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A FRAMEWORK FOR AQUACULTURE RESEARCH

UNDER THE CGIAR

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1. SUMMARY

1.1   Aquaculture research is recommended for support by the CGIAR to provide a new focus and a better coordination mechanism for this important food production system.   Significant research progress has been made to date by the various research organizations but the potential for increased production remains great, particularly if a CGIAR approach is applied.

1.2   A global framework of CGIAR support emphasizing expanded linkages under a system of regional research networks utilizing existing National Aquaculture Research Centres (NARC's) and Regional Aquaculture Research Centre's (RARC's) in the developing world is suggested.

1.3   A small International Aquaculture Research Centre (IARC) is suggested to serve as the global research and information coordinating centre, and secretariat for these networks.   Due to expected funding constraints, it should be noted that this IARC would not have its own central research facility.   The IARC would have an International Board and Program Committee similar to present CGIAR centres.   An existing Centre could be used to play this role (eg. ICLARM or FAO)

1.4   There are a number of Asian (NARC's and RARC's) with reasonably advanced research programs, staff and facilities.   Some are already organized in existing research networks.   Improved coordination, focus and some additional funding is the primary need.   Training and information support will be handled under a similar approach of upgrading existing institutions.   It is suggested that this be provided under the CGIAR framework through the IARC coordination centre described in (1.3) above.

1.5   In Africa, a new centre for training and research is recommended if the existing ADCP center cannot be made operational.   This centre would be linked with selected existing NARC's which would also require additional modest funding inputs under the CGIAR framework.

1.6   The Latin American region should receive similar support in a networking mode.   Similar to Africa, the existing ADCP centre in Brazil should be re-examined regarding its suitability for use as the regional centre. Financial requirements are likely intermediate between Asia and Africa.

1.7   The above approach can be time phased depending on funding and other
constraints.   It is suggested that Asia may be a useful starting point in
developing the most cost effective approach.

2. INTRODUCTION

2.1 Aquaculture is normally defined as the rearing of aquatic organisms in controlled or managed conditions. This definition distinguishes this husbandry practice from the capture of fish in the wild.

2.2 Aquaculture is already an important source of animal protein in many tropical developing countries. Fish production, through aquaculture, is increasing markedly (approx 10.5% annual growth rate over the last 11 years) and current projections indicate that considerable potential exists for further increases through this production system.

2.3 Previous reports to TAC [TAC/AWG 1973; DDDR : IAR 73/75; IDRC (1978); ADG/TAC: IAR/80/23: AGR/TAC: IAR/85/18] have reviewed the status of aquaculture and "recommended inclusion of aquaculture in the CG system should additional funding become available" (AGR/TAC: IAR/85/18 page. 97). TAC noted "however, that some important concerns would have to be addressed before embarking on such an initiative. These include: the identification of specific research problems and species (eg. tilapia) which can be appropriately addressed at the international level; the determination of priority regions for initiating efforts; and the identification of the appropriate institutional mechanism, such as a network or research station, to undertake the work. TAC has these issues under review and will be able to address them with more precision in the future."

2.4 This report is intended to follow on these earlier discussions and to support the report of the TAC consultant Dr C Idyll who has prepared a working paper for TAC on "Priority Research in Aquaculture". This paper will not repeat many of the justifications and background material provided in the earlier submissions to TAC.

2.5 A copy of the December 3, 1986 letter from the TAC Executive Secretary to IDRC is enclosed for reference. (Appendix 1).

3. THE CURRENT ARRANGEMENTS FOR AQUACULTURE RESEARCH IN ASIA

ASIA

3.1 Aquaculture is believed to have originated in Asia about 2,500 years ago. It has evolved primarily by trial and error methods into a significant food production system. Due to its long history and the strong market demand for aquaculture products, aquaculture is most well developed in this region. At present, more than 75% of the current world aquaculture production is produced in Asia. Present total Asian Aquaculture Production is estimated at 5.2 million MT 1983. However, it should be noted that there is still significant potential for increases in current production levels based on increased research inputs in a manner similar to earlier work on various agricultural crops. Due to its evolution through trial and error approaches by fish farmers, many aquaculture practices are inadequately understood in terms of the scientific basis for current production methods. Also, this evolution of aquaculture technology has resulted in the development of a variety of aquaculture systems but restricted to certain geographical areas. There have been limited attempts to transfer this technology to other regions with similar conditions. This approach has considerable potential for broader application but the lack of adequate understanding of the dynamics and interrelationships of biological and socio-economic factors is a major deterrant to transfer of existing technology to new regions. This same issue has likewise limited further increases in yields from existing systems. Finally research to support the needs of the small farmer is only beginning in aquaculture particularly in the last 20 years. Therefore, there is a major opportunity for significant increases in yield based on research.

3.2 Asia has a significant number of existing NARC's and RARC's in various stages of development. A selected list of existing NARC's and RARC's is given in Table 1. The numbers of staff are listed in column 2. It can be seen that a considerable institutional resource already exists in Asia. For this reason, it seems highly desirable to set up a support mechanism that will utilize this

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TABLE 1

SELECTED ASIAN NATIONAL AQUACULTURE RESEARCH CENTRES (NARC'S)

COUNTRY NARC'S	INSTITUTION	NUMBER OF FISHERY SCIENTISTS*
CHINA	Ministry of Agriculture, Animal Husbandry and Fisheries (MAAF)	
	1. Freshwater Fisheries Research Centre, Wuxi	180[+]
	2. Pearl River Fisheries Research Institute	n.a.
	3. Yellow Sea Fisheries Reseach Institute	201[+]
	4. Shanghai Fisheries University	339[+]
	Academia Sinica	
	1. Institute of Oceanology	600[+]
INDIA	Indian Council of Agriculture Research (ICAR)	
	1. CIFA (Central Institute of Freshwater Aquaculture)	52
	2. CIBA (Central Institute of Brackishwater Aquaculture)	50
	3. Bureau of Genetics Resources	7
	University of Agricultural Sciences	
	1. College of Fisheries, Mangalore	80[+]

COUNTRY NARC'S	INSTITUTION	NUMBER OF FISHERY SCIENTISTS*
INDONESIA	Agency for Agricultural Research And Development - CRIFI (Central Research Institute for Fisheries)	
	1. Research Institute for Marine Fisheries	62[+]
	2. Research Institute for Freshwater Fisheries	52[+]
	3. Research Institute for Coastal Aquaculture	42
MALAYSIA	1. University Pertanian Malaysia (UPM)	43
PHILIPPINES	1. Bureau of Fisheries and Aquatic Resources (BFAR)	2204[+]
	2. University of the Philippines in the Visayas	17
	3. Central Luzon State University	12
THAILAND	1. Department of Fisheries - National Inland Fisheries Institute - National Institute for Coastal Aquaculture	80 12
	2. Kasetsart University	37
	3. Chulongkorn University (Sichang Marine Science Research and Training Station)	6

Asian Regional Aquaculture Research Centre (RARC'S)	NUMBER OF FISHERY SCIENTISTS*
1. SEAFDEC Aquaculture Department (Southeast Asian Fisheries Development Center)	434
2. NACA (Network of Aquaculture Centers in Asia)	3
3. Asean Fisheries Development Center (planned)	-

+ Not all staff perform research on aquaculture

* BSc (or equivalent) or above.

n.a. - not available

existing capability but expand the level of operation to achieve the needed research objectives. This will be both cost efficient and positive for the development of these NARC's. However, this will take some time to achieve. It is believed that a critical mass of scientific expertise is needed at one centre in order to tackle some of the existing aquaculture research problems described later in paragraph 5.9. Few if any centres in Asia have achieved this necessary level of staff capability or numbers.

3.3 Research networking has been tried in Asian aquaculture and the results look very promising. Examples of successful networks in aquaculture are the FAO/UNDP Network of Aquaculture Centres in Asia (NACA), Asian Fisheries Social Science Research Network (AFSSRN) coordinated by ICLARM, Asian Fish Health Network, and Network of Aquaculture Genetics in Asia all supported in part by IDRC. Research networks on the other priority research areas are in an embryonic form at present but the basic building blocks are likewise available. However, it should be noted that at present, there are no LDC centres (NARC's or RARC's) in Asia capable of tackling all the necessary upstream research such as is needed in the key research areas of nutrition, genetics, disease, reproduction, germ plasm holding and exchange.(see paragraph 5.9). Also, although there is an increasing tendency towards linkage among some of these centres, it appears that more coordination and focus to the existing research is also needed.

3.4 Research support from national governments, bilateral and multilateral donors and the private sector is increasing. For instance, a recent FAO survey has shown that worldwide 368 million USD has been provided for aquaculture (research, technical and capital assistance etc) by a variety of donors from 1978 - 1983). However, funding and related resources are inadequate for present needs or future demands for aquaculture products in Asia. Also to date, aquaculture efforts have been very fragmented resulting in donor and national research centre confusion on whom to support and/or with whom to link. Private sector development is taking place but mainly for selected high market price species (eg. shrimp) which have a relatively proven technology. Lack of concerted donor support has led to pursuit of short-term research programs and no major push in a CGIAR style concerted research effort.

3.5 In a way, this has led to a lack of recognition in some quarters regarding the potential of aquaculture. Although difficult to quantify and explain adequately here, it is felt that there is not enough "prestige" given to the topic of aquaculture as an important global food production system. Surprisingly, this is true even in Asia, where current levels of production would suggest recognition of the importance of aquaculture should be at a much higher level. CGIAR support, even in modest financial terms, would greatly assist in overcoming these recognition and fragmentation problems. In fact this may be one of the most positive influences initially.

3.6 As indicated in Table 1, both government ministry facilities and university departments are listed as potential NARC's for this research networking approach. Each type of institution has advantages and disadvantages and specific recommendations can only be made later when more details are available.

3.7 Detailed future research needs in Asia are provided by the report "Priority Research in Aquaculture" by Dr C P Idyll. The research themes are summarized in paragraph 5.9.

3.8 In addition, this research support will require researcher training and information exchange mechanisms. A variety of researcher training options are available - eg. degree courses at Asian universities and short courses at various NARC's and RARC's. For a recent review see NAGA October 1986 "Fisheries Education and Training" and IDRC MR 145e (1987)" Aquaculture Training Needs in Developing Asia". Strengthening of existing postgraduate aquaculture training curricula in existing institutions is the main recommendation of the latter report.

3.9 Aquaculture information systems (as part of the broader fisheries information system) are evolving in Asia linked to the global FAO ASFIS system. A number of specific services are now available in Asia (see Appendix 2). Most of these services are in an initial stage of development and it will take some time before a fully integrated input and output system is operating in Asia to service aquaculture researchers.

4. THE NEEDS FOR AQUACULTURE RESEARCH IN AFRICA AND LATIN AMERICA

AFRICA

4.1 There is a major need for further aquaculture research in Africa. Present production from aquaculture is limited (approximately 49,865 MT in 1985 or less than 1% of total world aquaculture production). Most production is from freshwater ponds, lakes and reservoirs.

4.2 Despite present limited levels of production, most people believe that there is still considerable potential for increased fish production in Africa through aquaculture. As in other parts of the world aquaculture products produced on small farms in this region are never listed in the official statistics, but provide an important protein source for the small farmer.

4.3 In recent years there have been a number of reviews on African aquaculture (eg UNDP/FAO/Norway Thematic Evaluation of Aquaculture, the IDRC/ADCP Workshop on Research Priorities for Aquaculture in Africa and the ICLARM Asia/Africa Technology Transfer Round-Table). This information is now providing a sounder basis on which to make judgments on future needs. It is likely that further surveys and reviews to more precisely determine trends in African aquaculture will be needed. Specifically, more surveys on types of aquaculture systems that are most actively being taken up by farmers needs further definition.

4.4 Broadly based support for research is likely needed. Research support should include : training of researchers, capital expenditures to upgrade existing NARC's, funds for information transfer, meetings and other mechanisms to improve the information flow among researchers, policy makers and extension staff. More contact between anglophone and francophone African researchers seems desirable. ADCP has initiated a regional training program for senior African aquaculturists at ARAC (African Regional Aquaculture Centre) in Port Harcourt, Nigeria but due to institutional difficulties the future of this training program is in doubt. Further training options of both a degree and non-degree "short course mode" are needed and likely this training could be given in several different candidate centres in the region.

4.5   Most research inputs should be directed primarily to freshwater aquaculture emphasizing mainly local species such as tilapia. catfish and also possibly some introduced carp species. It is suggested that research focus on development of improved technology of existing systems initially. Thus it is recommended that research is required on some of the themes listed in paragraph 5.9 eg. mass seed production and nutrition. These themes would be developed under a series of networks. For instance, seed and feeding research suitable for pond culture systems for village level application should receive a high priority.   Seed research is needed on means of increasing fry production systems to supply fingerlings to farmers for the priority species listed above.   Also nutrition research on the two primary inputs to pond culture - fertilizer and feed is needed.   It is suggested that research on integrated fish farming with existing agricultural practices will be one approach to minimize these inputs. Finally, there is a considerable body of information on integrated fish farming in Asia which can be tested and adapted to African farm practices. Other types of aquaculture systems that are recommended for further research are integrated fish farming of pond fish culture and pigs or duck culture. All research should be more practical in its orientation aimed at low cost systems which are in use already in the African region. In addition, some research is needed on the economics of the above systems, social aspects of their acceptability, on-farm trials as well as interactions with agricultural researchers and extension agents.

4.6 In Africa, there are a number of existing aquaculture centres and stations with potential for expanded national or regional roles. However, political and national economic situations have an overriding effect on these potential centres and how they might be developed into a major centre or network of centres for the African region.   This will require careful future evaluation. As in Asia a network of research centres doing complementary research on various aspects of the priority research topics is suggested. The main effort of CGIAR is suggested to provide further support to these selected existing centres.   Earlier support by FAO/UNDP, USAID, CTFT, ORSTOM etc in conjunction with national governments has provided some of the needed facilities and staff. Research facilities in countries such as Malawi, Ivory Coast, Cameroun, Zimbabwe and Nigeria are candidates for these network centres.   However, significant infrastructural inputs will likely be required to make most of these centres able to tackle the suggested research problems.

4.7 Major inputs from the IARC described in paragraph 5.6. are likely needed in the African region. Some have suggested that this IARC should in fact be based in Africa. This decision cannot be made at present with the available information. Regardless of the IARC location, inputs to the African network centres by IARC staff are suggested as follows :

(i)   Research : further problem definition and priority setting, project development, monitoring (see paragraph 4.4.);

(ii)   Training : development of an integrated researcher training program where African regional (and subregional eg. SADCC) training needs are integrated with the overall research program finalized above. Degree courses plus short courses on topics related to system optimization (fry, fertilization and feed) are a priority. Some technician level training will also be required but this may best be done nationally or within subregions;

(iii) Information/Documentation : more reviews and syntheses of existing but fragmented sources of technology plus Asian approaches and methodologies are needed in French and English;

(iv)   Communications : a newsletter to improve researcher contact as well as another newsletter for transfer of research technology to farmers via extension services seem desirable. If this effort is linked to the information/documentation efforts described in (iii) and regular scientific meetings are also developed, information transfer should improve greatly; and

(v)   Donor Coordination : The IARC could play a significant role in proposal preparation and linkage with the various interested donors.

LATIN AMERICA

4.8 Historically, aquaculture has been a modest sized food production system in the Latin American region. Aquaculture production from this region is approximately 75,000 MT (1980). However, there are a number of aquaculture systems operating effectively in selected countries or even specific regions of one country. Systems such as freshwater tilapia and carp pond culture, trout pond culture, raft or longline culture of oysters and mussels in coastal areas and cageculture of tilapia in a variety of freshwater bodies are producing aquaculture products on a sound technical and economic basis. Considerable potential exists for adaptive research to transfer this technology to interested potential areas elsewhere in the region. In addition, there are major needs for further detailed experimentation on the development of suitable new technologies. Transfer of Asian technology as has been stated earlier, also has considerable potential.

4.9 There appears to be increasing interest in this region in recent years regarding the future potential of aquaculture. A variety of reviews of aquaculture research have been made : FAO (1985) La Acuicultura Y El Desarrollo Rural Capacitacion Y Promocion, UNDP/FAO/Norway Thematic Evaluation of Aquaculture, IDRC-MR-113s (1985) Memorias del Primer Seminario sobre Coordinacion Regional de los Proyectos de Acuiultura, Respaldados por el CIID en America Latina, ALA Symposium Valdivia Chile (1983) and Workshop on Production of Marine Larvae and Juveniles in Latin America, Coquimbo Chile (1986). Aquaculture in Latin America has often been assumed to be a low priority and has been given little recognition due to the high levels of meat production and large marine fish catches in the region. However, animal protein consumption rates in rural areas and among poorer sections of society continue to be low. Aquaculture could clearly play a role here.

4.10 There are a number of institutions now involved in aquaculture research. A selected list of key institutions is :

(a) Mariculture
     (i)   Coquimbo Marine Center - University Norte (Chile);
     (ii)   Las Cruces Coastal Station - University Catholica Santiago
                                                        (Chile);
     (iii) Austral University - Marine Institute (Chile);
     (iv)   Institute Professional Osorno (Chile);
     (v)   Marine Institute - IMARPE (Peru);
     (vi)   University Agraria (Peru);
     (vii) Invemar (Sta Marta) (Colombia);
     (viii) DINAAC Vacamonte Station (Panama).

(b) Freshwater Aquaculture
     (i)   CEPTA (formerly CERLA) [Brazil];
     (ii)   DINAAC Direccion Nacional de Acuicultura (Panama);
     (iii) COLCIENCIAS/INDERENA Aquaculture Network (Colombia)
     (iv)   IMARPE (Peru)

There is considerable variation in the numbers and quality of staff and basic aquaculture research facilities. However, it is felt that there is a reasonable foundation on which to build a few selected research networks. As in Africa, it is considered premature to now initiate research on all the global research themes listed in praragraph 5.9. Rather research on production oriented topics involving two of these themes, mass seed production and nutrition, is suggested. A Latin American regional aquaculture research network funded by IDRC with a coordinator based at COLCIENCIAS Bogota, Colombia has recently started which may also provide an initial starting point for expansion of a future CGIAR network research effort in this region.

4.11 A regional training, research and information centre was established under the FAO/UNDP ADCP program - CERLA (Latin American Regional Aquaculture Centre). Unfortunately, in recent years the suggested regional training courses have not been given. There is still considerable interest and

potential for a regional centre but a more detailed review of the problems of the existing centre is needed before proceeding. It may be useful to consider a network of research centres in Latin America for training courses and research. Subregional training courses were recently recommended as a mechanism to accommodate the demand for training slots as well as matching the geographical and ecological diversity of the region.

4.12 There is little information available at present on existing aquaculture information systems.

4.13 High priced species (eg. trout, shrimp) have attracted increasing attention by local governments in recent years as an attractive means of earning foreign exchange. Careful evaluation is suggested of the likely benefits to small farmers before embarking on research support for these species. Initially, research is suggested to focus on species for which there is existing market demand and some technological base (local species such as Colossoma sp., chame (Dormitator latifrons) plus tilapia and carp).

5. APPROPRIATE MECHANISMS TO STRENGTHEN INTERNATIONAL EFFORTS ON AQUACULTURE RESEARCH

GENERAL AND GLOBAL APPROACHES

5.1 As indicated in the earlier sections, there is clearly a major opportunity for research to have a significant impact on increasing aquaculture production. To date initial funding has been provided by a variety of donors and national governments and this has demonstrated that increases in aquaculture production from research are possible. This is particularly true in Asia. What is needed now is greater focus and coordination on an international level accompanied by relatively modest additional funding. It is felt that this can best be achieved under the CGIAR umbrella.
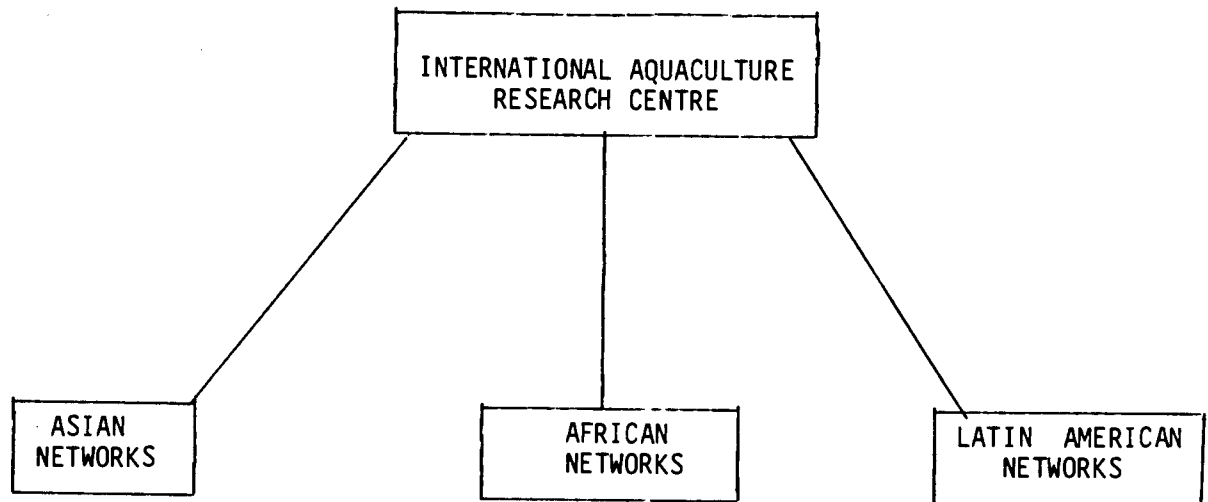
CGIAR GOAL AND PROGRAM STRATEGY

5.2 The framework for aquaculture research outlined below is in line with the long-term goal adopted by TAC (1985): "Through international agricultural research and related activities, to contribute to increasing sustainable food production in developing countries in such a way that the nutritonal level and general economic well-being of low-income people are improved" and this framework also attempts to follow the related points that "the above goal statement specifies and thereby focusses on :

- developing, not developed countries;
- research and related activities, not development or technical assistance activities;
- international, not national or regional research;
- food and feed, not industrial commodities;
- technologies for long-term sustainable production, not technologies that sacrifice ecological stability for short-term gains in productivity; and
- improved nutrition and economic well-being of low-income people not solely thrugh increased food production, but also thrugh improved food quality, greater equity in distribution, more stable food supplies, and increased purchasing power."

TABLE 2

A FRAMEWORK FOR INTERNATIONAL AQUACULTURE RESEARCH

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                  ┌──────────────────────────┐
                  │ INTERNATIONAL AQUACULTURE │
                  │     RESEARCH CENTRE       │
                  └──────────────────────────┘
                   /            |            \
                  /             |             \
    ┌─────────────┐    ┌─────────────┐    ┌──────────────────┐
    │   ASIAN     │    │   AFRICAN   │    │  LATIN  AMERICAN │
    │  NETWORKS   │    │  NETWORKS   │    │     NETWORKS     │
    └─────────────┘    └─────────────┘    └──────────────────┘
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1. NUTRITION RESEARCH NETWORK	1. MASS SEED PRODUCTION RESEARCH NETWORK	1. MASS SEED PRODUCTION RESEARCH NETWORK
2. GENETICS RESEARCH NETWORK	2. NUTRITION RESEARCH NETWORK	2. NUTRITION RESEARCH NETWORK
3. MASS SEED PRODUCTION RESEARCH NETWORK		
4. DISEASE RESEARCH NETWORK		

SUGGESTED FRAMEWORK FOR AQUACULTURE RESEARCH UNDER THE CGIAR

5.3 A tentative framework for this approach is outlined in Table 2. Obviously availability of donor funding is going to be the key factor in determining the most appropriate scale of this framework. There would seem to be a number of options for TAC to consider :

(i) limit the geographical area of coverage or better still time phase this regionally depending on funding. It is recommended that initial work start in Asia and expand to Africa then Latin America depending on funding and network definition constraints. For instance, relatively greater funding inputs for facilities and research staff training will be needed in Africa (see paragraph 5.10);

(ii) restrict the research to totally depend on existing NARC and RARC staff and infrastructure or selectively add on research themes depending on need (see paragraph 5.7) or fund the development of one or two centres for research on all themes in each geographical region associated with existing RARC's or NARC's.

Whichever framework is decided upon, a small central coordinating IARC guiding a series of research networks in one, two or three regions seems to be a minimum requirement to achieve the needed research outputs. It seems likely that costs should be kept to a minimum, therefore, it is not recommended to create a new international research centre with its own research facilities (laboratories, ponds, tanks etc). The main effort should be to build on existing centres and research networks which have been shown to be effective to date. It should be noted that much of what is proposed is not totally new but rather taken from a variety of on-going approaches in the various regions and worldwide. Parts of this model have therefore been tested and this will hopefully increase the likelihood of future success.

5.4 Use of regional research networks is emphasized as the cornerstone of this approach. This is felt to be the best way of dealing with a research subject with a variety of species, geographical regions, climates, production systems and market opportunities. Research participation should be determined primarily on the basis of regional consultations and priority setting with

regional scientists. However, it is suggested that there are a number of key factors to be considered in judging which NARC's or RARC's should participate in the proposed research networks. These include :

(a) strong support by national governments or regional bodies;

(b) clear research focus on significant international aquaculture problems;

(c) suitable quality and number of staff and facilities available;

(d) some training and information sharing capability exists or can be developed with modest inputs;

(e) earlier involvement in regional or international aquaculture research activities: and

(f) a clear policy allowing free flow in and out of researchers, information and materials related to the aquaculture research program.

5.5 However, there is also need for interregional as well as intraregional cooperation, linkage and information sharing. Asian experience (due to its more advanced state of development) can obviously be of use to the other regions. Training opportunities and information flow based on this Asian experience, needs to be encouraged. Additionally, some forum for overall planning and global focus is suggested. Therefore an International Aquaculture Research Centre (IARC) is needed. A small group of 5-6 professional staff likely initially based at one of the network institutions in Asia would provide this coordination, planning and information function. This IARC would also serve as the secretariat for this global program and would be guided by a suitable Board of Governors. Possible agricultural models exist in IBSRAM (International Board for Soil Research and Management) and INIBAP (International Network for the Improvement of Bananas and Plantains) as examples of how to structure this IARC and the associated regional networks.

5.6 Concern has been expressed regarding the amount and quality of research that can be accomplished through a networking mode utilizing NARC's and RARC's. Although, there is some justification for this concern, other networking systems (eg IIMI in Sri Lanka - The International Irrigation Management Institute) have achieved a satisfactory level of control while working with NARC'S. Obviously, these issues will have to be judged on the merits of each case. In principle, it is suggested that research work should be through national aquaculture programs wherever possible.

5.7 It is recommended that after consultant panel review, if certain high priority research topics are unable to be adequately dealt with using existing NARC's and RARC's, small research units be developed attached to existing NARC's and RARC's to deal with these problems. All of the above recommendations assume that no new developing country aquaculture centre becomes capable of tackling the needed research in the interim after this review and that funding limitations remain such that establishment of a CGIAR central aquaculture research facility is still not possible.

5.8 Another point of note are possible linkages to existing CGIAR centres. The trend in aquaculture is towards more intensive production systems. Increasingly agriculture and aquaculture are being integrated and this provides immediate linkage points with existing CGIAR centres (eg. IRRI, ILRAD, WARDA). A number of activities centred around integrated farming systems, in which fish produced through aquaculture are a component of a broader farming system, show good potential for wider application in most regions. For instance, IRRI is now developing with ICLARM a network on rice-fish culture in Asia. Integration with other crops as well as animals (cattle, pigs, chickens, and ducks) has similarly been shown to have major increased production advantages for the small farmer in the developing world.

5.9 The global research topics or themes have been reviewed by a number of earlier authors. Most differences relate to grouping of the topics. The main candidate research topics are :

(a)   nutrition, feed and feeding systems;

(b)   reproductive physiology and mass seed production (including larval rearing);

(c)   genetics;

(d)   disease control; and

(e)   socio-economic analyses.

5.10   Due to the differing levels of regional aquaculture development, there will be need for different level of approach or time phasing in each major region.

ASIA

5.11   In Asia, initially this networking approach is suggested to be discipline oriented with one network for each research area approved for support. (see paragraph 5.9).   As indicated earlier, there already exists partial research networks for most of the research themes listed.   Further funding and participation based on CGIAR guidelines are now suggested.

5.12   As data bases, scientific manpower, methodologies and scientifically understood technologies are developed, the networks are suggested to move into a multidisciplinary mode of operation.   Teams of disciplinary specialists would work together under a regional network on broader on-farm problems to develop an appropriate methodology for specific aquaculture systems-species complexes (eg. freshwater pond culture, cageculture in rivers, lakes and reservoirs , brackishwater pond culture etc).   Technical staff from the IARC would act as scientific advisors in the development and monitoring of the various research networks.

LATIN AMERICA

5.13   It is suggested that only two research themes may initially be desirable - [a] reproductive physiology and mass seed production and [b] nutrition, feed and feeding systems.   Most research would likely relate to mariculture and some on small scale integrated aquaculture systems.

Subequently the other research themes would likely be developed. It is difficult to be too specific on research areas and their likely future evolution but it is believed that most of the research themes described in (paragraph 5.9) will also apply in Latin America at some time in the future. Depending on future development of CEPTA in Brazil, a regional aquaculture centre may be available to link with the above research networks.

AFRICA

5.14 Africa will likely require strong support for all aspects of aquaculture research. Like Latin America initial research on mass seed production and feeding systems is suggested. Most efforts should aim at freshwater pond culture systems likely involving small scale integrated aquaculture systems. A new regional aquaculture research and training centre will likely have to be created in Africa. This judgment awaits the final outcome of discussions on the future of the ADCP ARAC (African Regional Aquaculture Centre) in Nigeria.

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                    South and Southeast Asia - IDRC Vancouver April 1978

10. IDRC (1984)   An International Network for the Improvement of Bananas
                    and Plantains by B Nestel

11. IDRC (1985)   MR 113s Memorias del Primer Seminario Sobre
                    Coordinacion Regional de los Proyectos de Acuicultura
                    Respaldados por el CIID en America Latina August 1985

12. IDRC (1987)   MR 145e Aquaculture Training Needs in Developing Asia
                    by Chua Thia Eng.

13. IDRC (in press)   Workshop on Production of Marine Larvae and Juveniles in
                      Latin America, Coquimbo Chile, August 1986

14. IDRC/FAO (in press) Workshop on Research Priorities for African
                         Aquaculture, Dakar Senegal, October 1986.

15. NAGA (1986)   The ICLARM Quarterly : Information 1986 - April 1986

16. NAGA (1986)   The ICLARM Quarterly : Fisheries Education and Training
                      - Challenges and Opportunities - October 1986.

17. UNDP/FAO/Norway   Thematic Evaluation of Aquaculture (MS).

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CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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PR 3/25
PR 3/10.42

3 December 1986

Dear Dr. Zandstra,

Further to our brief discussion during ICW'86 in Washington D.C., this is to confirm that Aquaculture research will be on the Agenda of the 42nd Meeting of TAC, to be held from 16-24 March, 1987 in Rome. In order to facilitate the discussion, a consultant, Dr. Claire Idyll from the USA, has been engaged to prepare a working paper for TAC on Aquaculture research, with special emphasis on Asia, to identify the scientific issues, assess the adequacy of current research, and identify major research gaps in Aquaculture.

The TAC Chairman would very much welcome IDRC's input in this exercise and particularly to have the views of IDRC on:

- appropriate mechanisms to strengthen international efforts on Aquaculture research;
- the current arrangements for Aquaculture research in Asia; and
- the needs for Aquaculture research in Africa and Latin America.

In this connection, the Chairman would also appreciate IDRC's participation at TAC 42. The item is scheduled for discussion on Thursday, 19 March 1987, at 09:00 hrs.

With warm personal regards.

Yours sincerely,

J.H. Monyo
Executive Secretary

Dr. Hubert G. Zandstra   cc: TAC Chairman
Director, Agriculture, Food and
   Nutrition Sciences
International Development Research Center
P.O. Box 8500
Ottawa, Ontario, Canada K1G 3H9

A Compendium of Fisheries Information Services in Southeast Asia

Here is a listing of current relevant Southeast Asian information sources to remind readers about services mentioned in earlier information issues, to update you on their activities, and to present four not previously mentioned (INFIS, INFOFISH, REMIN and THAIFIS).

Title	Products/Services	Status	Address for Enquiries
AIBA (Agricultural Information Bank for Asia)	Includes aquatic sciences in database; produces bibliographies; SDI; general enquiry-answering.	Began 1974; produced fisheries bibliography from 1976.	MC P.O. Box 720 Makati, Metro Manila Philippines
BRAIS (Brackishwater Aquaculture Information System)	A specialized information analysis center for brackishwater aquaculture to provide effective information services on the subject. Answers enquiries on subjects; searches on-line tapes of aquaculture section of ASFA; produced bibliographies on *P. monodon* (shrimp), mudcrab, *Perna* (mussels) and *Lates* (seabass). Upcoming state-of-the-art reviews on various species.	Began April 1984. Over 700 entries on subject database on HP3000 computer.	c/o Library, SEAFDEC Aquaculture Department P.O. Box 256, Tigbauan Iloilo City 5901 Philippines
INFIS (Indonesian Fisheries Information System)	A network of fisheries libraries and documentation centers coordinated by the Directorate General of Fisheries library. See next page.	Began October 1984. Organizational seminars held.	Directorate General of Fisheries Jalan Salemba Raya No. 16 P.O. Box 3071, Jakarta 10002, Indonesia
INFOFISH	FAO. Marketing information and advisory services for fish products in the Asia/Pacific region; bimonthly Marketing digest and trade news on subscription.	Began 1981. Fully developed with computerized services.	P.O. Box 10899 Kuala Lumpur 01-02 Malaysia
PASFIS (Philippine Aquatic Sciences and Fisheries Information System)	Proposed network of 12 institutions with the UPV as lead center, to produce national bibliography, abstract journals, reviews, digests.	Organizational seminar held 1982. No funding to date but some bibliographies produced by UPV. SEAFIS training course on ASFIS methodology (October 1985).	c/o Library, University of the Philippines in the Visayas Iloilo City, Philippines
REMIN/REMIC (Regional Mangrove Information Network/ Regional Mangrove Information Center)	To operate a regional mangrove information center for Asia and the Pacific and establish a regional network. To provide information and reference services to enquirers; prepare state-of-the-art reports; quarterly newsletter and bibliography. See next page.	Began May 1985. Databank under development. Regional newsletter "Bakawan" now available.	c/o Natural Resources Management Center (NRMC), Triumph Bldg. 1610 Quezon Ave. Quezon City, Philippines
SAFIS (Southeast Asian Fisheries Information Service)	Collects and translates extension material on request from member governments. Provides free copies of translated manuals on request; catalog of over 800 extension items in collection. Soon to produce 1985 Directory of Scientists and Technologists in SEAsia and Handbook for Extension Workers in SEAsia.	Began April 1982. Some 40 translations available, covering five languages. Ended March 1986. Products available through SEAFIS (see below).	c/o SEAFDEC Olympia Bldg., 4th Floor 956 Rama IV Road Bangkok 10500, Thailand
SEAFIS (Southeast Asian Fisheries Information System)	To collect, store and disseminate regional information about fisheries and act as the SEAsia input center for FAO's Aquatic Sciences and Fisheries Information System (ASFIS). Will receive bibliographic information from national centers and input relevant part to ASFIS. Compiled a Directory on Fisheries Information Sources in Southeast Asia. Will develop regional database on HP3000 computer.	Began April 1984. Currently assisting in development of national fisheries information systems.	c/o SEAFDEC Olympia Bldg., 4th Floor 956 Rama IV Road Bangkok 10500, Thailand
SFIS (Selective Fisheries Information Service)	Specialized information service in finfish aquaculture, resource management and small-scale fisheries. Answers enquiries via online computer database searches (ASFA, BIOSIS, etc.), with support from library and scientific staff. Products include bibliographies on tilapia; current awareness service via quarterly newsletter; several translations; upcoming state-of-the-art reviews on saltwater tilapia, integrated farming and tropical oyster and cockle farming.	Began April 1984. Over 400 requests answered to date. Soon to begin computerizing current awareness material on IBM XT microcomputer.	c/o ICLARM MC P.O. Box 1501 Makati, Metro Manila Philippines
THAIFIS (Thai Fisheries Information System)	Network of 23 fisheries libraries and information centers, with the National Inland Fisheries Institute as national focal point. To produce a national fisheries bibliography.	Began with organizational seminar in December 1984. Currently preparing a national fisheries bibliography.	c/o National Inland Fisheries Institute Kasetsart University Bangkhen, Bangkok 10900, Thailand