed" are produced in extensive quantity by human hands, released into suitable areas, and provided a certain degree of protection. The culturist thereby raises the fish under natural ocean conditions while awaiting their grow-out, and then harvests them. In 1963, the Seto Inland Sea was chosen as a model area for culture operations, and received nationwide attention. It was overseen by the local government and concerned fisheries operators. Such operations were thereafter promoted all over the country and set up in appropriate areas.

Additionally, salmon and trout hatch-and-release operations have a long history, having been first initiated in Hokkaido. Such works are being currently carried out in many parts of coastal areas, and as a result, Japan's salmon resources have increased greatly. Ocean ranching underlines just how nature and human wisdom can be put to rational use to produce something of necessity.

The look of today's ocean ranches is the result of targeting viable coastal areas and complexing the prerequisite basic technology with currently developed technology. Ocean ranching has certain disparities with culture fisheries, however. The former aims at development of a specific area, while the latter aims at upping biological production. The ocean ranch often exploits the open seas, for example, if the bluefin tuna were to be ranched. This species spawns in the vicinity of the Nansei Islands; young fish grow and make their way to coastal regions adjacent to Japan going northward, then migrate extensively to the California coast, and here mature, and then return to Japanese coastal waters. Here they become the target of commercial fishing operations. If this ecology can be utilized, in other words, artificially-produced seed is added to natural stocks to enhance numbers of fish returning, we can expect similar fruitful results as in the case of salmon. This concept, in which the high seas are used for large-scale ocean ranching, is expected to enlarge and develop as seed-production technology improves. In instances where new fishing grounds are established, it will also be necessary to establish a sound system of management for these. In order to resolve such as the above problems,

plans for natural resource development and management should be laid out with a definite grasp of the current resources situation, technologic needs, etc. It is necessary to gain the acceptance and cooperation of commercial fisheries operators, and is of extreme importance to conduct follow-up investigations to determine if actual results are being achieved.

Fisheries technology in Japan, as related to conventional fishing, was formerly in very high repute, and our country was considered to be a world leader. However, the recent world trend is to give attention to the cultivation of fisheries resources and rational utilization, and thus, culture fisheries, aquaculture, and ocean ranching are very highly esteemed together with new processing techniques that go along with these.

The operations and technology implemented in our country as well as in other developed countries comprise, as many developing countries point out, only an extremely small portion of the technology needed today. In subsequent cooperative research, we must strive to achieve research results which can be considered of value by anyone in the world, and to continue technological assistance.

Levels of education and technical skill differ among the developing countries of focus; accordingly, in undertaking work with a counterpart country, actual conditions must be fully appraised, and the contents of cooperation and assistance must be tailored to meet real needs.

Establishment of aquaculture technology in consideration of preservation of the environment (Dr. Hara)

In many countries which are among the so-called "developing regions", it is often the case that unique technologies and ways of doing things develop and flourish in context of unique historical and cultural background. Frequently, these compensate for shortfalls in technological strategies developed and promoted by advanced countries. Regarding fish and shellfish aquaculture, there are many examples. In Southeast Asia, predominantly utilized methods had been little changed from the extensive methods employed from over several hundred years ago as these methods had arisen from native culture and climate and were very suitable for the locations in which they were practiced. However, in the 1960's, the situation began to change drastically. These times saw rapid economic development, increased acquisition of foreign currency, and expanded employment opportunities; in Japan as well as in other countries, high-production aquaculture methods based on intensive feeding and the like were introduced. As a result, aquacultural production capacity increased greatly, but this was accompanied also by increased water pollution and environmental deterioration. Additionally, sudden price drops became a problem.

In traditional aquaculture in Southeast Asia, feed of natural origin (produced via spreading of natural fertilizer, such as manure) is used to raise fish and shrimps, etc., such that the natural ecology is very skillfully exploited. In principal, feed is not supplied by the aquaculturist, so that self-pollution of the water and surroundings does not occur. Rearing is done at low density, thus the incidence of disease is very low. The construction of facilities for water circulation and aeration is not required. This type of aquaculture is the exact opposite of highly intensive aquaculture, but both have their separate advantages. Yet, traditional aquaculture practices are in tune with today's motto "Technology which is kind to the Earth", in other words, is a form of aquaculture which works in context of preservation of the environment. Thus, traditional aquaculture can be considered superior in many ways, although it may seem to be an about-face from the technologic high-intensity practices. One reason is that these traditional practices, which may also be called "farm-integrated" aquaculture offers low production rates and somewhat unstable production. Furthermore, manuals have not been established, so it is very difficult to promote standardized techniques.

So, what are we to do about this? One means of reaching a solution is to analyze and improve existing aquacultural methods, targeting those which have arisen and become predominant in Southeast Asia. To take

best advantage of the merits of these methods and at the same time, elevate their production capability, scientific promotion is necessary. Here at JIRCAS, we are promoting "the development of farm-integrated aquaculture techniques for developing countries" as an important research topic. This will be principally handled by the Fisheries Division. Thus, developing regions, particularly in Southeast Asia, will be targeted, and in consideration of preservation of the environment, we will aim to increase fisheries production; one means will be the promotion of "farm-integrated aquaculture" tailored to be suitable to the many varied environments of targeted areas. Research is to be implemented according to the following headings:

1) Underground energy expenditures, elucidation of the food chain and necessary fertilizer or manure quantities, appropriate levels of seed production and release
2) Monoculture and polyculture－choice of appropriate target species
3) Development of "farm-integrated aquaculture" feed ingredients through practical application of locally available materials
4) Development of pond management systems
5) Structure and design of culture ponds
6) Establishment of rational "farm-integrated aquaculture" based on the above

In Southeast Asia as in other regions, it is often the case that with economic development, the tastes and preferences of the populace are seen to change. Aquaculture which is used only as a means of supplying a source of protein is of low economic importance, but in such countries, providing a constant protein source is of evermore importance. Aquaculture being currently carried out in Southeast Asia is almost always in brackish water/marshy areas which are considered unsuitable for conventional agriculture. In such areas, the implementation of environmentally-conscious technology harbors very significant meaning. Up until the present, technical assistance offered to developing countries by Japan have been transferred exactly as they were developed, without much consideration of how they would hold up in the targeted regions and without much trial application. In other words, in subsequent research, it will be prerequisite to understand the chemical environment and ecological mechanisms in each targeted region, and to do sufficient basic research on the physiology, ecology, and genetic nature of the biological species subject to aquaculture, aiming at an overall level-up in research and technology. The above should be a basis for developing sound aquacultural research in Southeast Asia and should serve the general realm of agriculture, forestry, and fisheries in developing a sustainable form of aquaculture in the future.

International collaborative research in the Japanese Ministry of Education, Science and Culture (Dr. Ohwada)

Under the jurisdiction of the Ministry of Education, Science and Culture, there exist public universities and private universities as well as satellite research institutes, science museums, and the like. I can not cover all of these in the scope of this lecture, so here I will limit my discussion of international cooperative research to that which can be considered scientific exchange. At the University of Tokyo, we are carrying out scientific exchange, and at the university's Ocean Research Institute (ORI), we are cooperating in the field of oceanographic studies with Southeast Asian countries with the support of the Japan Society for the Promotion of Science (JSPS). I will cover firstly general university exchange followed by scientific exchange at the ORI in this lecture.

(1) International exchange at the University of Tokyo

At the University of Tokyo (Todai) at present, Vice President Kusiro is chairman of the international exchange and programs committee, and the international student exchange committee, and each faculty is represented by a delegate in forming these committees. For the most part,meetings are carried out at a pace of once per month. Regarding the international exchange committee, one of the major duties is to handle agreements/conventions concluded between Todai and other universities. In recent years, inter-university agreements have increased a great deal. However, in many of the instances, when making such agreements with foreign universities, while there exists a mutual feeling of joint cooperation, it is very rare that any type of financial guarantee backs this up. Therefore, agreements executed between departments or universities are reviewed every five years, and only those which have produced any real activity during this period are renewed. Even if there is no form of financial support to the agreement itself, certain things are facilitated, for example, if one were to apply for auxiliary research funding to the Ministry, or a professor or student were to go abroad to the counterpart university for a sabbatical.

Presently, at Todai there are 1734 foreign students, and the Japanese government by the end of the century wants to have 100,000 foreign students in its universities. Given this, it appears that we are in for a drastic increase in students of other nations coming to Japan for study. At present, in general, foreign students are admitted into faculties, graduate schools and departments in a very disordered, unsystematic fashion. No guidelines exist for how to do this, and this is something we really have to think about. Therefore, at Todai, the international student exchange committee was newly organized last year to comprise all of the university faculties and departments. Here, problems concerning how to recruit and admit foreign students and problems that arise during their stay here both personal and academic, are taken up and studied by all of the academic and administrative sides of the University. We broke ahead of all of the other Japanese universities and put out the "University of Tokyo's basic policy on foreign student admission" (1st report of the University of Tokyo's international student exchange committee, February 1993). The contents of this report are the following: (1) concepts and ideas regarding foreign student admission; (2) foreign student daily life; (3)problems likely to arise regarding general matters of foreign students. Subcommittees have been formed to deal with each of these topics, to grasp the current situation and foresee future prospects. Incidentally, at Todai, the breakdown of foreign students according to country are as follows: China, 633; Korea, 484; Taiwan, 119; Thailand, 50; Indonesia, 37; Bangladesh, 26; others. Disregarding area of specialization, numbers of foreign students are much greater in the graduate schools than in the undergraduate departments; in engineering, there are 584 students, 223 in liberal arts, 210 in agriculture, 125 in social sciences, 122 in medicine, 118 in the natural sciences, etc. As stated above, the University is attempting to deal with problems that arise from carrying out foreign student admission and education. In examination of country breakdown, it is apparent that students from countries near Japan comprise a large portion of all foreign students. At JIRCAS, the Fisheries Division has been newly established; the division will carry out technical assistance to developing countries, and in doing so, similar problems that we at Todai have experienced may arise. It is hoped that some of the concepts we have put forth will be useful in tackling these problems.

(2) Scientific exchange at the ORI

Here I would like to introduce international cooperative research programs which are being currently implemented or are in the planning stages, which are based on international scientific exchange and funding from the JSPS. These concern oceanographic studies and are carried out according to basic university formulations. The ORI is an institute for basic oceanographic exchange, and is at the same time an organ available for common nationwide use, and the front window for international collaborative exchange. Because

of these many varied roles, we are hoping to build new facilities "International research center for oceanographic studies" to carry out the planning, operation, and management of international research and scientific exchange.

1) International collaborative research: Current projects

These are not necessarily in the realm of aquaculture-related work, so I will simply list off the project titles. ODP (Ocean Drilling Program, 1985-1993; 1993-1998), IGBP (International Geosphere-Biosphere Programme, 1990-1999), GOOS (Global Ocean Observing System, 1993-1997), GLOBEC (Global Ocean Ecosystem Dynamics, 1992-), KAIKO-Toki (1993-1997), Inter Ridge (International Cooperative Research on the Energy and Mass Flux of Ridge Crests, 1991-). These projects are not limited to only university cooperation, but also include the participation of the Fisheries Agency and other government institutions.

2) Inter-university agreements and international collaboration

Programs currently exist between us and the following: the University of California-San Diego (no time limit), the University of Maryland (1990-), the Woods Hole Oceanographic Institution (WHOI) (1989-), the University of Hawaii, Department of Earth Sciences (1991-), Norway and Norwegian Universities (1992-). Among these, regarding the University of California, the Scripps Institute, and the University of Maryland, the Center of Marine Biotechnology and the Center for Environmental and Estuarine Studies are particular targets for collaboration, and at the above four institutes/universities in the U.S., very active exchange is being carried out with the additional financial support of Monbusho Grants-in-Aid and other types of aid.

(3) Scientific exchange according to basic university formulation

The JSPS serves as a front window for scientific exchange, and has been pursuing for the past ten years, the theme "Scientific cooperation with Southeast Asia" in which the following have been being implemented: 1) university-formulated exchange; 2) general exchange; 3) non-course Ph.D. candidate support. At present, 24 operations are being carried out in 6 countries which are Thailand, Indonesia, the Philippines, Singapore, Malaysia and China with the appropriate counterpart organizations. This got its start in 1978 with Tokyo University of Agriculture becoming a focus university for agricultural exchange. Fisheries-related exchange comprises a certain portion of these programs, but exchange in scientific oceanography is considered separate, and the ORI is a key institute here, having started in 1988 with Indonesia. Thailand joined in 1989 and Malaysia in 1991. In implementing this university-formulated exchange, we selected institutions with appropriate facilities for specific research areas which could become core institutes. Next, we assembled the cooperating universities as well as the individual collaborating researchers, forming a comprehensive alliance. Thus, the following types of exchange are being practiced: 1) exchange of investigators; 2) execution of research pertaining to specific topics; 3) planning of seminars, etc. In any of the fields being covered,operations are based on the mutual interests and consultations of the concerned parties; they are executed upon final confirmation between the concerned institutions and the JSPS. Regarding oceanography, we are forming a network of cooperating universities from those which have faculties or departments with concerns in oceanography, and individuals within these are becoming collaborators. This is how our collaborative research activities are progressing. The results of these activities have been compiled only partially for 1993, but we have the following information, for example. From Indonesia, 56 investigators came to Japan, and 54 Japanese scientists went to counterpart institutes in Indonesia. Between Thailand and Japan, 43 people went both ways. From Malaysia to Japan and vice-versa, 20 and 21 people made trips. If these figures are averaged, about 8 people per year, more or less, are involved in exchange, but this is only a simple average. Actually,

researchers that are dispatched to Japan ordinarily stay for about two months, while Japanese dispatched to another country usually stay for only two weeks. Quotas are very limited, but long-term stays for up to six months are also available. In carrying out exchange, especially on the Japan side, we want to widen as much as possible of scope of researchers and institutes that will serve as hosts. Without such cooperation, progress can not continue for very long. Regarding those on the Japan side who have served as collaborators, we want them to go as a counterpart to the respective country of the hostees. All along, we have been emphasizing oceanography, but in counterpart developing countries, aquaculture and fisheries resource development are of most concern and serve as a base for other forms of research. Along these lines, environmental studies, oceanographic physics, and basic biology are becoming areas of much importance. In actuality, 60% of all of those involved in scientific exchange are in the fields of fisheries or oceanography.

Unfortunately, as of yet, no specific theme for collaborative research has been authorized, but we are thinking of future projects. As for seminars, the following have already been carried out:

1st Seminar. February 19-23, 1990. ORI. "Planktonic studies in the coastal waters in the western Pacific Ocean.

2nd Seminar. January 21-24, 1991. Debongo University, Indonesia. "Coastal oceanography: Environmental characteristics and resources.

3rd Seminar. August 19-22, 1992. ORI. "Fisheries Oceanography."

4th Seminar. December 2-4, 1993. Sonkhura, Thailand. "Marine science."

5th Seminar. November 15-17, 1994 (planned). Jakarta, Indonesia. "Marine science"

These seminars have been attended by researchers from each of the concerned universities participating in university-formulated exchange, and additionally, investigators from Singapore and the Philippines came at the invitation of the JSPS. We are also thinking of having a system of rotation including Japan and three other countries in seminar sponsorship.

Regarding the system of non-course Ph.D. degree programs, a foreign researcher can pursue a degree while residing at an institute or university in his/her own country with out being enrolled at the respective Japanese host institute. At present, this system is very popular, and applications have greatly increased. Under this system, the Ph.D. dissertation must be accomplished within 5 years ; the program allows for the candidate to come periodically to Japan to work with the dissertation supervisor for two months at a time, or for the supervisor to go to the candidate's institution to give guidance and do cooperative work.

Therefore, university-formulated change, as we have been discussing is, rather than being a program with a large budget allocated for cooperative research, a means for the cultivation of researchers and exchange. As many more people are becoming involved in international exchange every year, this is a very important point. If we can get JIRCAS and JICA and the like involved in these alliances, we can look forward to even more active and fruitful activity. First of all, we'd like to call for more exchange of information regarding our mutual activities. Additionally, if we are planning a seminar somewhere and if JIRCAS staff happens to be going to the country in which it is held, we'd like to ask them to participation, and if possible, to give a presentation. So, let's take more steps to work together and develop a good cooperative relationship.

Trends in technical assistance at the Fisheries Agency, MAFF (Mr. Kaminokado)

1. Requests from developing countries for (Japanese) technical assistance in fisheries are very diversified and levels of technology demanded are becoming very high. At the same time, numbers of requests are increasing greatly.

2. Regarding forms which fisheries-related technical assistance takes, in addition to the dispatch of individual experts in various fields, the acceptance of counterpart collaborators, and the implementation of project-type assistance, we are also promoting the transfer of technology via merger companies, and dispatch of JICA volunteers.

As for the actual organs involved in implementation, JICA and the Overseas Fishery Cooperation foundation (OFCF) are main. Special features of technical assistance offered by the OFCF are: 1) operations based on requests of the industry; 2) rapid mobilization for special operations.

3. Technical assistance carried out by JICA is based on the following: (1) humanitarian considerations; (2) reciprocal reliance and understanding; (3) efforts to support self-reliance; (4) basic concepts regarding preservation of the environment, etc. The above are being implemented based on gratuitous fisheries aid; organization of such activities is taking a very dynamic form, with the tie-up of different areas, so the "securing of overseas fishing grounds" is not necessarily unrelated to such items.

4. Compared to conventional fishing and processing, in aquaculture, implications are stronger regarding the necessity of research cooperation than of technologic assistance.

*In aquaculture, it is necessary to deal with fish species which differ from those in Japan and differing environments as well, and these species must be cultured in great quantity. Furthermore, a uniform and standardized system of knowledge and technology are called for in a range of fields, encompassing environmental studies, physiology, ecology, water quality, feed control, etc.

<Actual examples>

- Transfer of technology for raising chum salmon in Chile
- Aquaculture in the South Pacific (grass carp, giant freshwater prawn, oysters)

5. Regarding the Southeast Asian Fisheries Development Center Aquaculture Department, Japan has 20 years of experience in cooperating and helping out in survey research and technology transfer programs. At the department headquarters together with branch institutes in the Philippines,there are 370 staff members (157 are specialists).

6. The promotion of fisheries development through aquaculture in any country is dependent not only on that country's climate; it is also necessary to tailor promotion to be in accordance with the existing level of technology. A form of aquaculture which is based on current trends, if it stretches the limits of technology for a certain country, is not desirable for those receiving assistance nor for those providing it.

7. Yet, for example, if a specialist in a certain field is dispatched to a developing country, actual achievements (in aquaculture) are expected to increase. That they do is a fact. Partial results will be achieved no matter what, if the research contents are of high level. Given the context of this situation, the reorganization of TARC into JIRCAS and the creation of the Fisheries Division is certainly a break-through,and this is excellent new for those specialists fighting a difficult battle, as a follow-up and support system will now be available. This has been long-awaited. Of course, in fisheries resources and environment-related fields, and in aquaculture as well (especially in basic research), numerous specialists are working in various public institutions, but now, the choosing and dispatching of these specialists should be facilitated. Previously, this had been very difficult.

8. However, if we take one step back to look at our own research systems in view of technical cooperation in aquaculture, we should not harbor the attitude that we are going out of our way to meet the requests of developing countries; rather, we should extend cooperation commensurate with our stature and what we are capable of doing.

Certainly, research achievements in Japan are increasing not only in aquaculture but in other fields as well. Yet, requests for cooperation are ever-increasing and we can only address a small portion of these. This we can not ignore; we will just have to do as much as possible.