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AGRICULTURAL RESEARCH PROJECT II (SUPPLMENT)

REPORT ON
BARC/ICLARM/USAID WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"
29 SEPTEMBER - 01 OCTOBER 1991

PREPARED BY

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AQUACULTURE SPECIALIST

OCTOBER 1991

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT (ICLARM)

REPORT ON
BARC/ICLARM/USAID WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"
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Fish and fisheries play an important role in the economy, nutrition and employment, in Bangladesh. In recent years, there has been a decline in per caput consumption of fish, which contributes some 71% of total animal protein intake of people of Bangladesh, as the increase in fish production could not keep pace with the increasing population. This has resulted in malnutrition, especially in rural areas. To meet increasing demand for fish, the Government of Bangladesh has set targets for increased production during the first three Five Year Plans. These targets could not be realized, as along with targets, the Government has neither identified the priority growth areas and strategies for their development, nor formulated policies, to reach the goals. However, it was agreed by all, that aquaculture has a major role to play in increasing fish production in Bangladesh.

The International Center for Living Aquatic Resources Management (ICLARM) with financial assistance from United States Agency for International Development (USAID) under Agricultural Research Project II(Supplement), has been providing technical assistance to Bangladesh Agricultural Research Council (BARC) and the Fisheries Research Institute (FRI), in aquaculture, a sector which has been given importance by the Bangladesh Government in its development plans.

Within this context, a three-day workshop entitled "Inland Aquaculture Development Strategies for Bangladesh", was jointly organized by Bangladesh Agricultural Research Council (BARC) and International Center for Living Aquatic Resources Management (ICLARM) from 29 September - 01 October 1991, in the auditorium of Bangladesh Agricultural Research Council, Farmgate, Dhaka. United States Agency for International Development (USAID) provided Tk. 182,000 for organizing the workshop. The rationale and objectives of the workshop are detailed in attachment 1.

The workshop was organized in five sessions, four technical sessions dealing with (i) freshwater aquaculture, (ii) brackishwater aquaculture, (iii) culture-based fisheries and (iv) policies for aquaculture development. The fifth session concentrated on finalizing the recommendations.

The workshop was inaugurated by the Hon'ble Minister for Agriculture, Irrigation and Flood Control, Major-General (Rtd.) M. Majid-ul-Haq. Hon'ble Minister of Fisheries and Livestock, and Forests and Environment, Mr. Abdullah Al-Noman was Special Guest.The inaugural session was chaired by the Secretary, Ministry of Agriculture, Mr. K.M. Rabbani.

The Organizing Committee of the Workshop, identified the need for a total of 12 background papers under 4 sessions which were prepared by Senior Scientists of Bangladesh Agricultural Research Council, Fisheries Research Institute, Department of Fisheries, International Center for Living Aquatic Resources Management, Dhaka University, Chittagong University and Bangladesh Centre for Advanced Studies. Details of the papers presented and their authors are given in workshop program in attachment no. 2. The Chairpersons for different technical sessions were : Mr. Abdus Salam, Secretary, Division of Statistics, Ministry of Finance; Mr. Kazi Serajul Hussain, Joint-Secretary, Ministry of Fisheries and Livestock; Prof. M. Aminul Islam, Director, Fisheries Research Institute; Dr. M. Youssouf Ali, Rtd. Secretary, Ministry of Fisheries and Livestock and Senior Consultant, Bangladesh Centre for Advanced Studies and Mr. M. Lutfullahil Mazid, Secretary, Ministry of Home Affairs (former Secretary of Ministry of Fisheries and Livestock).

After completion of four technical sessions during first two days, 4 (four) separate panels (for freshwater aquaculture, brackishwater aquaculture, culture-based fisheries and aquaculture policies) each consisting of 13-25 senior researchers, planners, administrators and extension workers (both national and expatriate) met concurrently, identified strategies and came up with recommendations for development of aquaculture and policy support needed for the same. Names of persons who participated in different panels, are in attachment 3. These different panel recommendations (see attachment 4) were discussed in detail in Technical Session V. The Chairman of the session suggested constituting a committee, to finalize the recommendations, for submission to the Government. The workshop participants agreed with the suggestion and a committee comprising of following persons, was constituted :

1. Mr. A.K.Ataur Rahman, Director, Department of Fisheries, Convenor

2. Dr. M.V. Gupta, Aquaculture Specialist, International Center for Living Aquatic Resources Management (ICLARM), Member

3. Prof. M. Aminul Islam, Director, Fisheries Research Institute, Member

4. Dr. A.K.M. Nuruzzaman, Member-Director (Fisheries), Bangladesh Agricultural Research Council (BARC), Member

5. Dr. Youssouf Ali, Consultant, Bangladesh Centre for Advanced Studies, Member

6. Dr. Mahmudul Karim, Consultant, Second Aquaculture Project, Member

7. Ms. Judith Beckwith, Team Leader, Third Fisheries Project, Member

8. Prof. Mahmudul Amin, Professor, Dhaka University, Member

9. Dr. Saleemul Haque, Director, Bangladesh Centre for Advanced Studies, Member

10. Mr. Mozaffar Hossain, Director, Bangladesh Fisheries Development Corporation, Member

The workshop was well attended by over 124 persons (detailed list in attachment 5) from Government research and development departments, Ministries, Universities, NGOs, International Organizations, national and expatriate consultants and a Member of Parliament.

Papers presented at the workshop are in attachment 6.

The workshop received wide coverage by national press, T.V and radio, including an editorial in one paper (some press reports in attachment 7).

WORKSHOP
ON
INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH

Organized by
Bangladesh Agricultural Research Council (BARC)
and
International Center for Living Aquatic Resources Management (ICLARM)
29 September - 01 October 1991

RATIONALE

Development of aquaculture sector is being given importance in different parts of the world, because of the decline in growth of capture fisheries and potential the aquaculture sector has, in bridging the gap between supply and demand. Aquaculture provides much needed animal protein and creation of employment, especially in economically depressed communities. Among rural populations where farmers pursue a number of agricultural practices, increasing food production through aquaculture adds to household food and capital income. Also, potential for foreign currency earnings, is influencing policies of Government. It is predicted that development of aquaculture will closely follow that of agriculture and the world economy in general.

In Bangladesh, fish contributes some 71% of the animal protein intake of the population. In recent years, there has been a decline in per caput consumption of fish from 12.0 kg per annum in mid 1960s to 7.9 kg in 1988, as fish production could not keep pace with increase in population, resulting in malnutrition, especially in economically backward, rural communities. It has been estimated that the average per capita intake of fish in rural areas has declined from 97% of the urban sector in 1973-74, to only 75% in 1985-86. The retail prices of fish have increased faster than prices of other food commodities.

Realizing the urgent need for increasing fish production to meet the demand of increasing population, the Government of Bangladesh has set a production target of 1.0 million tons

of fish by the end of Third Five Year Plan (1989-90), as against a production of 751,000 tons at the end of Second Five Year Plan. However, the actual production is much below the targeted production. During the Fourth Five Year Plan, the Government has set up a target production of 1.2 million tons, as against a production of 0.847 million tons at the end of the Third Plan, i.e., an increase of 41% in five years.

Marine fish production in Bangladesh has increased considerably during the last two decades from 85,000 tons in 1970 to 227,000 in 1987-88. Studies undertaken in recent years have indicated that marine fish production comprising of demersal and pelagic fish are close to maximum sustainable yield (MSY) and hardly there is any potential for further expansion. Hence, any increase in production has to come from inland waters. In this connection, aquaculture can play a major role in increasing fish production in the country. There are some 1.3 million ponds covering an area of 147,000 ha, in addition to 5,480 ha of ox-bow lakes, 90,000 ha of shrimp farms, and some 3 million ha of floodplains. During 1987-88, aquaculture contributed some 176,000 tons of fish (21.3 % of total production), which includes 25,000 tons of high value shrimp. The productions that are being presently obtained from these water areas are very low, as compared to the production potential they have and what is being obtained in neighboring countries, under similar socio-economic conditions. Realizing this, the Government has set a production target of 938,000 tons from inland fisheries by the end of Fourth Plan, as against a production of 599,000 tons at the end of Third Plan.

Aquaculture has been recognized as a sector of economic importance, both for domestic supply and for export, by the Government and the donor community in Bangladesh. Many organizations and agencies in the country are involved in aquaculture research and development. Inspite of this, aquaculture contribution is not what it should have been, rural small-scale operations have not prospered and integration of aquaculture with other rural production systems has not developed. The problems for this non-realization could be technical and planning related. Hence, for maximum utilization of available resources, it is essential to assess the status of the sector, identify priority needs and opportunities and develop appropriate aquaculture development strategies, which could be implemented both by Government and non-Government organizations. There is need to identify new approaches for production of low-cost fish through review of production

systems. If aquaculture is to make a serious contribution to food production and rural economy of Bangladesh, considerable attention should be given to problems at the level of policy formulation, planning and implementation of programs.

PURPOSE AND OBJECTIVES

In view of the above, the Bangladesh Agricultural Research Council (BARC), in collaboration with International Center for Living Aquatic Resources Management (ICLARM) and funding from the United States Agency for International Development (USAID), is organizing a three day **WORKSHOP ON INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH** during 29 September - 01 October 1991. About 100 researchers, development/extension workers, planners, policy makers and administrators from Government and non-government organizations will participate in the workshop. Invited resource persons will present status papers on various aspects of aquaculture development, constraints, potentials, priorities and policies, which will be discussed by the august gathering. The discussions of the workshop will help in :

i) Review the state of art, of inland aquaculture research and development in Bangladesh;

ii) Identify constraints that impede the development of aquaculture and suggest technical and managerial mitigative measures;

iii) Identify coordination needed between different Government agencies on one hand and with the private sector on the other hand and recommend measures to achieve needed coordination for enhancing aquaculture production;

iv) Recommend environmentally compatible aquaculture development programs;

v) Formulation of aquaculture development policies and preparation of a National Aquaculture Development Plan.

BARC/ICLARM/USAID WORKSHOP
ON
INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH

Venue : Auditorium of Bangladesh Agricultural Research Council
Farm Gate, Dhaka

29.09.91 (Sunday)	08.30 - 09.30	Registration
	10.00 - 11.20	Inauguration
	11.20 - 12.00	Refreshments
	12.00 - 14.15	Session I : Freshwater Aquaculture

Chairman : Mr. Abdus Salam
Secretary
Division of Statistics
Ministry of Finance

Moderator: Dr. A.K.M. Nuruzzaman
Member-Director (Fisheries),BARC

Rapporteurs : Mr. Khabir Ahmed
Mr. S.N. Chowdhury

12.00 - 12.10	: Resource use and constraints for freshwater aquaculture development

Dr. M.A. Mazid, Additional Director
Fisheries Research Institute &
Dr. M. A. Wahab, Associate Professor
Bangladesh Agricultural University

12.10 - 12.20	: Research needs and strategy for aquaculture development

Prof. Aminul Islam, Director
Fisheries Research Institute &
Dr. M. S. Shah, Chief Scientific Officer
Fisheries Research Institute

12.20 - 12.30	: Extension and support service needs for aquaculture development

Mr. A.K. Ataur Rahman, Director
Department of Fisheries &
Mr. Kazi Azizul Hoque, Addl. Director
Department of Fisheries

12.30 - 13.00	Summarization by Moderator
13.00 - 14.00	Discussions
14.00 - 14.15	Chairman's remarks

29.09.91 14.15 - 15.00 Lunch Break

15.00 - 17.15 Session II: Brackishwater Aquaculture

Chairman : Mr. Kazi Serajul Hossain
Joint Secretary
Ministry of Fisheries and
Livestock

Moderator : Prof. M. Aminul Islam
Director
Fisheries Research Institute

Rapporteurs : Dr. Aminullah Bhuiyan
Mr. S.B. Saha

15.00 - 15.10 : Potential and strategies for brackishwater aquaculture development

Dr. Nuruddin Mahmood
Institute of Marine Science
Chittagong University

15.10 - 15.20 : Research needs for brackishwater aquaculture development

Dr. Abul Hossain, Chief Scientific Officer
Fisheries Research Institute

15.20 - 15.30 : Inter-sectoral conflicts and environmental issues in brackishwater aquaculture

Dr. M. Youssouf Ali
Bangladesh Centre for Advanced Studies

15.30 - 16.00 Summarization by Moderator

16.00 - 17.00 Discussions

17.00 - 17.15 Chairman's remarks

30.09.91 (Monday) 09.00 - 12.00 Session III: Culture Based Fisheries

Chairman : Dr. Ekram Hossain
Member (Programming)
Planning Commission

Moderator : Mr. A.K. Ataur Rahman
Director, Dept. of Fisheries

Rapporteurs : Mr. Nasiruddin Ahmed
Mr. Liaquat Ali

30.09.91 09.10 - 09.20 : Potential for culture based fisheries in Bangladesh

Dr. M.V. Gupta, Aquaculture Specialist
International Center for Living Aquatic Resources Management (ICLARM)

09.20 - 09.30 : Institutional arrangements and management needs for culture based fisheries

Dr. Mahfuz Ahmed, Technical Coordinator
International Center for Living Aquatic Resources Management (ICLARM)

09.30 - 09.40 : Ox-bow lake fisheries development in Bangladesh and lessons learnt

Prof. Aminul Hoque, Ex-Vice- Chancellor
Bangladesh Agricultural University

09.40 - 10.20 Summarization by Moderator

10.20 - 10.40 Tea.break

10.40 - 11.45 Discussions

11.45 - 12.00 Chairman's remarks

12.00 - 13.00 Lunch break

13.00 - 16.00 Session IV: Policies for Aquaculture Deveopment

Chairman : Mr. A.T.M. Shamsul Haque
Director
Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP)

Moderator : Dr. M. Karim
Consultant
Second ADB Project, DOF

Rapporteurs : Mr. S.R. Bhuiyan
Mr. Yousuf Harron

13.10.- 13.20 : Role of public and private sector in aquaculture development

Prof. Shahadat Ali, Chairman
Department of Zoology, Dhaka University

	13.20 - 13.30	: Aquaculture policies - efficacy - future directions Dr. A.K.M. Nuruzzaman Member-Director (Fisheries), BARC
	13.30 - 13.40	: National credit policy for aquaculture development Dr. Salimul Hoque Bangladesh Centre for Advanced Studies
	13.40 - 14.20	Summarization by Moderator
	14.20 - 14.40	Tea break
	14.40 - 15.45	Discussions
	15.45 - 16.00	Chairman's remarks
01.10.91 (Tuesday)	09.00 - 12.00	Panel discussions (concurrent) Panel 1: Freshwater aquaculture Panel 2: Brackishwater aquaculture Panel 3: Cultured based fisheries Panel 4: Policies for aquaculture development
	12.00 - 13.00	Lunch break
	13.00 - 16.00	Session V : Recommendations

Chairman : Mr. M. Lutfullahil Mazid
Secretary
Ministry of Home Affairs

Presentation : Mr. A.K. Ataur Rahman
Director
Deptt. of Fisheries

Rapporteurs : Mr. S.B. Bhattacharya
Dr. M. A. Wahab

WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"

Panel 1 : Freshwater Aquaculture

Panel discussants

Sl.No.	Name	Designation & Organization
1.	Dr. A.K.M. Nuruzzaman	Member-Director (Fisheries) Bangladesh Agricultural Research Council
2.	Mr. Quazi Jamal Uddin	Fisheries Expert Flood Action Plan
3.	Ms. Anwara Begum Shelly	Project Coordinator CARITAS
4.	Dr. A.G. Jhingran	Consultant Second Aquaculture Project Department of Fisheries
5.	Mr. Kazi Azizul Haque	Additional Director Department of Fisheries
6.	Mr.A.M. Anwarul Karim	Fisheries Extension Expert FAO/UNDP : BGD/87/045
7.	Dr. M.A.Wahab	Associate Professor Faculty of Fisheries, BAU
8.	Mr. A. Rob Mollah	Asstt. Professor Zoology Department Dhaka University
9.	Dr. M.S. Shah	Chief Scientific Officer Fisheries Research Institute
10.	Dr. A.S. Bhuiyan	Chairman Department of Zoology Rajshahi University
11.	Dr.Md. Rafiqur Nabi	Jahagirnagar University
12.	Mr. Ruhel Kabir	Sr. Program Officer FIVDB

13. Mr. Md. Abdur Rahman	Programme Coordinator (Fisheries) Proshika
14. Mr. Muhammad Zaher	Senior Scientific Officer Fisheries Research Institute
15. Mr.Md. Giash Uddin	Fisheries Officer Gachihata Aquaculture Farms Ltd.
16. Mr.Md. Anisur Rahman Akhand	Field Officer, IFIB Rotary Club of Comilla
17. Dr. Garry.Bernacsek	Consultant North.East Regional Project (FAP-6)
18. Mr.Md. Liaquat Ali	Principal Scientific Officer Department of Fisheries
19. Mr.Md. Shamsul Karim Khan	Deputy Director Department of Fisheries

WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"

Panel 2 : Brackishwater Aquaculture

Panel discussants

Sl.No.	Name	Designation & Organization
1.	Prof. M.Aminul Islam	Director Fisheries Research Institute Mymensingh
2.	Dr. M. Youssouf Ali	Bangladesh Centre for Advanced Studies
3.	Dr. Nuruddin Mahmood	Associate Professor Institute of Marine Science Chittagong University
4.	Dr. M.N. Kutty	Sr. Fishery Training Expert Food and Agriculture Organization Dhaka
5.	Mr. C.L. Angell	Aquaculturist BOBP/FAO
6.	Prof. Abu Tweb Abu Ahmed	Zoology Department Dhaka University
7.	Dr. M.A. Hossain	Chief Scientific Officer Fisheries Research Institute
8.	Mr. K.N. Rashid	Chief Scientific Officer Fisheries Research Institute
9.	Ms. Hosne Ara Akhter	N. Superintendent Bangladesh Fisheries Development Corporation
10.	Mr. S. B. Saha	Senior Scientific Officer Fisheries Research Institute
11.	Mr. Niamul Naser	Department of Loology Dhaka University
12.	Mr. Yousuf Haroon	Senior Scientific Officer Fisheries Research Institute
13.	Mr. A.H.M. Rezaul Haq	Aqua-Tech Associates

WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"

Panel 3 : Culture Based Fisheries

Panel discussants

Sl.No.	Name	Designation & Organization
1.	Mr. A.K. Ataur Rahman	Director Department of Fisheries
2.	Dr. M. V. Gupta	Aquaculture Specialist International Center for Living Aquatic Resources Management (ICLARM)
3.	Mr. A. Atiq Rahman	Director Bangladesh Center for Advanced Studies
4.	Mr. Khairul Alam Khan	General Manager Bangladesh Fisheries Development Corporation
5.	Mr.Md. Ibrahim Miah	Manager Bangladesh Fisheries Development Corporation
6.	Mr. John D. Balarin	DANIDA Project Advisor Ox-bow Lake Project
7.	Mr. Judeth Beckwith	Team Leader Third Fisheries
8.	Mr. Nasir Uddin Ahmed	Deputy Director Department of Fisheries
9.	Mr. Mokammel Hossain	Deputy Director
10.	Mr. P. Jahim Ullah	Consultant Flood Plain, 2nd ADP (ADB)
11.	Dr. Mahfuzuddin Ahmed	Technical Coordinator International Center for Living Aquatic Resources Management (ICLARM)
12.	Dr. Gulroo Sufi	Aquaculture Specialist Dhaka University

13.	Mrs. Akhtaruzzessa Chowdhury	Associate Project Department of Zoology Dhaka University
14.	Dr. A.K.M. Aminullah Bhuiyan	Fisheries Consultant Department of Fisheries
15.	Mr.S.A. Ainul Qari	Executive Engineer (Planning) Bangladesh Water Development Board
16.	Mr. Nazrul Islam	Deputy Chief Department of Fisheries
17.	Mr. M.M. Husain	Director (Marketing) Bangladesh Fisheries Development Board
18.	Prof. Shahadat Ali	Professor of Zoology Dhaka University
19.	Dr. Gulshan Ara Latifi	Associate Professor Dhaka University
20.	Mr. Francis Halder	Project Officer CCDB
21.	Mr. Subash Das Gupta	Principal Scientific Officer (TTMU) Bangladesh Agricultural Research Council
22.	Mr. A.T.M. Shamsuddin	Deputy Director Bangladesh Rural Development Board
23.	Mr. M. Kabir	Consultant, ADB Fisheries Project
24.	Mr. M.N. Alam	Chief Scientific Officer (P&E) Bangladesh Agricultural Research Council
25.	Mr. Aayeb Ahmed	Assistant Chief Ministry of Land

WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"

Panel 4 : Policies for Aquaculture Development

Panel discussants

Sl.No.	Name	Designation & Organization
1.	Dr. Mahmudul Karim	Fisheries Consultant Second Aquaculture Project
2.	Mr. Imtiazuddin Ahmed	Sr. Program Officer World Bank
3.	Dr. J.J.C. Madamba	Team Leader Checchi & Co.
4.	Mr. Saleemul Huq	STA Coordinator Third Fisheries Project
5.	Mr. Md. Panna Shaikh	Executive Engineer Bangladesh Water Development Board
6.	Dr. Md. Ferdous Alam	Associate Professor Department of Agriculture, BAU
7.	Mr. Md. Mohabubul Haque	Assistant Secretary-General Jatiya Torun Sangha
8.	Mr. Abdul Halim Howlader	Principal Scientific Officer SPARRSO
9.	Mr. Md. Abul Hossain	Senior Scientific Officer Fisheries Research Institute
10.	Mr. Mian Akbar Hussain	Project Coordinator SCI-Project
11.	Mr. Goutam Barua	Senior Scientific Officer Fisheries Research Institute
12.	Mr. S.B. Bhattacharjee	Deputy Director Department of Fisheries

13. Mr. Md. Alamgir	Fish Culturist Fisheries Development Corporation Rangamati
14. Dr. S.K. Paul	Senior Scientific Officer Fisheries Research Institute
15. Mr.M. Akhteruzzaman	Senior Scientific Officer Fisheries Research Institute
16. Mr. Md. Shahab Uddin	Senior Scientific Officer Fisheries Research Institute
17. Mr. Md. Anwar Hossain	Farm Manager Unnayan Sangha, Jamalpur
18. Mr.Md. Amjad Hossain	Scientific Officer Fisheries Research Institute
19. Mr. Swapan Bairange	Pisciculturist, SCF (USA)
20. Mr. Tanvir Islam	Fisheries Trainer Jagorani Chakra, Jessore
21. Mr. Masud Rana	Programme Organizer (Fisheries) Bangladesh Rural Advancement Committee
22. Mr.Md. Zahirul Haque	Senior Scientific Officer Fisheries Research Institute
23. Mr. Badray Alam	Project-in-charge SOSAG
24. Mr.M. Abul Khair	Agriculture Officer Rangpur-Dinajpur Rural Services
25. Mr. Francizco Noble	IUS Volunteer Association for Development Agencies in Bangladesh
26. Mr. S.N. Chowdhury	Principal Scientific Officer Department of Fisheries
27. Dr. M.A. Mazid	Additional Director Fisheries Research Institute
28. Mr. A.B.M.F. Wahab	Professor (Rtd.) Bangladesh Agricultural University
29. Mr. Atowar Khan	Training Coordinator Grameen Bank

PANEL 1 : FRESHWATER AQUACULTURE

RECOMMENDATIONS

1. A National Fisheries Advisory Committee should be set up to determine the strategies for research and development of the fisheries sector.

2. Further introduction of new exotic species should be strictly restricted. A National Screening Committee of competent scientists should be set up to examine the desirability of any new introduction of exotics.

3. Those indigenous species whose biology, production potential, etc. are known should be extended for culture.

4. To accelerate the fisheries production emphasis should be given for intensive carp fry nursing, establishment of adequate number of carp and prawn hatcheries and improvement of the existing facilities.

5. Small scale cottage industry for fish feed development with local ingredients should be supported and encouraged.

6. Various imported aquaculture inputs like hormones, artemia cyste, piscicides and chemicals, and machineries should be included as tax free items for import.

7. Aquaculture needs special credit and specific allocation of the local body funds. UFO should be included in the Upazila Credit Committee.

8. DOF Fish Seed Farms should be utilized as training, demonstration and technology transfer centres.

9. Extension service of the DOF should be strengthened by setting up a separate Extension Division.

10. The data acquisition system of BARC should be utilized to develop a proper data based on aquaculture.

11. Coordination among the various research institutions, universities, development and extension agencies should be strengthened. In the evaluation and monitoring of all research activities supported by BARC shall include external members. Necessary funds for this should be allocated by BARC.

12. Specific allocation/enhanced allocation for fisheries activities should be made by BARC in its annual budget.

13. Wherever necessary the development projects of DOF should have a research budget to solve any problem that may raised during their implementations.

14. Technical and policy support by the government should be extended to the NGOs involved in fisheries extension activities.

15. Socio-economic research in fisheries sector should be strengthened and facilities should be created if they do not exist.

16. Need for an extension research cell is felt and should be established at a proper place.

PANEL 2 : BRACKISHWATER AQUACULTURE

RECOMMENDATIONS

1. Prospective shrimp farming areas in the coast should be classified on the basis of salinity gradients, taking into consideration the earlier reports/studies.

2. Construction of brackishwater aquaculture farms to be developed with adequate water exchange facilities and area specific pond preparation methods should be well planned.

3. Encourage the development of nursery facilities for PLs of shrimp.

4. In order to reduce pressure on wild seed stock backyard/commercial hatcheries may be developed to meet the timely demand of seed supply.

5. Research and development for supplying brood stocks of P. monodon for hatchery operation should be encouraged.

6. Horizontal expansion of shrimp farming should be discouraged, and increase in production per unit area should be encouraged with due consideration to environmental, socio-economic consequences, as well as international market demands.

7. Adequate support facilities to combat the constraints concerning feed, water quality, and disease control measures need to be made available.

8. Polyculture of shrimp and suitable species of finfish should be encouraged.

9. Institutional research is needed to promote mono and polyculture of finfish and shell fishes.

10. Since shrimp farming is an export oriented industry, a generous import policy for procuring equipment, feed ingredients, vitamins, and chemicals, etc., should be adopted.

PANEL 3 : CULTURE BASED FISHERIES

RECOMMENDATIONS

1. The Government should provide institutional and financial support to create a positive investment climate and stimulate private sector participation for meeting the fingerling requirements of openwater stocking and aquaculture.

2. In view of the massive fingerling requirements and lack of sufficient nursery space, the technology of intensive rearing of fingerlings in nursery cages, pens and enclosures should be tested and/or adopted.

   Intensive, high density rearing of fry/fingerlings in nursery ponds should be demonstrated and disseminated to the nursery operators.

3. Where possible, private sector should be encouraged to raise fry in beels.

4. Roadside ditches, seasonal canals, and other impoundments should be utilized as nurseries. Private sector nursery operators should be encouraged to undertake nursery operations in and around the stocking areas in order to minimize transport risks.

5. The prospect of utilizing deepwater paddy fields as nurseries should be explored. If found feasible, fry production programs should be undertaken under suitable arrangements with the farmers.

6. Environmental and biological impact of stocking of exotic species should be monitored and studied.

7. Studies should be initiated for a better understanding of food webs in selected aquatic ecosystems to determine compatible species composition/size, and intensity of stocking.

8. In order to ensure early stocking of floodplains, it is necessary to develop brood fish management techniques for early maturity and breeding of native carps.

9. All water bodies in the FCD/FCDI Projects and others (e.g., oxbow lake) should be developed under the concept of culture based fisheries enhancement, and the Government should seek additional funding support to initiate such activities at the earliest possible time.

10. Government should expand investment in support services to perform managerial, extension and technology transfer responsibilities with regards to culture based fisheries.

11. Floodplain stocking should be supported by effective programs of conservation and protection with a view to prevent overfishing and fishing of undersized fish. The strategy in this regard should be to involve the community of fishermen and farmers in addition to Government departments. Also, attention should be given to the creation of sanctuaries and shelters (such as brush piles) within the culture based fisheries areas.

12. A working committee comprising representatives of different ongoing development projects should be established for the purpose of studying problems and issues relating to culture based fisheries. All information generated should be disseminated.

13. Any future flood control related activities should take into account the impact on fisheries and incorporate remedial measures.

14. In managing culture based fisheries, the Government should follow the guidelines of NFMP with reinforced arrangements for institutional support and community involvement.

15. Appropriate mechanisms should be developed to recover public sector investment in the development of culture based fisheries in the open waters.

16. Once the viability of the culture based fisheries program is established and the impact of such stocking is quantified, the private sector should be encouraged to take over such activities under suitable arrangements.

17. Development of culture-based fisheries should follow a basin-wise approach, integrating stocking and fishing programs with the development of other floodplain dependent operations as well as with those of upstream and downstream activities. For this, Government and NGO activities should be linked.

PANEL 4 : POLICIES FOR AQUACULTURE DEVELOPMENT

RECOMMENDATIONS

1. In view of the immense opportunities for creating productive employment, production of fish for local consumption and export, and production of broodfish fry and fingerlings for increasing productivity of the degraded and impoverished open water systems and improvement of the rural and urban environment, aquaculture should be given topmost priority in the national development plan.

2. A National Aquaculture Development Plan should be formulated based on the aquaculture prospects and constraints by union.

3. A complete inventory should be made of the aquaculture-related resources, including natural and artificial feeds as well as the present status and development needs of various types of ponds, road-side canals, borrow-pits, FCDI canals, enclosed flood lands, dead rivers and other waters in which fish can be cultured by applying appropriate pond culture, pen culture and cage culture technologies either immediately or subject to further water area development.

4. As a key policy for inland aquaculture development, the basic framework for identification of research, technology transfer, and policy support shall be current production and marketing systems for key aquaculture-related commodities, such as:

   i) fry and fingerling production and marketing systems

   ii) finfish production and marketing systems (i.e. carps, nilotica, catfish, etc.)

   iii) crustacean production and marketing systems (i.e. shrimps, crabs, etc.)

   iv) mussel production and marketing systems

   v) aquaculture feed production and marketing (i.e. natural feed resources, artificial feed)

   vi) aquaculture equipment production and marketing systems (i.e. pumps, aerators, nets, gears, etc.)

In this context, problems and technology-generated opportunities shall be the basis of research plans/projects, the mature technologies emerging from these shall be the basis of technology synthesis and technology transfer programs, while appropriate policy support instruments should be formulated which would ensure the full utilization of such mature technologies in aquaculture production and marketing systems.

5. Species selection and culture technology should be determined in accordance with the seasonality, flooding nature, physico-chemical and biological parameters of the water bodies in question as well as in consideration of the socio-economic needs of the fish farmers (particularly smallholders).

6. Advice-oriented aquaculture extension should be replaced with practical demonstration of aquaculture in private ponds, pens and cages, nursery rearing, as well as for table-size fish production in each potential union found to be appropriate for aquaculture production systems

7. Aquaculture should be defined as a separate and very important focus area for the institutional financial credit sector. This will mean both allocation of proportionately greater amounts of credit for the aquaculture sector as well as the identifying and putting in place the necessary reforms of the financial credit sector to achieve the full disbursement of such fund allocation.

8. All types of small and medium size public waters (ponds, road-side canals, borrow-pits, FCDI canals, dead rivers, etc.) should be placed under the Upazila Parishad for long-term distribution to selected target groups against convincing production projects. In order to introduce and effectively implement improved aquaculture technologies and also to ensure equitable distribution of the water resources, the public waters will be distributed to three classes of people:

   a) Fisherfolks, landless and marginal farmers and unemployed youths

   b) People trained in aquaculture

   c) Entrepreneurs truly interested in investment on aquaculture development.

9. An AEZ map for aquaculture should be prepared so that technology transfer advice and support services can be made more effective.

10. All aquaculture production and marketing activities should be done through the private sector (i.e. smallholder fish farmers and aquabusiness entrepreneurs).

11. Over the short-term, a high priority should be given to mass production of hatchlings, fry, and fingerlings of the appropriate species combinations in keeping with the currently generated need for fish seed in support of massive stocking programme for various types of open water bodies.

12. Marketing opportunities (at the local, national and international level) should be the basis for the formulation and implementation of production and marketing systems of key aquaculture commodities.

13. As quickly as possible, but in an organized fashion, the existing facilities and resources (i.e. hatcheries, fish farms) now in the hands of public sector agencies should be turned over to aquabusiness entrepreneurs who can come up with a technically sound, economically viable, and socially acceptable program for the utilization of such resources. In this context, full credit and policy support should be provided to ensure the success of such ventures.

Environmental Policy

14. Environmental evaluation should be a part of all major fisheries sector activities and projects including increasing area under shrimp farming, flood control and irrigation projects, use of harmful pesticides, etc.

WORKSHOP
ON
"INLAND AQUACULTURE DEVELOPMENT STRATEGIES FOR BANGLADESH"

29 SEPTEMBER - 01 OCTOBER 1991

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RESOUCE USE AND CONSTRAINTS FOR FRESHWATER AQUACULTURE DEVELOPMENT

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1.0 INTRODUCTION :

The need for judicial use of fisheries resources and the prospects and problems of aquaculture development in Bangladesh have been realized only recently. The realization came after the fish production from natural resources declined to a level of serious concern due to various environmental reasons. As a matter of fact, fisheries as a whole was one of the most neglected sectors until mid 1980s and no attention was given by administrators and planners for its development. When we try to analyse the reasons for this neglect, the main reasons appears to be that, fish was much abundant in the past in innumerable water bodies of Bangladesh without any human intervention and management. These natural water bodies particularly, the floodplains, beels and rivers were automatically stocked during monsoon through natural spawning. Fish grew on natural productivity of these waters without any additional care. As a result, a wrong impression was created in the minds of the people to this effect that we could have a continued supply of fish in bounty even without any management and developmental activities.

Over the last decade, the natural breeding grounds and habitats of fish have considerably degraded and eliminated by continued water development activities, particularly by flood control measures which in consequence resulted in a decline in natural fish production. With the decline in production and increase in population, the gap between demand and supply of fish has widened which in turn reduced the daily per capita consumption of fish from 33 g in 1963-64 to 20.5 g in 1989-90. The decline in consumption is more evident in rural than in urban areas. This has resulted in wide spread hunger and malnutrition in rural population as fish is the important food and main source of animal protein for them.

2.0 THE ROLE OF FISHERIES IN ECONOMY :

Although there has been a short supply for domestic consumption, the importance of fisheries in the agro-based economy of Bangladesh has further

increased in the recent years as it plays an important role in nutrition, income, employment, foreign exchange earnings and other areas of the economy. Fisheries is second to agriculture and contributes nearly 6% to GDP and more than 12% to the export earnings of the country (FFYP,1990-95).

Over the Third plan period, export earnings from fishery commodities experienced a sharp increase in terms of value due to favourable export prices. According to Ali (1991) Bangladesh earned Tk. 4790 million (Table 1) in foreign exchange through export of shrimps, froglegs, fish and fishery products during 1989-90. Like other developing countries, Bangladesh will continue to have an acute need for foreign exchange for balance of payment and will be in search for export opportunities from natural resources. Critical evaluation of trends indicate that external .pn4 debt problems would constantly pressurize the Government to choose export oriented and import substitute options in industry as well as in fisheries development. With the increase in international demand and price, shrimp culture has rapidly expanded during the last 10 years and significantly contributed to increased export earnings. Development of shrimp culture may further strengthen the base of the national economy.

Fisheries provide full-time employment for about 2 m people, equivalent to 7% of the total employment; about 1.4 m people are engaged in fishing and fish farming on full time basis while the rest work in transportation, packing and processing. Approximately, another 11 m people are involved in seasonal or part-time fishing or other ancillary activities. An estimated 73% of the rural house-holds undertake some sort of fishing annually. On an average, 1.18 persons per rural house-hold are involved in subsistence fishing (Rahman,1989).

3.0 FISHERY PRODUCTION SYSTEMS :

Fisheries production systems prevail in Bangladesh are diversified in type, character and source. The inland fisheries are constituted by rivers, canals, natural depressions (beels, haors, oxbow lakes), reservoirs, floodplains, inundated paddy fields and ponds, cover an area of 4.3 m ha. In addition, the country has 12 nautical mile Exclusive Economic Zone (EEZ) in the Bay of Bengal. Total marine water area in the Bay of Bengal covers nearly 64,000 sq. km with an extensive continental shelf area. These vast water systems serve as potential grounds for fish production and provide unique opportunities for aquaculture development.

3.1 Types of inland water resources :

Fisheries producton systems prevailing in Bangladesh can primarily be categorized into:1. Inland fisheries producton systems and 2. Marine fisheries production systems. Types of water bodies in the inland production systems with their productions are presented in Table 2. Inland fisheries resources are

Table 1. Quantity (Metric tons) and value (Million Taka) of frozen shrimp, fish and other aquatic products export from Bangladesh from FY 1981-82 FY 1989-90

	Frozen shrimp tail		Frozen frog leg		Frozen fin fish		Dry fish		Salted and dehydrated fin fish		Live turtle & tortoies		Crab		Shark fin fishmaxs		Total	
Year	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
1981-82	6903	904	1589	112	703	42	39	4	123	13	507	22	NA	NA	63	13	9927	1110
1982-83	9312	1499	2029	120	1294	77	79	8	139	13	479	23	7	0.6	64	17	13401	1758
1983-84	8818	1555	2495	192	2907	142	74	9	283	32	440	24	11	0.9	43	13	15071	1966
1984-85	12682	1994	1365	103	3297	148	47	5	382	36	425	23	17	1	108	21	18323	2331
1985-86	13871	2739	2463	301	5057	365	796	101	422	49	678	41	2	0.02	50	11	23329	3607
1986-87	16271	3418	2132	295	4037	353	400	49	295	38	489	35	NA	NA	113	35	23737	4224
1887-88	18665	3473	2824	478	4270	269	915	128	186	21	393	45	109	11	NA	NA	27362	5325
1988-89	15386	3820	2685	438	2427	226	567	139	293	41	293	22	NA	4.3	62	22	21719	4719
1989-90	NA	4143	NA	103	NA	256	NA	234	NA	14.4	NA	9.2	NA	0.3	NA	28	NA	4787.

Source : Towards sustainable Development : Fisheries Recource of Bangladesh by M.Youssouf Ali 1981.
Note : NA = Not Available

Table 2. Area under different fisheries production systems with their contribution to total fish production.

System category	Water area (ha)	production as 1989-1990	Contribution to total production(
1. Inland production system			
Openwater capture system			
Rivers and Estuaries	10,31,563	1,90,000	22
Floodplains	28,32,079	1,78,000	21
Beels & Haors	1,14,161	50,000	5
Reservoir	68,800	5,000	0.59
Total capture	40,46,603	4,23,000	49
2. Closed water culture system			
Ponds	1,46,890	1,61,000	19
Oxbow lakes (Baors)	5,488	1,600	0.18
Brackish water	87,300	27,000	2.95
Total culture	2,39,678	1,89,600	22
Total inland	42,86,281	6,12,600	71

generated from openwaters (rivers, estuaries,floodplains, beels,haors and reservoir), inundated paddy fields and closed waters (ponds,ditches and baors). In Bangladesh, aquaculture means culture of fish in ponds. So, the potentials of pond culture system which is the focus of this paper is discussed below.

3.2 Ponds :

Ponds are man-made closed water bodies excavated at the rural homestead primarily for washing and bathing purposes by the rural people. There are an estimated 1.3 m ponds (Table 3) in the country covering an area of 0.151 m ha out of which nearly 46% are cultured, 30% is culturable and 24% is derelict (FIB,1986). In addition, there are a large number of seasonal ponds and ditches which are presently not used and are lying fallow, covered in most cases with water hyacinths. Aquaculture development in these closed waters can play a vital role in increasing fish production. Presently, there is no fish culture *per se* in most of these ponds, resulting in very low productions of 600-800 kg/ha/yr from wild fish or fish stocked without any basis or care.

Although the inland openwater system presently contribute about 50% to nation's total fish production, the inland fisheries are in real danger due to rapid enviornmental changes, both natural and man-made. Fish production from ponds on the other hand, has progressively increased although its contribution to total production is still only 19%. If the large number of ponds which are presently unutilized or underutilized can be brought under aquaculture, even at the present low rate of production of 1350 kg/ha, an amount of 0.20 m tons of fish can be produced from existing 0.15 m ha of country's pond areas, an increase of about 27% over the present aquaculture production. Through development of appropriate technologies and their subsequent transfer to farmers, it would be possible to increase the production by 50% from inland culture fisheries in the next five years, with a projected growth rate of 10% per annum.

4.0 FISH PRODUCTION STATUS :

The current level of production of fish and shellfish has been estimated to be about 8.47 lakh tons. According to the latest available statistics, 71% of the total production comes from inland waters and 29% from marine fisheries. Of the inland production, 69% is from capture fisheries and 31% from culture. The inland openwater fisheries production declined markedly from 4.72 lakh tons in 1983-84 to 4.42 lakh tons in 1985-86. However, aquaculture production has been steadily rising showing a growth of 31% over the last five years although its contribution to total production is only 22%. However, ample scope remains to increase aquaculture production through using intensive or semi-intensive

Table 3. The number and estimated area of freshwater ponds by old District.

Name of district	Total no. ponds				Estimated area of ponds			
	Cultured	Culturable	Derelict	Total	Cultured	Culturable	Derelict	To
Chittagong	43471	47085	12701	103257	6201	6662	1796	14
Comilla	70315	35941	14352	120608	2009	1768	2854	6
Noakhali	58172	29735	11874	99781	10393	4984	846	16
Sylhet	20639	40340	56287	117266	1882	3428	5008	10
Dhaka	17311	14380	22574	54265	1720	859	2711	5
Faridpur	15948	13248	20798	49994	3433	2590	3376	9
Jamalpur	4204	2097	3877	10178	166	159	115	
Mymensingh	47906	19304	11583	78793	5914	3728	1648	10
Tangail	4272	2130	3942	10344	863	315	688	1
Barisal	85657	41190	29176	156023	9932	2493	2129	14
Jesssore	63209	14213	10859	88281	5056	1191	908	7
Khulna	35402	12276	9421	57099	6500	2109	1514	10
Kushtia	15552	7523	8534	31609	755	367	411	1
Patuakhali	48057	23108	16369	87534	2856	1428	952	5
Bogra	7964	8445	8875	25284	2090	2215	1685	5
Dinajpur	13452	14263	14987	42702	2564	2564	3844	8
Pabna	11629	16390	8322	36341	674	413	301	1
Rajshahi	23240	32753	16630	72623	5195	8261	3854	17
Rangpur	12299	10821	23119	46239	1033	983	1919	3
Total	598695	385242	304285	1288222	69236	45517	36559	15
Percentage	46.48	29.90	23.62	100.00	45.80	30.10	24.20	10

Source : Fisheries Information Bulletin 3(1), 1986 Department of Fisheries

culture technologies. The country ranks third among the world's inland fish producing countries (Islam, 1989). A comparisom of the fish production targets and achievements for various Plans is summerised in Table 4.

Table 4. Fish production targets and achievements during various five year plans

Pland Period	Target (lakh tons)	Annual Production (lakh tons)
FRYP (1973-78)	10.20	6.43
TYP (1978-80)	8.08	6.46
SFYP (1980-85)	10.00	7.74
TFYP (1985-90)	10.00	8.47

5.0 PROJECTED FUTURE DEMAND FOR FISH :

The population of Bangladesh has been projected to grow to 16.62 crore by the year 2005. Even to maintain the present low level of consumption (20.5 g/capita/day), fish production would have to increase to 12.20 lakh tons by the year 2005, an increase of nearly 44% over the present day production. If the per capita fish supply were to reach the recommended level of 38 g per person per day, the production would have to reach 19.00 lakh tons which is an increase to the tune of about 118% over the present production.

Our demand for fish as food, foreign exchange earner and for industrial use is projected to increase to 12.00 lakh tons by the end of the FFYP (1994-95). Due the state of the fisheries as exists today, increase in production from openwater capture fisheries is almost impossible even through further intensive or extensive fishing efforts. Only better management of resources could ensure sustaining the present level of openwater fisheries production. So, the increased production will have to be obtained from aquaculture, particularly freshwater and brackishwater aquaculture as mariculture is yet to be developed. Although aquaculture is still in its infancy, it has made a good growth of about 31% over past five years. Experts believe that inland aquaculture has immense potential for further development and has to be given high priority in national programmes to take advantage of export opportunities, to create new or alternative employment opportunities for rural people and to compensate for declining catches in capture fisheries due to adverse effects of flood control, drainage and irrigation projects and excessive or over-fishing and pollution.

6.0 ISSUES AND CONSTRAINTS :

Issues and constraints to aquaculture development are highly deversified and mostly related to and variable with the type, character and source of fisheries. The major factors that impede aquaculture development in Bangladesh related to problems of property rights, competing water uses and related conflicts, lack of appropriate management policy, inadequate supply of fish seed and fish feed, lack of technology, credit facilities and policy guidelines, lack of awareness and motivation, prevailing socio-economic conditions, natuaral calamities,poor infrastracture and others. This part of the article deals with the major issues, constraints and suggestions for aquaculture development in Bangladesh and are detailed below :

6.1 Aquaculture policy :

A national aquaculture policy is very much needed to guide and plan aquaculture development programmes. Although aquaculture in Bangladesh has not guided by a national development plan, it has made about 31% growth over the last five years. If aquaculture is given a high priority in the national programme, it would be possible to increase aquaculture production by about 50% in the next five years. Since the fisheries of Bangladesh are highly deversified in nature and vary not only from ditches to seas, culture to capture, seasonal floodplains to reservoirs, but also from place to place, the formulation of aquaculture visa-vis fisheries policy should be comprehensive enough to reflect the sources and potentials, constraints, system approach for utilization and better management, development of technologies, provision of credit to fish farmers and fishermen, land and water use policy, the role of the government and the private sector enterprises, the role of R and D activities, socio-economic conditions of the farmers, So that the strategies and plans prepared on the basis of the policy can be successfully implemented for the development of the sector.

In all rural development programmes such as integration of farming systems, water management, marketing and village trade; the interest of aquaculture should receive adequate attention as a national policy.

6.2 Development of appropriate aquaculture technology :

In order to sustain aquaculture development, continuous generation and improvement of technologies through research are needed. Since, aquaculture is growing faster, research should be concentrated in developing appropriate aquaculture technologies and related aspects like seed production, nursery management, feed manufacturing, fish disease etc. to provide technical support to the farmers to sustain the growth of aquaculture.

As research is very costly, the Government should be liberal in allocating adequate resources for effective research for technical backup and sustenance of the economic development process of the country.

6.3 Transfer of technology :

Although a number of viable aquaculture technologies are available in Bangladesh (integrated aquaculture, aquaculture of nilotica and rajpunti, polyculture etc.), they have not been transferred to farmers due to absence of proper extension mechanism. DOF is the major agency of the Government for transfer of new aquaculture technologies to the farmers but it neither has a organized extension system nor even a programme to perform this function.

The Upazila Fisheries Officer (UFO) has a vital role to play in extension of aquaculture technologies. However, in some of the Upazilas, the post of the UFO is vacant and in some occupied by nontechnical persons. The UFOs have no specific assignment or directions nor they have been provided with necessary field equipment, transport and funds to work properly. Therefore, reorganization of extension services of DOF should be given priority consideration. There should be Union Extension Supervisor to link up the farmers with the extension programme. In order to to vitalize the extension programme, the UFOs should have a preset yearly extension programme to be achieved i.e. the number of technologies to be extended to a number of farmers be decided at the start of the year. The performance of the UFOs should be evaluated at the end of the year. In addition, each fish farm should have a demonstration unit for new aquaculture technologies to show the farmers as " seeing is believing."

As a strategy for immediate extension of available aquaculture technologies, the existing extension services of DAE which is extended up to village level through block supervisors may be utilized. The services of NGOs could be complimentary to the Government programme.

6.4 Manpower development and Training :

Skilled manpower is vital for development and dissemination of technologies which are seriously lacking in Bangladesh. The required skills of DOF field officers have to be developed through regular in-country training on the job. Training over seas both short and long-term is also needed for scientists and extension workers to increase their technical and managerial capabilities. DOF field officers may also undertake training in FRI to learn the advanced aquaculture technologies it has developed to transfer to rural farmers.

Since training is an important means of technology transfer, it is imperative that DOF should develop core resource persons to offer regular

training on improved aquaculture technologies to fishermen, fish farmers, private enterpreuners and other interested people, to aid technology transfer programme.

6.5 Inputs Supply :

Even though aquaculture ensures high profit, farmers simply can not go for it for lack of finance. High cost and unavailability of inputs such as feed, fertilizers, hormones, drugs for disease etc. hinder aquaculture development in rural areas.To encourage fish farming activities in rural areas fish farmers should be provided financial assistance along with technologies. Considering the complicated procedure of the commercial Banks for loans to the poor fish farmers, a separate Fisheries Bank should be established for disbursement of soft-term collateral free loans to the genuine farmers. Until such a Bank is established, Government may take up a programme for disbursement of fisheries loans through the extension set up of DOF. Use of Grameen Bank might be another alternative for credit to farmers.

6.6 Coordination among various water resource development agencies :

Because of multipurpose usage of water, the water bodies in many cases are managed and controlled by other departments like, DAE, Land and BWDB who normally do not pay any attention to fish production. Therefore, an effective interministerial coordination among these agencies is absolutely needed to safeguard the interest of each of the sectors. Fish as renewable aquatic resources, need to maintain sufficient stocks in water for continuation of renewal process. In addition, coordination between the fisheries research and fisheries extension agencies must be strengthened to help generation and transfer of appropriate technologies. **6.7 Fish seed production :**

Insufficient production of fry and fingerlings, high mortality of fingerling during nursing and transportation, lack of nursery management technology and poor transportation facilities are the major constraints in fish seed production.

The quantities of fish seed presently available both from hatchery and natural sources are not sufficient for expansion and intensification of aquaculture. Presently, private sector hatcheries produce about 7,000 kg and public sector hatcheries (84 nos.)about 1350 kg of spawn annually. Natural spawn production from various rivers and their tributaries amounts to over 12,000 kg. Although the hatcheries produce a large quantity of fish seed, only 15% of the requirement for pond culture operations could be met from this resources. An additional huge quantity of seeds of various culturable species is also needed for Government openwater stocking programme. This needs establishment of more

new hatcheries, renovation of existing hatcheries and expansion and improvement of nursing system to increase level of production. Although natural seeds are of good quality, they are not of appropriate sizes and species which emphasizes the need for hatchery spawn for planned growth of aquaculture. Besides carps, seed production of Magur, Koi, Golsha, Pabda, Punti etc. needs to be encouraged to enable farmer to undertake aquaculture of these species. To satisfy the high demand for fingerlings, the nursery operators should be trained on improved methods of fingerling raising for better survival and production of high quality seed under intensive system. Although the existing ponds in Bangladesh are not suitable for nursery operation, it is needed to expand nursery rearing in seasonal water bodies, irrigation and drainage canals etc.

6.8 Fish feed development :

Intensive aquaculture is largely dependent on supplemental feeding. Feed cost accounts for over 60% of the total operational cost of aquaculture. Although a large variety of potential indigenous ingredients are available in Bangladesh, no effort is being made for commercial production of fish and shrimp feed due to lack of technology. Recently, one fish feed manufacturing plant named as Saudi Bangla Fish Feed Ltd. has been set up at Bhaluka in Mymensingh district under assistance from Saudi Arabia pioneered fish feed production in Bangladesh. Establishment of more fish feed industry can accelerate aquaculture development in Bangladesh.

6.9 Prevailing socio-economic conditions :

Majority of the rural people who constitute about 80% of the population are poor and illiterate farmers with low socio-economic status. It is difficult to organize them for aquaculture which they believe as a low status profession and less profitable activity compared to agriculture. The hatchery and nursery operators and fish seed traders are although important in the promotion of aquaculture have relatively less prominence and role in the society. Due recognition should be given to the services of the hatchery and nursery operators.

Multiple ownership and multipurpose use of ponds lead to adverse cultural conditions and conflicts over the use of ponds for aquaculture. The owners normally can neither unite together nor allow the other owner to undertake aquaculture in the ponds they possess. As a result the ponds normally remain unutilized. The reasons for non-utilization of ponds in aquaculture is shown in Table 5.

Table 5 : Percentage distribution of non-utilized ponds and reasons for their non utilization.

Reasons for non-utilization	Percentage of ponds
Lack of finance	68.12
Multiple ownership	18.27
Unprofitability	7.04
Unproductive and others	6.57

(Source : Aquaculture in Bangladesh : Opportunities and Challenges, 1990)

Poaching and poisoning in fish ponds are also a common problem which need to be controlled by legal action against such immoral act to protect the farmers from such loss. Demonstration of economic benefits through extension services and creation of awareness among the farmers of their production potential would help eleminating the existing problems and encouraging rural farmers to adopt aquaculture as a viable economic activity.

The management of direlict ponds which need repair and renovation should be brought directly under Government aquaculture programme or may be given to the NGOs for using as production units through the landless, poor farmers and destitute women.

6.10 Infrastructure development :

Required infrastrucural facilities are needed to be developed for expanded aquaculture and nursery rearing Programme. As aquaculture operates in rural areas where infrastructural facilities are normally not available, development of facilities like marketing, transportation, electricity, hatcheries etc. would attract people in aquabusiness.

6.11 Risk management in aquaculture :

Aquaculture in Bangladesh has to face a high risk as associated with flooding and drought. Ponds in flood-prone areas, particularly in the southern part of Bangladesh are washed away by flood waters almost every year, discouraging people for invest in aquaculture. On the other hand, most of the ponds all-over the country dry up during dry season when drought prolongs and

make aquaculture impossible. Aquaculture thus suffers a heavy loss during monsoon as well in dry season. Thus it is important to offer pond production models that will be well adapted to the flooding or dry season risks and provide profitable new possibilities such as fingerlings and freshwater shrimp production. The basic pond model may includes pond rehabilitation, double stoking, fertilizing and supplementary feeding, raising fish yields from 600-800 kg/ha to about 2000 kg/ha. In perennial ponds, addition of freshwater shrimp (*Macrobrachium rosenbergii*) can be a useful subsidiary crop. Deep tubewell facilities must be made available to a number of ponds in a manner that does not affect irrigation to crops.

Outbreak of disease like epizootic ulcerative syndrom cause massive loss to individual fish farmers and discourage them to take up aquaculture again. Whatever curative or preventive measures known to the fishery scientists must be made available to the farmers immediately. In order to compensate the loss of poor farmers, the Government should introduce aquaculture insurance scheme against such natural disasters beyond their control.

6.12 Development of integrated aquaculture system :

Aquaculture in Bangladesh still follows a traditional pattern of single commodity approach. Because of limited farm resources, integrated fish farming incorporating various aspects of agriculture (rice-fish farming) and livestock raising would ensure optimum economic returns to the farmers. So, farming system multi-commodity approach would go a long way towards attaining self reliance of the small farmers.

7.0 STRATEGIES FOR FUTURE AQUACULTURE DEVELOPMENT :

The scarcity of animal protein calls for urgent development of aquaculture, as development of capture fisheries seems to be a difficult task due to lack of sound management and conservation practices of the complex resource. Aquaculture should be given high priority in the national programme to continue the present increasing trend in aquaculture production. Since, private sector enterprise has an important role to play in aquaculture development, Government support in the form of technical inputs, credit, extension, infrastructure facilities, production incentives, pollution control, appropriate land-water use policy, inter-agency coordination etc. would acclerate its development on industrial basis. Following strategies are suggested for aquaculture development in Bangladesh :

7.1 Development of appropriate aquaculture technologies through research in the FRI. While generating technologies, FRI should bear in mind that under the existing socio-economic conditions, how best the fisheries component can fit and

7.10 As pond culture along with artificial stocking of openwaters would need large quantities of fingerlings, development of nurseries should be emphasized both in private and public sectors through development of nursery technology and related physical facilities.

7.11 Development and commercial production of supplementary fish feed from locally available ingredients for gradual intensification of aquaculture to obtain increased production per unit area.

7.12 Cultivation of fish fed on macro-vegetation and detritus should receive attention.

7.13 Formulation and implementation of a well-defined land-water use policy to avoid wasteful resource conflicts.

7.14 Coordination among water resources development agencies in planning, designing and implementing water development projects is absolutely necessary for proper management and growth of fisheries.

7.15 Subject to successful experimentation, pen and cage culture technologies need to be employed on large-scale in various suitable water bodies such like Kaptai lake, Baors and other irrigation canals and drainage reservoirs.

7.16 An aquaculture Advisory Board may be formed by the Government for identification of appropriate research programme, suggest measures for improvement of research and extension agencies for development and transfer of technologies,identify and document mature and transferable technologies and to help intensifying joint effort of the Research Institute and the Extension agencies for effective adoption of modern technologies by the farmers.

Now it is needed to frame out a comprehensive National Aquaculture Development Action Plan encompassing the Strategies as suggested above to support the farmers undertaking massive aquaculture Programme of culturable species in all available public and private ponds, seasonal ditches and other prospective water bodies throughout Bangladesh.

8.0 ROLE OF NGOs IN AQUACULTURE DEVELOPMENT :

Many of the Non-Governmental Organizations (NGOs) are actively involved in income generating activities for the poor rural farmers in agriculture,

integrate with other components available with the farmers for optimizing production. The existing aquaculture technologies also need to be upgraded through appropriate research.

7.2 Transfer of technically and economically viable technologies to the farmers by DOF through demonstration in farmers pond. DOF needs to develop an effective extension system at the Upazila and Union levels and to work hand in hand with the farmers for dissemination of technologies. The services of NGOs should be utilized for dissemination of technologies to the poor farmers.

7.3 Training of extension workers, technicians,farmers, and entrepreuners on improved aquaculture technologies. DOF should intensify training as one of the effective means of dissemination of technologies.

7.4 Development of manpower in the fisheries sector is vital for planning, research and dissemination of aquaculture technologies.

7.5 Development of basic infrastructure in the prospective aquaculture zones in terms of water supply, electricity, communication, marketing and post-harvest facilities to support expansion of aquaculture.

7.6 Provision of technical inputs and credit. Soft-term and quick sanction of bank loans and aquaculture insurance must be ensured to attract people in aquaculture business.

7.7 Large number of ponds, seasonal ditches, public (khas) water bodies, irrigation canals and drainage reservoirs should be brought under direct Government aquaculture programme. Culture of fish with paddy be developed in low-lying paddy fields. Fast-growing species eg. Nilotica, Rajputi etc. have to be given consideration for seasonal waters.

7.8 Capture-based culture fisheries be developed in Baors and other reservoirs to maximize exploitation.

7.9 Considering the farmer's resource constraints, aquaculture should be integrated with poultry and crops for best possible utilization of farmers available resources and maximize economic returns.

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handicrafts, health and nutrtition, in an attempt to improve their economic and living standards. Although the Programmes of NGOs have been found very effective in boosting up rural economy, their involvement in aquaculture is not much. The main reason is lack of interaction between the NGOs and the Government agencies involved in fisheries development, extension and research.

However, a number of NGOs such as BRAC, MCC, CARITAS and PROSHIKHA have recently undertaken and increased their aquaculture activities with the technical assistance from FRI. In Trishal Upazila in Mymensingh district BRAC has extended nilotica, rajpunti, polyculture and poultry cum fish culture technologies as developed by FRI from a few farmers to about 5,000 farmers within a span of three years with assistance to them in training and organization and in facilitating their access to resources and inputs. The other NGOs as named above have also started dissemination of these technologies to different selected parts of the country. As an essential step for the success of NGOs in aquaculture programme, FRI offered training on improved aquaculture technologies to the extension workers of the NGOs with follow up.

The NGOs need technical and policy support from the Government in their efforts to expand and sustain fisheries Programme. They may be given responsibility for development of aquaculture in such water bodies like derelict ponds, flood control and drainage reservoirs, baors etc. where Government management system does not work properly because of bureaucratic,political and other constraints. NGOs can identify landless farmers, unemployed youths and potential women and organize them for fish cultivation in these water bodies, with credit and extension services. Government agencies should extend effective cooperation and establish linkage with the NGOs for implementation of aquaculture Programme wherever possible under joint collaboration.

9.0 ROLE OF GOVERMENT IN AQUACULTURE DEVELOPMENT :

The Government has a vital role to play in aquaculture development and guide the sector in proper direction. To this end the planning and management capabilities of the Ministry of Fisheries and Livestock and all other agencies under it, need to be developed to translate aquaculture policy into strategic action plan with realistic targets. The major shortcomings of DOF as a Government agency are weak extension and training support to farmers, insufficiency of trained staff, lack of authority on water bodies, absence of policy guidelines and lack of interagency coordination. The Government intervention in these areas is needed for making a breakthrough in aquaculture.

Despite of these problems, the country has made a good progress in aquaculture. So, the main thrust should now be given on disseminating more sophisticated technologies to more advanced pond fish farmers including hatchery and nursery operators. Since the fish seed production technology has been well adapted by the private sector and since DOF is currently lacking an effective

extension setup, the DOF funds and personnel presently engaged in fish seed production and nursery operation should be shifted to develop its extension services. The Government should lend due support to research for technological backup of aquaculture.

Government should also assist the farmers or fish traders for access to institutional credit through preparation of Bank financial plans and in linking fish farmers with Bank till the time a separate Bank to finance aquaculture is created. Creating public awareness of the aquaculture potential through training and demonstration would be an important responsibility of the Government towards expansion of aquaculture. It is important to note here that, other than MOFL, various other Ministries and Departments such as MIWDFC, BWDB, MOL, MOA, MOE and MOLGRD have got control over the water bodies for their respective uses.. Therefore, a high level coordination committee should be formed comprising representative from all these organizations to avoid conflicts and protect interests of each of the agencies in respect of water use. The Government should take necessary steps for the utilization of derelict and other unutilized water bodies for aquaculture through the NGOs.

The inevitable loss of fisheries by the water resources development projects must be compensated through making such provisions in the project as establishment of nurseries, creation of nursery facilities for hatchery produced hatchlings to fingerlings and culture of fish in available standing water bodies. In water resources development projects, minimum water requirement for aquaculture must be maintained. The Upazila Parishads should actively take part in aquaculture activities in khas ponds.

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RESEARCH NEEDS AND STRAGEGY FOR AQUACULTURE DEVELOPMENT

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Paper for presentation at the Workshop on "Inland Aquaculture Development Strategies for Bangladesh", organized by BARC/ICLARM, 29 September - 01 October 1991, BARC, Dhaka

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RESEARCH NEEDS AND STRATEGY FOR AQUACULTURE DEVELOPMENT

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1.0 Introduction

Fisheries sector has an important contribution in the form of income, employment, human nutrition and foreign exchange earnings to the national economy of Bangladesh. It accounts 3% of GDP, 8% of gross value added of the agricultural prduct, 71% of the animal protein intake and more than 11% of export earnings. Out of a total employment of 28 million in Bangladesh, approximately 7% is fisheries. Total fish production in 1988-'89 was 8,40,000 mt of which 72.3% was from the inland fisheries and 27.7% from marine fisheries. Of the inland production, 50.5% was from open water capture fisheries and 21.8% from closed water aquaculture. Although it appears that the inland capture fisheries occupies an important place in the total production of the country, the hard fact is, the area, condition , yield and production from capture fisheries declined over the years. During 1983/84 to 1987/88 the rate of decrease from capture was 2.7% a year, where as the pro-duction from culture fishery increased at

a rate of 10.7% a year.

According to the Department of Fisheries projections, the annual growth in fish production from 1987/88 to 1994/95 would be about 10.8% for inland culture fisheries. The state of aquaculture in the country has remained at the extensive level with respect to the management and input utilization. With the present level of production being obtained from aquacultural operations, such a plan for increase of production from the sector would be defficult unless such plan has well defined strategics to be adopted.

2.0 Aquacultural Resources

The water resources of Bangladesh is unique in the world. The various types of water of the country can be dilimited as for different aquaculture systems as follows.

2.1 Perennial System

Pond aquaculture;

Ox-bow lake aquaculture;

Irrigation canals;

Kaptai lake, Muhuri reservoir; Dakatia river portion of the CIP and flood plain fisheries where stocking programmes can be adopted as a culture-based capture fisheries.

2.2 Seasonal System

Homestead small ponds/ditches

Road side ditches and cannals

shallow paddy field with flood control dykes and various low lying area in unban and sub-urban areas.

2.3 Pen and Cage Culture

Pen and cages can be set up in all perennial waters

2.4 Coastal aquaculture

Aquaculture of shrimp and fin fishes in the coastal bheries of the country.

3.0 Aquaculture Potential

Role of aquaculture towords increase of production in Bangladesh is imperative especially at the backdrop of continuous decline of production from capture fisheries. Globally, the capture fisheries grounds have suffered depletion and even application of strict measures like ban on fishing seasons and adopttion of selective gears has not improved the situation. Thus attention has been directed towards the culture-based fisheries, as here the measures for control on the factors of production can be relatively easily adopted. The inland waters of Bangladesh afford unique potential for the development of aquaculture. It has numerous seasonal and perennial waters including haor, baor, seasonal flood plain, road and railway track side ditches, irrigation canals, and homestead small ponds/ditches which could be

brought for aquacultural purposes. So long, these waters were not judiciously used for culturing fish. This was due to the lack of suitable technologies and lack of awareness among people. Moreover, Bangladesh has large coastal areas for development of brackishwater aquaculture of shrimp. The country has also enough potential for increasing production from practicing pen and cage culture in many perennial waters. In view of the present demand for fish and of the comparative easiness of achieving control measures for increasing production from aquaculture, efforts should now be made for the derivation of technologies suitable for utilizing the diverse aquacultural resources of the country.

4.0 Aquaculture development strategy

The strategies for the development of aquaculture like any other sectors of economy of Bangladesh have to be set at the perspective of the prioritized problems of the sector at the national context. The strategies can be both long term and short term to circumvent different interacting situations. They are not mutually exclusive, however the long term and short term strategies could be like the following:

4.1 Long term strategies

i) effective fisheries education;

ii) strong aquaculture research system;

iii) strong and effective extension system;

iv) useful credit system;

v) effective manpower in the sector;

vi) development of marketing infrastructure ~~structions~~;

vii) mechanisms for involvement and co-ordination among different GOs and NGOs;

viii) enforcement of fisheries laws and regulations and

ix) longer term genetical research for new and improved strain development.

4.2 Short term strategies

i) development of appropriate technologies for critical problems of culture and management for increase of production. These may include fish feed, seed, fertilizer and disease control etc.

ii) looking for better available avenues for increase of production such as identification of suitable species water types and culture systems.

iii) introducing high yielding exotic strain for quick increase of production.

iv) looking for better options of management and input utilization for better cost effectiveness and

v) short term training for farmers and managers on culture and management.

5.0 Technology derivation: Considerations

Planning for the derivation of aquacultural technologies has to be based on the existing socioeconomic conditions of the people, whom the technologies would be ultimately meant for. Majority of the farmers of Bangladesh are small and marginal who are mostly

poor with scanty resource base, thus technologies in aquaculture have to be simple and low cost. Without these considerations, the technologies derived would not find place in the society. A technology, whatever may be its excellence at the on-station conditions, if would not be spoken of as such until and unless it is tested for its effectiveness and appropriateness at the on-farm conditions. Bringing out of a technology is not a means to an end in itself. It's development, optimization, and adaptation to the prevailing social, ecological and economical conditions of the farmers are of utmost importance. Sometimes it is amazing to see how the appropriateness of a technology with the farmers gets affected with very minor and finer socio-cultural aspects of the farmers, which are not visualized and accounted for at the on-station context. Thus it is prudent that, the technologies derived have to be tested at on-farm with the interacting situations of the farmers' various socio-cultural factors to make the technology an associated part of social, economical and cultural activities of the farmers. The innunciated concept of the Farming System Research on the aquacultural technologies has appeared to be fruitful in this direction. Such an approach can very easily identify the gaps in the technologies with regard to the actual needs and practices of management with the farmers' conditions. Those gaps, as the researchers with these arrangements do involve themselves right with the farmers, can be better dealt with right at the farmers' fields or can be brought back to the research station for further fresh trials.

6.0 Aquacultural research planning with short term strategies

Increase of production through aquaculture in Bangladesh is imperative at the context of the present demand of fish availability. The research planning for the development of aquaculture has to have a short term strategy that might ensure quick increase of production at the existing poor resource base of the farmers. In otherwords, research should be aimed at bringing out such technologies that are simple and adaptive. Efforts have to be made to identify the salient features that confront the farmers, the appropriate culture systems, and suitable species of fishes that can be adopted.

6.1 Utilization of the seasonal waters

In the rural areas of Bangladesh, most of the farmers have homestead ponds/ditches which retain water for 4-5 months of the year. These ponds either remain fallow or at best used to hold wild fishes only. Most of these waters are used for various household purposes excepting some which are used for jute retting also. The farmers have an inherent belief that nothing can be grown in those ponds because of their seasonal nature, but those ponds actually hold tremendous potential for adopting culture systems with species having shorter life cycle, and quick growth but requiring low inputs. The small indigenous fish species like Koi (Anabas testudineus), Shing (Heteropneustes fossils), Sharpunti (Puntius sarana), Gulsha (Mystus gulio). Magur (Clarius batrachus), Pabda (Ompok pabda) and a few of the introduced small species viz; Tilapia (Oreochromis niloticus) and Rajpunti (Puntius gonionotus)

could be very suitably fitted in to the system of seasonal small ponds and ditches.

6.2 Utilization of the perennial waters

Aquaculture in the perennial ponds and in waters of that type has not been developed in Bangladesh. The Indian major carps are traditionally cultured in these waters, but the present level of production is very low. This is because of the lack of technologies, but there are vast potential for increasing fish production from these perennial waters if the present traditional method of polyculture can be improved through experimentation on the types of species involved, stocking density of fishes, feed used and methods of ponds fertilization. At present, 6-8 different species of carps are used in the polyculture system, but experimentation needs to be undertaken with respect to the development and standardization of the methodology.

6.3 Integrated aquaculture

Modern successful aquacultural operations entail the requirement of supplementary feed and pond fertilization. These two requistes, though are essential, would be seen that they are difficult to achieve under the existing socio-economic conditions of the rural farmers. Thus, the programme of an improved production would suffer considerably until and unless an easy alternative to feeding and fertilization is found.

Supplementary feed in the form of many agricultural bi-

products are not in plenty in supply. As they are scarce and costly, fertilization of the ponds can be done either with inorganic or organic fertilizers as a low cost alternative for the farmers, and since inorganic fertilizers are extensively used in agriculture, the excreta of the livestock population can be used to fertilize the ponds. Of the various livestock excreta, poultry dropping are not used in any production purposes in Bangladesh. If the rural farmers can integrate their poultry or duck with fish culture, the operational costs could be brought down to the minimum and productions can be increased many fold.

Fish culture could also be integrated with paddy culture. Short cycle species like Rajpunti and tilapia have been found suitable for culturing in shallow paddy fields. Such culture has been found more workable if a shallow ditch is available adjacent to the rice plot. Such ditch can be used as a refuse for the fish in time of need.

6.4 Hatchery and fish seed technology

For easy availability of quality fish seed of desired species in time of need, hatchery production and nursery management technologies should be developed and widely disseminated to the farmers. Of late, though, a large number of hatcheries have been established in public and private sectors, the performance of these are not up to the mark. Thus there are special needs for the development of skills of the hatchery managers with regard to brood fish handling and manipulation. The persons engaged in nursery

operations should be given training on the many variables that are determinant of the successful operation and management of nurseries.

6.5 Fish feed development

Even if we solve the above mentioned problems, availability of fish feed could come out as a single serious problem in the development of aquaculture. Thus, a strategy for the successful venture on aquaculture would be to develop proper fish feed. With the intensification of aquaculture in future, nutritionally balanced diets have to be developed. Judicious efforts have to be made for the utilization of the traditional food items as fish feed for minimizing the cost of production.

6.6 Fish health monitoring

Development of aquaculture in future would necessitate planning for the improvement of fish pathological work. Fish diseases and environmental problems are the major risks, in the aquaculture business. Successful fish health monitoring ability would mean a great deal in stabilizing the development in aquaculture. Fish immunology and therapeutics sciences should be developed to check health hazard situation in the aquacultural species.

6.7 Exotic germplasm introduction

There are agruments for and against introducing exotic breeds/strains in to the country. The exotics can bring unknown disease or parasite that are new to the natives. The new species can be

competing with that of the native species, but a commercial species, if found better in adaption to the local condition and if found economically feasible, there should be no harm to keep it in confined culture systems. The whole world is engaged in transferring many useful plant and animal species for the betterment of mankind. In fish's world there are many species that have been extensively dispersed throughout the world. Tilapia is a buring example. In Bangladesh quite a few exotic species have been introduced and excepting for one or two, all the species have appeared to play a significant role in increasing fish production. There is no harm in introducing more, if found suitable to our situation and economically feasible, provided there is codes of practice for the introduction of new species as well as quarantine for the introduced species.

6.8 Cat fish (magur) culture technology

Magur (Clarias batrachus) belongs to the small fish group in Bangladesh. This is a short cycle species that can be cultured both in seasonal and perennial waters. Efforts are being made for the last few years for the derivation of technology on magur culture. The technology for artificial breeding and seed production of magur are yet to be perfected, as such although the species possesses a great significance, its improved production will still take sometimes in the country. Oflate, another magur species (Clarias gariepinus), originated from Africa has been introduced in to Bangladesh. This species has drawn a great deal of interest of the people, but at the moment there is no mature technology for its

culture under Bangladeshi context. The country has to wait until such technology is developed. Efforts are going on for bringing out a technology on the African cat fish culture in the country.

6.9 Pen and cage culture technologies

It is true that pen and cage culture has potential in many perennial waters in Bangladesh but there are serious concerns over the economic feasibility of the system in Bangladesh. The pen and cage construction materials are not easily available in Bangladesh. Many synthetic netting materials that are mainly used in other countries of the world, have to be imported and that would add negatively to the economic viability of the culture system. Moreover, the very concept of culturing fishes in pens or in cages is an intensive culture proposition and it is obvious that such culture operation will require nutritionally balanced and thus costly foods for the operation to be made profitable. This would again add negatively to the economic sustainability under the present context of feed situation in Bangladesh. Under such juncture, the pen and cage culture operation in many and varied type of waters in Bangladesh needs judicious experimentation with regard to the use of cage and pen materials, species to be subjected in the culture systems, as not all species perform equally well in pens and cages, and formulation of appropriate feed to make the culture system viable.

6.10 Management and conservation of the culture-based capture fisheries

It has been mentioned that the commerical fisheries throughout the world have suffered from over-exploitation and various remedial measures like ban on fishing seasons and adoption of selective gears have not proved fruitful. This indicates that probably negetive genetic effects have occurred in these fisheries. The Bangladesh open water capture fisheries have also been subjected to serious threat due to multifarious problems like over-exploitation, drought, siltation and pollution. The sector is presently contributing a great deal to the total annual fish production. Although, a decreasing trend is noticed in the catch from the open water capture fisheries and increrase from the culture-based fisheries, in future, the bulk of production will still have to come from the open water capture fisheries. This means that there is much to be done, for the conservation and management of the open water fisheries especially those waters where the methodology would be a blend of culture and management. Special care should be taken in rehabilitation of the natural stocks of these waters. There are ideas that such waters can be rejuvenated with qenetically tailor made better breeds to face the odds in the nature.

7.0 Fisheries Institutions: Lapses and gaps

The diverse fishery resources of the country are mainly looked after by the public sector and thus it is mainly the public sector which is involved in planning, research, promotion, development, management and regulation of the fisheries sector as a whole.

The role of the private sector in fisheries in general has rapidly increased in recent years, especially with the introduction of aquaculture technologies, shrimp farming, sea food export and mechanised fishing. The cooperative sector has been involved in different fisheries aspects, however, this sector could not flourish satisfactorily.

The performance of the different fisheries institutions has been poor in achieving expected goals. Of the many government bodies, that are involved with the fisheries sector, the most important is the Ministry of Fisheries and Livestock. The other key institutions that are involved with other diverse function related to fisheries are.

i) Bangladesh Fisheries Development Corporation (BFDC)
ii) Fisheries Research Institute (FRI)
iii) Ministry of Land
iv) Upazila Parishad
v) Ministry of Flood Control, Water Development and Irrigation
vi) Ministry of Local Government Rural Development and Cooperations
vii) Ministry of Industry
viii) Ministry of Commerce
ix) Ministry of Shipping
x) Ministry of Education
xi) Ministry of Finance

xii) Forestry Department

xiii) Nationalized Banks and

xiv) Planning commission

The main problems with the fisheries institutions that adversly affect the growth of the sector as a whole are 1) the agencies become so many with overlapping activities. 2) inadequate planning arising out from poor definition of their crucial role in the sector 3) lack of technical manpower 4) the financial performance of the institutions are poor but with no accountibility for that and 5) very unsatisfactory role in project, implementation. There is a lack of clear understanding about the total activities that the public sector can participate in. As such the public sectors have been engaged in many activities which can best be dealt with by private sector. The one other factor that devilitated the proper functionality of the public sectors is the dominance of the sectors by the technocrats or generalists and lack of technical or professional personnels. As a result, the agencies lack a macro economic perspective and are unable to highlight the proper role of fisheries the planning and development of fisheries in Bangladesh.

Under the above, the institutions involved in fisheries in general and in aquacultural activities in particular should be remodelled as to their role in the total process of planning, and development.

7.1 Effective fisheries education

A strategy for the development of aquaculture should be to project plan for the availability of competent manpower in the sector to handle the need for future development activities.

Availability of technical manpower in the field of fisheries was a problem in the recent past as there was no institution for formal fisheries education in the country. As a result, various positions in research and management were filled up by non-professional personnel. This has hindered the development of the sector. The situation has been significantly improved with the establishment of the Faculty of Fisheries in the Bangladesh Agricultural University in Mymensingh in 1967 and now there is competent manpower in the field. However, it has been revealed that the curricula and the courses followed in the fisheries education in the BAU is largely inadequate and as such there is a serious need for modernization of the undergraduate and postgraduate courses and curricula of the Faculty of Fisheries in line with the present fisheries problems in the country. Reportedly, attempts are being made for the reorganization of the curricula. There are fisheries courses at the postgraduate level in Dhaka, Rajshahi, Jahangirnagar and Chittagong Universities under the major subject of Zoology. The exposure given in Fisheries through these courses are very limited. It is imperative that to produce competent manpower in fisheries, these courses should be refurbished.

7.2 Strong Aquacultural Research System

Like fisheries education, similar long term strategies should also be there in case of developing and equipping the fisheries research system in the country. In the past, fisheries research has suffered due to ill-planned and uncoordinated research. There was no formal fisheries research organization in the country and research was carried out by the Department of Fisheries which is mainly concerned with extension, management and conservation of public fisheries. It was realized that there should be a separate research organization in the country and as such the Fisheries Research Institute was established in 1984. This has been a right step towards the development of fisheries research in the country. The institution has four research stations and aquacultural research is being done from one of these stations. It is heartening to note here that the institute during its activity for the last four years, has been able to made a breakthrough in the development of a few aquacultural technologies.

Fisheries Research Institute is a new and developing institute and enough efforts have to be made to keep its pace in the process of development.

7.3 Strong and effective extension system

The present extension set up in the Department of Fisheries is weak having no definite plans and goals. There is an urgent need in the restructuring and redefining the duties and responsibilities of the people engaged in the Department of Fisheries, for extension

purposes. Government should take a priority measure in relocating necessary facilities with regard to manpower and resources in the unit administrative and management areas of the country, so that without losing any more time, the aquacultural technologies that are now available in the country can be disseminated widely to the farmers.

7.4 Useful credit system

Availability of a suitable credit system in aquacultural operations is a problem. The institutional credits operated by a few commercial banks in Bangladesh are not easily available to all types of farmers. The poor and marginal farmers have no access at all to the institutional credit; although reportedly, a few of the rural banks viz. the Grameen Bank provides credit to rural farmers, with high success of utilization. The poor have the inherent difficulty with interacting situation of credit utilization and recovery.

7.5 Effective manpower in the sector

To effectively deal with problems of aquaculture development, the necessity of trained manpower in this field is a must. This requirement is thought to be categorized as a long term strategy as the infrastructure needed for this prpose is vast in term of the physical and financial requirements. The Government has to have a comprehensive plan with respective to the number of manpower needed and the physical facilities required to deal with problems in the years to come. For this, arrangements have to be made for in-

country and overseas training if necessary.

7.6 Development of marketing infrastructure

Development of proper marketing facilities simultaneously with the aquaculture development, would determine the sustainability of the development. Intensive aquacultural operation would necessitate steady disposal of the harvest through improved system of marketing that may include good communication system, improved storage facilities including icing, processing etc.

7.7 Enforcement of fisheries laws and regulations

The important laws and regulations that are in existence in the fisheries sector and that could directly influence the development of the fisheries sector are; 1) The Protection and Conservation of Fish Act, 1950, as amended in 1982, 2) The Tanks Improvement Act, 1939 with modification upto August 31, 1986, 3) The Fish and Fish Products (Inspection and Quality Control) Ordinance, 1983, and 4) The Marine Fisheries Ordinance, 1983 and Marine Fisheries Rules, 1983.

These four sets of rules and regulations, are in application to the fisheries sector as a whole, however, for aquaculture development, number 1 and 2 rules are necessary. The fules are not mentioned in the present communication, however, they are fairly comprehensive and can protect and encourage fisheries develop in the country. But they are not being properly enforced and as the reports come, there are a serious shortcomings in the resources

(human, physical and financial) allocated to the unit administrative areas of the country. The officials responsible for enforcing the laws, for example, lack transport facilities to monitor the waterbodies under their jurisdiction. There is also lack of manpower and this is especially so in the areas where there are more waters bodies. It many so suggested that, the fishery officials placed in areas with more jalmahals be given the magisterial power to try and punish people violating the rules.

8.0 Machanisms for involvement and coordination among GOs and NGOs

Development of aquaculture in Bangladesh necessitates redefining the role of the public sector. It should not be involved inactivities that can be handled by the private sector. Public sector should be engaged in activities for the development of necessary infrastructure, derivation, dissemination and promotion of new and improved aquacultural technologies, measures for the prevention and control if diseases, and other natural hazards, stocking and monitoring of the public bodies of waters and looking through the fisheries laws and regulations.

The private sector should be made as a trusted partner of the public sector in various aquacultural activities like fish production, marketing, supply of aquacultural inputs and services. In fact, in Bangladesh many NGO's have proved very helpful in augmenting aquacultural production through organizing farmer's groups in rural areas.

ROLE OF EXTENSION AND SUPPORT SERVICE IN AQUACULTURE DEVELOPMENT

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ROLE OF EXTENSION AND SUPPORT SERVICES IN AQUACULTURE DEVELOPMENT

1. INTRODUCTION

Deliberations made at various fora around the globe have always pointed out that reaping a good developmental harvest in rural sector largely depends upon three basic inputs - appropriate technological base, extension efforts and credit and other service supports. In the process, extension catalyses the crystallization of development as soon as the reagents i.e. improved technologies and mobilized inputs are mixed in the background of available natural and human resources. Extension is only one aspect of fisheries and fish farmer's/fisher folk's development, however, it is a crucial link in the chain of development or the cement that holds the building blocks of development together. Fish farmers and fishermen are the primary producers of the fisheries sector and as such without their total involvement the planned national developmental objectives could not be accomplished. Ultimately near total targeted production in this sector is expected from these primary producers. Fishery extension is essentially the means by which the new knowledge or the improved fish production technologies and ideas are introduced and assimilated among the primary producers in order to accomplish the national fisheries objectives. Credit support and input mobilization through support services are also equally important raw materials in the development process.

Proper analysis of the laid past plan objectives and accomplishments made so far show that the production targets were always fixed much lower than the national requirements of the population and in spite of that the targets could never be achieved. Among several reasons attributed to the shortfall, one of the most acceptable explanation remained the extremely inadequate extension and service support in the fisheries sector.

Recent experiences in several countries have pointed that an organized or reorganized extension service along with strictly professional lines can have a significant and rapid impact on increasing fisheries production and raising the standard of living of fish farmers and fishermen. If we review the pace of fisheries development in many Asian countries, we find that the development depends upon many factors including the development of necessary infrastructure such as roads and markets and timely mobilization of proper inputs such as seed, feed, nets, gears, crafts, drugs etc. Perhaps the most important of all these factors are the need for a system of information transfer from the Research and Development Centres to the concerned fish farmers and artisan fisher folk at grass root level and secondly organizing well efficient interdisciplinary service support for mobilizing credit, material input supply, channelizing marketing. R and D is off-course totally wasted, unless the results are applied and adopted

by the target group. It always makes better sense to talk of R, D and E rather than R & D alone.

2. ROLE OF DOF IN AQUACULTURE DEVELOPMENT

Unlike Agricultural Directorate the Directorate of Fisheries was first set up in 1942. After partition it was bifurcated and shifted to Comilla. In 1954 the developmental functions along with the staff were transferred to the newly formed Directorate of Extension and Rural Development. However, this arrangement did not work and the Directorate was again restored to its original form in 1955. Extension was felt vital but could be experienced that it works better when the activities are controlled by the Fisheries Directorate proper. Even during the first 5 year Plan the development programme for fisheries had integrated research and extension components. A scheme was prepared even during those days wherein it was proposed to have an extension unit under the control of Fisheries and specialist who will utilize the Fisheries and other related personnel for social, economic and general improvement of the area so far fish, fisheries and fishing industries was concerned. The second 5 year Plan period comprised 35 schemes at a total cost of 30.72 million Rupees with a foreign exchange component of 4.00 million Rupees. Out of 35 schemes, 21 were related to development of fisheries and the remaining 14 were for research, education and extension. During the said plan period a total of 9.5 million fry were produced out of that approximately 8 million distributed to the interested fish culturists bringing about improvement in over 50 thousand bigha of water areas. 51 Fish Seed Farms were constructed to meet the growing demand of fish seed among the fish culturists. The subject of conservation and biological management was also felt equally important and accordingly 23 Fisheries were declared as sanctuaries. For the first time a Fisheries Extension Service scheme was introduced at an expenditure of Rs 9.56 lakhs. During the period approximately 50,000 ponds were surveyed, 18000 ponds were brought under culture and 480 model demonstration started. A "Grow more Fish" scheme was also taken up under which even 11 million fry were raised and distributed free of cost among the interested farmers.

The fisheries development activities of the public sector was by and large limited to inland water until 1964 when the Fisheries Development Corporation was created for exploiting marine resources. In order to explore fisheries resource potential of the Bay of Bengal (BOB), a pre-investment survey was undertaken in collaboration with FAO. Extension and other infra-structural support were given recognition as these were found to be essential instrument for development. As early as 1960 a post of Extension Officer was created to coordinate the extension activities of the department.

Since independence the Government of Bangladesh has taken vigorous attempts to enhance the development of Fisheries Sub-sector. Several major fisheries development projects were planned, financed and implemented by the public sector. Four plans have already been implemented. The four plans include First Five Year Plan FFYP (1973-78), Two Year Plan TYP (1978-80), Second Five Year Plan, SFYP (1980-85) and Third Five Year Plan, TFYP (1985-90). In the FFYP, Government set forth an ambitious programme to increase fish production and

exports to create greater employment opportunities and to improve the Socio-economic conditions of the target group particularly fishermen. In mid seventies a UNICEF sponsored project "Strengthening of Fisheries Extension Service" was started under which 25 FSMF were developed and 60 posts of Unit Extension Officers were created to promote fisheries extension activities. The Two-year Interim Plan restated the objectives to increase fish production and exports. The main objective of the SFYP was to improve nutritional level of the people through increased production and consumption of fish. Other specific objectives of the plan were to expand employment opportunities and improve socio-economic conditions of rural people in general and fishermen and fish farmers in particular and to increase export earning from fishery products including shrimp and frog legs. The TFYP envisaged the same objectives with an additional objective to improve general environment and public health. Thus all the four successive development plans have emphasized three key national objectives for fisheries Sub-sector.

- to increase fish production and improve human nutritional status
- to create additional gainful employment opportunities for the rural poor and
- to increase export earnings from fish and fish products.

All the plans had basic objective of significant increase in national fisheries production and the production was always expected from primary producers. In view of this, vigorous attempts were made to increase infrastructural and support services and to some extent extension support through organizing demonstrations etc. No systematic or exclusive extension system was planned. However, a post of Chief Fisheries Extension Officer was created at the Head Quarter who was expected to coordinate extension programme net work 60 unit extension officers in the then Subdivisions. In 1983 " Enam Committee submitted its report and provision was made for 2234 Officers and Staff to take responsibilities of growing activities. After the creation of Upazila the same committee reorganized the DoF structure in 1984 and provision was made to raise the staff strength up to 3411. Presently under revenue head an additional number of 1267 officers/staff are linked with ongoing development projects.

Looking close to these phased developments we find that even as early as in 1942 the extension and support services were given due importance and a separate Division relating to Fishermen's Rehabilitation was created and manned at District and higher level by staff holding a Master's Degree in Anthropology. This Division was responsible for the improvement of the socio-economic status of the fishing community and arranged the supply of fishermen's needs such as cotton yarn for net making, timber for fishing boat construction, cloth for sails, coal-tar, nails, staples, ropes for fishing boats and nets and kerosine oil at controlled prices. The Division was also expected to motivate fishermen to organize themselves into co-operatives and to have such cooperatives registered with the co-operative Department of the Government, so as to obtain the various commodities at controlled prices. Soon after the partition the functions of this division were taken over by the new production Division as they felt that

production and rehabilitation of the primary producers must go side by side. However, due to infrastructural development and expanded support services some of these functions of the division gradually decreased with the wider availability of commodities in the open market.

If we look back closely we can draw few lessons out of our past experiences. It was evident that the delinking fisheries extension activities from the Department of Fisheries and incorporating it to other Departments dealing with rural development in general or any welfare department or even Agricultural Department had suicidal consequences. Secondly, bringing out legislations without creating platform for mass awareness ends up into fuss. In the Bengal Province of British India there existed a Tank Improvement Act, to improve and utilize tanks for irrigation. In order to promote fish culture in derelict tanks the Tank Improvement Act was amended in 1961 to incorporate provisions giving powers to District Magistrates to requisition derelict tanks and allocate them to people interested in fish culture. However, this piece of legislation applied very infrequently.

The Department is expected to enforce rules and regulations under few legislations wherein provision exists empowering fisheries officers, police officers, forest officials and magistrates to enforce the rules. However, because of the vast extent of the inland and marine waters and lack of proper approach and mobility the rules and legislations are difficult to enforce.

Since 1986 the Department has been implementing the "New Fisheries Management Policy" (NFMP) of the Government. This policy aims at directing the maximum benefits from the living fisheries resources of the Government owned fisheries in the rivers, beels, estuaries and ox-bow lakes to the poor fishing communities and also ensuring the sustainability of the capture fisheries resources.

During sixties the Department of Fisheries established 101 Fish Seed Farms in different agroclimatic zones of the country. Out of the total 25 such farms were upgraded and activated in the mid seventies by creating hatcheries, water supply system, training dormitories and other facilities with assistance from UNICEF. Another 50 Fish Seed Farms have been upgraded recently under the ADB assisted First Aquaculture development Project. 13 more Farms are currently being upgraded by GOB sponsored project. During 1986, however, management of 20 FSMF has been transferred to Grameen Bank to facilitate one spot input and credit support to fish farmers. Most of the Fish Seed Multiplication Farms have now excellent facilities for demonstration of fish breeding techniques, seed rearing, table size fish production etc. These farms also offer testing of newly developed aquacultural technologies and transfer of tested technological know-how to fish farmers, unemployed youth and DoF Extension Staff. These farms also provide sufficient support to ongoing developmental activities.

In addition to the network of Fish Seed Multiplication Farms (FSMF), several Fisheries Training and Extension Centres have also been established with excellent facilities for practical and field oriented training for officers, staff and fish farmers. Such training activities are of regular feature at FTEC Faridpur,

FTEC Chandpur, Central Fish Breeding Centre, Kotchandpur, Fish Breeding and Training Centre, Raipur, Lakshmipur.

More or less similar facilities now exist at FSMF Natore and a better facilities are expected to be created soon at Parbatipur, Dinajpur. Freshwater prawn hatchery at Cox's Bazar has also been established to extend extension support to the neighbouring shrimp farmers.

However, looking into the vastness of available water and human resources in the country the existing support services and extension network were always considered far below the inadequate level. Such realization lead to incorporation of strong extension and institutional strengthening components under several developmental projects. The ADB assisted Second Aquaculture Developmental Project will tend to promote extension of Shrimp and carp culture in 25 districts of the country. The basic strategy of the extension programme of this project is training the existing DoF Staff working in the selected districts and organizing demonstration of improved culture practice, pond engineering, hatchery and fry handling techniques etc. The project will mobilize the desired material inputs to the farmers, the cost of which would be realized after the farmers sell their crop. During the span of the project such demonstration will be carried out in 148 shrimp and 1113 polyculture farmers ponds. Due this strategy production is expected to increase from the existing 75 kg to 250 kg/ha/yr for shrimp and from existing 1 ton/ha/yr to 2.1 ton/ha/yr for carps in the operational areas of the project. Similar strategies are also being followed in other areas of the country under the Integrated Fisheries Development Project of DoF.

The IDA assisted Shrimp Culture Project covers shrimp culture extension activities in the four coastal districts namely Cox's Bazar, Satkhira, Bagerhat and Khulna. Under this project the technology of producing post larvae of *P.monodon* in hatcheries have been demonstrated in Cox's Bazar and *M.rosenbergi* in Khulna region. Besides, two demonstration Farm cum Training Centre (DFTC) one each in Khulna and Cox's Bazar area are being established to demonstrate improved culture technology and to provide training to shrimp farm owners and hatchery operators. Adequate financing for construction of shrimp farms and hatcheries in the private sectors will be provided from the credit component of the project. Initially the extension staff have been trained in various aspects of shrimp farming practice, completed the base line survey and now they have been trained in various aspects of shrimp farming technology so that they may render technical advice to the farmers. They are also expected to process loan application, supervision and implementation of on farm investment, credit and business management of farms.

Under the IDA Oxbow Lake development Projects Six Oxbow lakes in the districts of Greater Jessore were developed and managed by stocking and subsequent harvesting by listed fishermen since 1980-81. As a result significant rise in the production from 125 kg/ha to an average 500 kg/ha in 1989-90 have been recorded. This has greatly contributed to the rise is family income of the involved fishermen from Tk. 150 to Tk. 1500/month. Development of other 30 baors have also been taken up under IFAD assisted project.

Under joint programme of BRDB and DoF, 80 ha. of khas ponds in greater district of Rajshahi, Pubna and Kushtia have been re-excavated and developed for fish culture and leased out to landless poor/marginal farmers. They are also being trained for 15 days at FSMF Kushtia and Natore.

Under DANIDA assisted Noakhali Rural Development Project which covers greater Noakhali district, over 11000 persons have been trained in fish culture, breeding, hatchery and nursery operations. In addition to this 380 fish farmer's ponds have been taken up as demonstration right in the project area for transfer of improved technologies.

DANIDA supported Aquaculture Extension Project (AEP) is under operation in 6 Upazilas of Mymensingh District with the overall objectives of increasing fish production, creating employment and income and creating cooperation and group formation. The extension approach followed by the project guarantees availability of all aquacultural supports down to the village level with efficient and quick credit delivery system.

BOBP of FAO is also operating Extension Development Project in Patuakhali and Barguna Districts. Several micro level projects have been designed with active participation of groups of fisher folk. Group formation, initiative of Group Saving Scheme, credit delivery to support economic activities, participation and involvement of the women, introduction of aquaculture and post harvest technology and implementation of social programmes like literacy, health education, water and sanitation etc. are the core functional design of the project. Regular fortnightly group visits by extension staff to support and monitor the activities are being followed.

Under FAO/UNDP Project BGD/87/045, the DoF is operating an extension programme which is based upon trickle down approach. Extension orientation for the Upazila and District level Officers attempted to create awareness, change their attitude and remind their social and professional responsibilities towards serving the poor and needy fish farmers. Selection of the farmers was based upon their culture resources and interest. One day preparatory training was organized for the selected fish farmers to implant self pride, self-confidence and most basic aspect of culture technology they intended to follow. Depending upon the level of resources available with the farmer, his capability, interest and local situation, appropriate aquaculture technology is being suggested. Absolutely no input support is extended and to compensate this intensive efforts are rendered towards motivational and convincing aspects. However, as soon as they initiate their culture operation and start operating with whatever meagre resource they have, the problem gradually becomes less and less. The growing volume of standing crop brings enough changes in their attitude. Each such farmer is designated as Result Demonstrator who involves 10 neighbouring farmer with him designated as Fellow Farmers (FF). Result Demonstrators get one day training once in every 3 months and in turn they organize a day training for their linked 10 Fellow Farmers at their pond site. Over 150 Farmers with 1500 Fellow Farmers have been adopted from 11 districts. To bring about efficiency among the involved Fisheries Officers 7 days comprehensive training programme have been conducted which include aspects of programme planning, technologies and

transfer of technology skill. Around 80 Officers and 1700 farmers are expected to be trained by the end of this month.

3. ROLE OF NGOs

To exploit the water resources of Bangladesh for fish production it is deemed tantamount that the active participation of NGOs is required. NGOs contribution and direct impact in this field can be counted on their:

1. organizational mechanism and network especially in the rural areas;
2. direct or close relationship with the villagers, and
3. well-defined management system which is vital in running a fishery enterprise.

In fact, presently there are more than 100 international, national and local NGOs that are active in promoting fisheries development throughout the country. Their inputs or types of activities range from:

1. pond leasing and excavation,
2. re-excavation of derelict ponds,
3. conversion of roadside canal into fishponds,
4. fish fry production (fish hatcheries),
5. introduction of new fish farming technology e.g. integrated farming, rice-fish farming, etc. to rural farmers,
6. providing credits or loans to poor farmers for fish cultivation,
7. providing fishing nets and boats to sustainable fishermen,
8. providing fish farming inputs to farmers like seed, fertilizers, feeds, etc,
9. arrange training, seminars and workshops for fish farmers,
10. shrimp farming,
11. open water fisheries through release of fish fry to benefit poor people living around the area,
12. extend technical assistance to the farmers,
13. assist farmers in planning, implementation and monitoring of their fishery projects,

14. research on farm ecology.

NGOs have a total beneficiaries of more than 3,000 groups or more than 55,000 target members consisting of landless farmers, poor farmers, destitute women, youths and students. Their common objectives are:

1. to create employment opportunities for the poor especially in the rural areas,

2. to increase the fish production and meet the protein requirements of the poor,

3. help them conservation of resources for sustainable yield.

These groups serve as their partners in their development activities. Some other NGOs notably BRAC, Banchte Shekha, Thengamare Mohila Sebuj Sangha and SNSP are encouraging the participation of women in their fisheries programmes. Women groups are motivated and taught of the gains of fish farming to them, economically and socially.

NGOs employ more than 400 workers in fisheries programme. These workers are skilled and well-trained with educational background ranging from HSC to degree holders. They are trained in various fishery-related courses by the government like DoF and FRI, by NGOs like BRAC, ADAB, MCC and Proshika and by other authorities involved in the field like ICLARM, FAO/UNDP, some are also trained abroad.

Some NGOs in their effort to strengthen and expand their fisheries programme have established linkage and cooperation with the government and organizations promoting fisheries development. BRAC for example is currently implementing the integrated fish farming and Thai puti farming in Mymensingh in collaboration with FRI and AEP/DANIDA. ODA/CARE International and BRAC are jointly implementing a pilot project on rice-fish farming in Rangpur, SOJAG with the support of DANIDA is involved in the introduction of the induced-breeding technique in village Shallan in Dhamrai. Organizations like Proshika-MUK and Gono Unnayan Prochesta (GUP) are introducing the ecological farming to farmers in Manikganj and Rajoir, respectively.

ADAB while playing its role has established a cooperation with the FAO/UNDP Project - "Institutional Strengthening in the Fisheries Sector" to provide trainings to NGO fisheries extension workers. The Aquaculture Extension Project/DANIDA in Mymensingh was convinced to provide credits to local NGOs in Mymensingh for fish farming project. A NGO Aquaculture and Fisheries Forum was established in Bangladesh with the objective of bringing together organizations to share experiences and discuss problems related to fish culture development in the region. The Forum was formed in collaboration with ODA who will support it till 1994.

Some other NGOs have established their own training centers with adequate facilities to further strengthen their capabilities in providing basic and effective

training to their staff. BRAC has its MTC in Rajendrapur, Proshika in Koitta, Manikganj and Comilla-Proshika in Comilla.

4. AQUACULTURE RESOURCE POTENTIAL

Bangladesh is endowed with vast areas of water resources of various types. Incidently these water resources command high potential and prospect for production of fisheries products. Even the agroclimatic condition also offers optimum growth environment almost around the year. The total area of perennial waters having fish production potential is estimated at 1.45 million hectare. During the Fourth Five Year Plan period major production increase is expected to come from aquaculture in conventional and unconventional waters. Inland waters with aquaculture potential are ponds, baor and coastal aquaculture covering an area of 151925, 5488 and 108279 ha respectively. In addition many of the water bodies such as borrow pits, drainage and irrigation canals etc. also considered to be potential areas for aquaculture. During the period from 1983-84 to 1987-88, pond fish production approached to be increasing at an average trend rate of 3.9% in the face of negligible increasing trend rate of growth for the overall fish production. Consequently the total fish production from the culture fishery sources have shown an increasing trend rate of 4.8%. On the basis of utilization status ponds are divided into three categories - cultured, culturable and derelict. If all the culturable and derelict ponds could be brought under fish culture, total pond fish production would increase to approximately 2.5 lakh metric ton even with the current semi-intensive culture practice using manure and limited feed application. In addition to bringing derelict and culturable ponds under fish culture, there is also urgent need for semi-intensification and intensification of the ponds already under culture.

During the Third 5 Year Plan fish harvest from Inland open water sources had been continuously declining. Several factors have been responsible for such drastic decline in production. Population pressure and resultant over fishing have reduced the natural stock in open waters. Large-scale siltation, discharge of industrial effluent, increasing use of insecticides and other related factors, reduction in inland fish habitat and changes to aquatic environment resulting from the implementation of flood control, drainage and irrigation projects etc. are the principal causes of decline of fish production. The decline of fish harvest from open waters during the plan period has been estimated to be 40,000 tons. However, this decline has been largely compensated by increased production through aquaculture to the tune of over 65,000 tons. Shrimp aquaculture has also shown sharp increasing trend. All these facts suggest that to meet the increasing demand of fish to our growing millions we will have to depend largely on aquaculture.

5. NEEDED DEVELOPMENT

5.1 Water Resources

Although fish supplies about 80% of the country's animal protein sources, its consumption level has shown steep decline from 33g/capita/day to 20-21g/capita/day during the last 30 years. This declining trend is expected to continue in the background of 2.5% population growth rate. Under the circumstances, especially when inland open water fisheries which is showing a declining trend aquaculture deserves high priority for development. Active involvement of both public and private sector is desired. To attract more participation from private sector, aquaculture has to be developed as industry and to promote that strong support services in the form of technology, adequate credit, infrastructure facilities, production incentives, input mobilization and aggressive extension thrust are required. Consequently fish seed industry and trade will be auto stimulated to keep pace with the development.

Besides ponds and baors, a new water area of 40,000 ha consisting of irrigation canals, road side ditches, low-lying enclosed areas, borrow pits etc. need to be brought under the fold of aquaculture.

5.1.1 Freshwater Aquaculture

Diversification of culture practice for aquaculture is also desirable for proper exploitation of varied culture resources. Small seasonal borrow pits, road side ditches and other similar water bodies may be utilized for culture of nilotica, magur, punties etc. High local demand, export potential and abundance of suitable culturable waters and ready availability of culture technology, macrobrachium also deserves great attention. However, immediate efforts are required for the establishment and growth of Macrobrachium seed industry. As already practised in China and other South East Asian countries, integrated fish culture with live-stock, horticulture, agriculture is yet another area of potential development. However, due to problems associated with husbandry of live stock animals, restricted of quality feed and relatively high cost of feed ingredients coupled with social taboo restricts desired rate of development in this area. But when we closely view the planned aquacultural development we will have to depend upon livestock farming sector for organic manure supply. Feed based intensive aquaculture can emerge only after manure based semi-intensive aquaculture is widely practiced. Economic structure of the primary producers of this sector may not allow immediate switching over to feed and fertilizer based intensive aquaculture.

Subject to successful experimentation, pen and cage culture technologies also possess great potential for utilization of capture oriented larger water bodies through landless and marginal farmers.

5.1.2 Brackishwater Aquaculture

Brackishwater aquaculture has already shown a sharp increasing trend. However, developmental efforts are required to expand the area of operation and

refinement in culture technologies. Facilities in the form of water distribution and drainage canals, if provided, may bring substantial areas under brackishwater shrimp and fish farming. Larger unmanageable units need to be divided into smaller efficiently manageable and more productive units. Keeping in view the shrimp price in the world market, improved traditional or semi-intensive culture practice seems to be more lucrative. However, year-round culture may be promoted in areas where salinity remains suitably high throughout the year. Intensive shrimp culture practice requiring high cost of imported feed and high level of water management may not have developmental potential at least in near future.

5.1.3 Seed Production

To match the massive open water stocking plan under the FFYP and greatly expanded aquacultural development plan, hatchery and fish seed rearing sectors need serious attention and many fold development. Besides carps, the fish industry is expected to take up seeds of other fish species such as *Clarias, Puntius, Pungasius* etc. Attention is also required towards development of suitable carrying methods containers and carriers to avoid high rate of mortality usually encountered during large distance transport and post-stocking mortality due to rough handling and stress.

Improved brood stock management and carefully planned breeding programme maintaining parent stock of genetically vigorous brood fish need to be undertaken. Unplanned and unconscious breeding practice may lead to repeated inbreeding resulting into genetic degradation.

Fingerling production needs special attention in view of open water stocking programme and over expanding aquaculture. In fact the rearing of fry to fingerling needs many fold expansion. Greater availability of fingerling will also help in avoiding present practice of overstocking of fry in stock ponds. Seed procurement from wild sources still comprises significant portion of the total seed production. Refinement in seed collection, handling, packing and transport techniques is bound to bring extra availability of spawn to the fish seed rearing sector.

Shrimp seed availability is mainly from wild collection. Refinement is also needed in collection, handling, packing and transport techniques to prevent colossal losses. Locating new seed grounds and development of storage and transport chain system wherein provision may be made for mass collection, temporary holding facility near the collection site, quick packing and shipment facilities to the farming areas is sure to pay significant dividend. Centralized shrimp hatcheries need to be established in the Cox's Bazar region depending upon the water quality criteria and demand zone. However, decentralized seed production centre may be more strategic for freshwater shrimp seed production through establishment of backyard hatcheries along the coastal zones.

5.2 Human Development - Welfare of Primary Producers

Welfare and community development of the primary producers who are expected

to achieve the targeted production needs equal priority. Some of the measures such as granting the openwater fishing right to the licensed fisher folks, introduction of supervised credit in place of compulsory requirement of collateral, identification of the fishing community as a privileged target group for allotment of khas waters and lands for aquaculture etc. are bound to yield results. Suitable irrigation and drainage canals, road side ditches, borrow pits and other similar public water bodies can be better utilized by giving them on long term lease to local fisher folk, landless and marginal farmers, trained youths etc. Fisheries sector absorbs about 10% of the national labour force close to 13 million people out of which 2 million are getting full time employment and the remaining 11 million part time. In the wake of development in fisheries sector during FFYP period it is expected that the sector will provide additional gainful employment to 1 million primary producers.

Provision of security is equally important. Measures are expected to be taken to introduce special insurance scheme at a reasonable premium to cover crafts, nets, gears and catch. Community development schemes need to take up family planning, family health, nutrition and hygiene and education aspects of the community. Women are unrecognized silent worker in our rural community. They contribute significantly to the family income without being recognized. They participate in all spheres of rural production endeavour either it is agriculture, fisheries or livestock. Special emphasis to be made to ensure participation of women in aquacultural development activities. Their participation is sure to improve management of the resources, supplement family income and bring pride and confidence among them. Such participation also offers their involvement in family decision. Appropriate aquacultural technologies/subsidiary activities to aquaculture sector need to be identified by the women themselves. Additional family income through the involvement of womenfolk is sure to foster closer family relationship. it has also been seen that fertility and family size decline with increasing affluence. This aspect will have significant bearing on national population problem.

6. MAJOR CONSTRAINTS

Some of the major constraints to aquaculture development identified by several projects, developmental and extension personnel are as follows:

1. Large number of client group, majority of whom are poor, semi-literate or illiterate.

2. Inadequate number of extension manpower and their contradictory role.

3. Lack of organized extension system in aquaculture/fisheries sector.

4. Lack of technological knowledge among the farmers regarding scientific fish culture.

5. Lack of timely communication and cooperation of the Govt. field level fisheries officers.

6. Poaching

7. Deliberate poisoning of the pond as an act of enimity.

8. Inadequate financial resource for taking up semi-intensive aquaculture.

9. Inadequate supply of fingerlings of desired species at village level.

10. Lack of easily available credit for aquaculture.

11. Paucity of organic manure due to depleting cattle population.

12. Restricted use of organic manure or adopting integrated fish-livestock due to socio-religious reasons.

13. Unavailability/high cost of some basic input like piscicide.

7. EXTENSION SUPPORT

It is surprising but true to note that all the aquaculture development/production targets are laid by planners and administrators with the expected accomplishment by the primary producers - mainly fish farmers, hatchery operators, fry/fingerling raisers. To facilitate accomplishing these objectives, in addition to appropriate technologies and support services, an effective and dedicated technology transfer mechanism is a bare necessity. Fishery extension is essentially the means by which the new knowledge or the improved fisheries technology and ideas are introduced and assimilated among the primary producers in order to accomplish the national aquaculture/fisheries objectives including overall improvement in the life style of this lot of people. Extension service is, therefore, a critical need. Without such a service the target group would lack access to the support services required to improve the fish production systems. Ultimately major portion of the production is expected from only these primary producers. Support services will try to help them from outside but a core service as a catalytic agency very much of professional nature is critically needed. DoF extension service has remained weak since the inception of the Department. Although a Fishery Extension wing does exist under the organizational structure of DoF, in relation to its major future role and vast population of about 22 million poverty ridden illiterate/semi-literate client group it can be regarded as non-existent functional component. Altogether an additional functional set up is immediately required for Fishery Extension under the DoF to achieve the plan objectives.

Recent experiences in several countries prove that an organized or reorganized extension service along with strictly professional lines can have a significant and rapid impact on increasing fisheries production and raising the standard of living of fish farmers and fishermen. If we review the pace of fisheries development in Asian countries, it is evident that the development depends upon many factors including the support services and the system of information transfer from the Research and Development Centres to the farmers/fishermen at the grass root

level. Without the existence of such a system even the output of research and development is totally wasted. The development and introduction of a low cost aquaculture technology in most circumstances require a modest amount of applied research and great deal of hard work by the adequately trained basic Union/Upazila level professional Fishery Extension Officers/workers. The illiterate or semi-literate fish farmers and fishermen needs a very different kind of service. They need someone close at hand who can satisfy their simpler needs and can translate the more complex technical knowledge into simple messages easily understood by them. However, to establish this critically required catalytic link, employment of rather large number of people at the Union/Upazila level is needed. Such people must inevitably be trained as professional fishery extension workers.

In Srilanka the Government is in the process of restructuring and evolving an extension service to suit its decentralized governance and also to answer the changed needs of primary producers. Maldives is just evolving an extension service to cater the needs of its thriving fisherfolk communities. Malaysia has already developed a solid fisheries extension service based on locating technically trained staff at field level and uses modified form of Training and visit system.

7.1. Trickle Down Extension Approach

Appropriate extension approach is needed for any organized and well directed extension system. "Trickle Down" extension approach for aquaculture is presently being followed by the DoF under FAO/UNDP assisted Project BGD/87/045 in 11 districts of the country. Initially fish farmers are selected on the basis of well laid criteria and the farming types are designed as per their own resources, activities and area of interest. While designing the farming plan proper care is taken to honour their values, tradition, belief and sentiment. Those selected fish farmers are designated as Result Demonstrators (RDs) and are assigned to demonstrate the results of selected aquaculture practice in his own pond. Various steps of the package of improved practices related to that particular culture technology including overall results are demonstrated to at least 10 neighbouring fish farmers designated as Fellow Fish Farmers (FFs). While selecting the FFs, the concerned RDs are involved and their recommendations are honoured. All the FFs are kept informed about the successive steps of farming type by the RD and are frequently invited to visit his pond. It is ensured that they are invited to participate as and when any method demonstration or crop demonstrations harvesting are organized. The records of all the activities undertaken, inputs involved and the expenditure incurred are properly maintained by the RD in the especially designed record book supplied to him. The visiting Upazila Officer/Asstt. Upazila Officer makes at least 2 visit in a month and extend necessary guidance. He also makes him understand that what is to be done next. After properly explaining him, the Officer also records his advice in the record book so that if the farmer forgets, he is having access to read it or someone near by can read for him in case he is illiterate. The Officer also helps in recording all the expenditures and receipts. UFO/AFOs are advised to make it a point to visit each RD at least once in a fortnight as per fixed schedule, review the progress, identify problems and advise solutions. All the activities are systematically monitored and communicated through their lines of

authority. Especially designed field diary has been given to DFO/UFO/AFO for this purpose. Once in a month the diary is submitted to the respective DFO to apprise him on the ongoing activities and receive necessary guidance if required. DFO records his remarks/guidance in the diary of UFO/AFO for future course of action. The progress is also discussed during the scheduled monthly meeting at the district head quarter where all the UFOs, Farm Managers do attend.

Training is the core function of this approach. Initially one day extension orientation is organized for the officers to acquaint them the approach and methodology. Such orientation is followed by a week long Comprehensive Extension Training in Fish Culture for all the involved officers. It brings about clarity in their understanding about the technology and mechanism of its transfer. Several, day long discussions are organized to discuss certain problems encountered in the Process and solutions are found out.

Selected farmers (RDs) are invited for a day long training at a place convenient to most of them preferably at a farmer's pond site. The content of training is directed towards building up self confidence, leadership, managerial capability and fish culture skill. The set up of the training is always kept informal so as to encourage them to discuss their problems, clear their doubts etc. RDs are also explained how and when they can initiate their culture operation. Briefing is done regarding maintaining records. They were also reminded their social responsibility to train up 10 neighbouring fellow fish farmers (FF) in fish culture technology they are going to practice. After 3-4 months all the RD's (never more than 20) are again invited to participate in a day long training cum discussion session conducted by the concerned DFO/UFO. This second successive day long training cum discussion for RDs serves as follow up/refresher course. They are also trained how to organize a method demonstration and training for their linked Fellow Fish Farmers (FFs). Following this, RD's are helped and supported to organize a day long training programme and certain method demonstrations at their pond site for their FFs. For convenience and economy of time usually 2 RDs and their 20 linked FFs are grouped together for the training. While conducting the training, extension materials and tools are used. Several "do it yourself" sessions are organized during the training for making it more practical and acceptable. Simple and pictorial instructional manual on fish culture is being distributed among the participants. Such demonstration cum training programmes are to be organized once in every quarter. At the time of harvest, the crop as well as the economics are properly displayed and explained to all the FFs and other neighbouring farmers. Such an approach prepares the FF to act as RD in the subsequent cropping, and by the time the RD becomes fully confident and requires little care and occasional supervision. Under this theorized approach the knowledge and skill of new culture technologies would trickle down from the adopted RD to the rest of the Fish Farmers in due course. However, it requires very tight supervision, monitoring and pond/home visit schedule.

Material input assistance remained base for most of the fisheries extension programmes. Pond selection, material input assistance commitment and supply followed by demonstrations seemed to be the major components of aquaculture extension programmes. However, such strategy fail to select the genuine farmers to certain extent. Most of such farmers participate and take active interest till

the input assistance are assured and as soon as the input assistance is withdrawn or the extension service is no more available, they stop all such activities. Such a crippling after effect is very common to input assistance based extension programmes. Keeping these facts in view it is advised to provide material input assistance to limited extent and only when it is critically needed. More and more investments are made by the fish farmers, more they become serious in their project. It requires high degree of motivational efforts to change the attitude of the fish farmers, although it is a difficult proposition as receiving free inputs is a common expectation among the fish farmers.

In fact the farmers will have to build up their problem solving capacity. Enabling and strengthening collective action for implementation of activities and problem-solving plays increasingly more important roles in extension. This system is based upon both individual and group approach of extension. The approach enables the DoF to create a large number of extension agents in the form of RDs through which a large coverage of the extension service is possible.

8. SUPPORT SERVICES

An efficient extension system can bring about desired changes including accomplishment of production objectives only if a range of other services are favourable. These include timely supply of material inputs, adequate credit mobilization on reasonable terms, provision of support price, availability of preservation, transport and marketing facilities, tenure improvement etc. These services depend largely on the efficiency of other related institutions. The following factors are important to be mentioned for consideration.

8.1 Material Input Support

Although the Extension personnels are not directly involved in procurement and distribution of material inputs required for production plan, they can tabulate the anticipated input requirements, especially the species wise quantity of fingerlings, piscicide, lime, fertilizer etc. and try to explore the availability in the nearest possible Upazila/District. Accordingly the farmers should be advised about the availability and prices of inputs required by them. In case of serious shortage the UFO/AFO has to bring the situation to the notice of the DFO during the monthly meeting or earlier, if necessary. They should also keep a close contact with the nearest FSMF and other local seed raisers to know the availability position of seed of desired fish species. It should also be kept in mind that all extension recommendations should be made depending upon the availability of inputs, if not, it should be modified accordingly. Such a role of the Extension Personnels emphasizes the information and coordination functions.

8.2 Credit Support

Lack of easily available credit support is one of the major constraints in the development of aquaculture. This is mainly due to the absence of a coherent lending policy and collateral requirements for processing of loan applications. As a result the fish farmers and the landless community are compelled to borrow from the Mahajans and the money lenders. To give greater emphasis for the

development of this sector, a separate fisheries bank may be created or the Krishi Bank may open separate windows for disbursing fisheries credit in selected areas. Soft term loans need to be made available to the fish farmers and marginal farmers without collateral.

Credit allocation in the fisheries sector is shrinking in number and amount due to poor recovery of loan. This is a really unhealthy sign. Consistent with the approach to stimulate the small scale private sector which in Bangladesh, comprises entrepreneurs mostly of limited, financial means and without mortgageable assets. The credit institution need to liberalize credit policy and introduce a supervised credit system not essentially requiring a collateral for loan. This system must ensure appropriate utilization of the loan, application. Correct technology and management, ensure production and easy loan recovery.

Khas waters taken on lease for 5 years or a longer period, should be acceptable as a collateral to the Bank for sanctioning loan. Shrimp, Carp, Magur and Puntius farming may be reorganized as an export industry so that it may be entitled to bank loan at reduced interest rates, moratorium and other concessions allowed to the export industries.

The UFO/AFO are expected to play important role in the above mentioned credit management, such as, initial preparation of crop production programme, getting it through the UACC to the financing banks. Once the credit is approved by the lending institution, the Extension Officer need to play a motivational role in encouraging the farmer to make repayment on time.

8.3 Marketing Support

Marketing of fishery products are by and large in the hands of private sector. However, Bangladesh Fishery Development Corporation helps the fish farmers market their products in certain terms and conditions. The Corporation operates through its several centres scattered throughout the country. They also posses proper infrastructure for cold chain transport of perishable fishery products.

8.4 Staff Training Support

A systematic effort has been made by the DoF to give training support to its staff by strengthening organization and institutes involved in training. A broad range of training activities covering senior, middle and lower level staff as well as the primary producers have been initiated under FAO/UNDP Sponsored BGD/87/045 and other Projects. However, provisions are to be made to intensify conducting pre-service, in-service and on-the-job training more frequently. Under the "Trickle Down Extension" approach there is ample provision of on-the-job training for the Extension Officers and frequent *in-situ* training for the fish farmers. However, the existing training infrastructure need to be upgraded to accommodate the volume of regular training of staff expected during the near future for keeping pace with the development of this sector. Establishment of a Central Fisheries Academy is under consideration.

8.5 Creating Inter-institutional linkages

Development of fish culture and other related technologies, their transfer and adoption is to be considered as inter-related process of an integrated and dynamic system. Making the system more effective will require:

- Planning of integrated research and extension strategy;
- effectively linking fisheries research and extension at all possible levels; and
- establishing two-way communication channels between the farmer and the researcher through and in coordination with extension workers and for subject matter specialists.

Fisheries research programmes are conducted mainly by Fisheries Research Institute and Fisheries faculty of Bangladesh Agricultural University Mymensingh. In addition to this some fragmented efforts are also made by zoology Department of other Universities. Significant achievements have been made by these institutions. However, the tendency of these institutions to work in isolation is clearly marked which is the main hurdle in the evolution of an effective and institutionalized linkage between research and development. Consequently, there is a need for a more systematic and coordinated approach to aquaculture research and extension inter-relationship.

Presently Institutional linkages and co-ordination are done by BARC to some extent. However, in order to make such a body more effective and functional, it should have the necessary power and capability to monitor, evaluate and plan research and extension programmes on a regular and consistent basis. Provision of fisheries extension liaison offices by research institutes also serves as the institutional link with extension. Experiences indicate that joint planning, implementation and evaluation of fisheries research and extension programmes at all levels are most essential for the success of institutional linkage. Some of the important indices to this aspect are:

- establishment of problem solving and action oriented fisheries extension and research programmes and plans of works;
- research programmes and plans of work should be regularly communicated to extensionists and vice versa;
- extension and research programmes and plans of work should be mutually discussed and evaluated;
- periodic meetings should be held during the programme implementation between subject matter specialists and scientists of DOF/FRI/BAU to discuss and solve common problems.
- at times scientists should also participate in conducting training for extension workers.

Close and functional linkage between research and extension is also advantageous in terms of cost effectiveness.

- It reduces unnecessary duplication of function.
- Reduces time lag between the development of new technology and its widespread application by fish farmers/fishermen and;
- maximum utilization of research and extension resources.

R & E coordinated committees is to be established at least at Directorate and Division level.

In addition to the linkage with research, the extension department should have more or less similar close coordination with Development departments, voluntary organizations, financial institutions and local self Government organization such as Upazila Parishads, Zila Parishads, etc. Under the existing condition, the sole responsibility of fisheries extension lies upon the shoulder of Upazila fisheries officer who is in fact an employee of the Upazila Parishad but for all practical purposes seeks technical guidance and instructions from the DoF. Without a coordinated approach it is difficult to make satisfactory and sustained progress in the field of aquaculture.

9. IMPORTANT CONSIDERATIONS

- Production targets fixed by the Govt. are to be achieved by the primary producers - the fish farmers and fishermen. It needs provision of intensive extension and suport services to the primary producers.
- Extension catalyses the crystallization of development as soon as the reagents i.e. improved technology and support services are mixed in the background of available natural and human resources;
- Extension promotes not only production but also human development and social justice.
- Aquaculture development brings about affluency and affluency in turn reduces fertility resulting into small family size.
- With the increasing investment from own resources fish farmers pay more attention towards production programme.
- Enforcing Fisheries Acts and promoting Fisheries Extension are two contradictory functional roles.

-= THE END =-

POTENTIALS AND STRATEGIES FOR BRACKISHWATER AQUACULTURE DEVELOPMENT IN BANGLADESH

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INTRODUCTION

As a valuable export commodity of Bangladesh, frozen food is next to jute and jute goods. Its contribution to the country's total foreign exchange earnings is about 14%. The main product of freezing industries (85%) is shrimp (Sobhan, 1990), a significant portion (24%) of this product originates from the coastal brackishwater aquaculture sector.

Prevalence of tropical maritime climate and some favourable physical factors offer a great potential for development of shrimp farming in our country, as well as offer challenges in respect of some environmental and socio-economic consequences. This paper focuses some of the technical constraints in shrimp farming which the author encountered in the field during his long observation since 1975 and the socio-economic ones are based on observations made by other workers (Rahman et. al., 1984; Roy, 1984; Hart and Nandy, 1990). Hopefully these will draw attention of the shrimp farmers, government and non-government agencies responsible for promotion of shrimp farming in our tidally inundated coastal lands.

EVOLUTION OF SHRIMP FARMING IN BANGLADESH

Shrimp farming in 'bheries' 'ghers' or 'ghonas' (i.e. areas impounded by dykes) of the coastal area is an old traditional practice. However its rapid expansion in the coastal brackishwater areas during the past few years is the most remarkable development in the fishery sector of Bangladesh, which

is linked with increasing demand of shrimp in the world markets after the independence of this country. Fortunes were made within a short span of time and shrimp farming has become a lucrative venture, inducing increasing number of farmers, land owners and outside entrepreneurs to be inclined towards this business. This led to an exponential increase in production (Fig. 1), the production figure of 1987-88 (17,889 tons) was more than 8 times larger than that of 1982-83 (2,220 tons). This increase was largely due to an increase in area of coastal shrimp farming, from only about 20,000 ha of brackishwater ponds in 1980 (Mahmood and Chowdhury, 1989), the area expanded to about 150,000 ha at present. Shrimp yields per unit area from the coastal aquaculture ponds are very low; the weighted average is 120 kg/ha/year.

Shrimp farms are primarily located in Bagerhat (29%), Satkhira (19%), Khulna (19%) and Cox's Bazar (31%). In addition, there are about 422 ha in Keshalepur Upazila of Jessore, 43 ha in Kalapara Upazila of Patuakhali, and 87 ha in Anowara and Banskhali Upazila of Chittagong. The average size of a shrimp farm in Bangladesh is about 28 ha.

Shrimp farming is done here following four traditional styles as illustrated by Mahmood (1988) : Salt production vis-a-vis shrimp and finfish culture; round the year shrimp and finfish culture; bheri culture, and monoculture of bagda shrimp, *Penaeus monodon*. In all these types of culture, source of fry are wild postlarvae and juveniles of shrimps which are trapped in the ponds during tidal water intake or intentionally gathered, and directly stocked in the growout ponds. Generally, the traditional farmers practise no management measures except fortnightly replenishment of water in the growout ponds following spring tides. In some areas farmers have adopted a few management measures, e.g. selective stocking of wild bagda shrimp fry and screening of tidal water during intake for controlling predators in the growout ponds.

CONSTRAINTS AND MITIGATION MEASURES

The indiscriminate horizontal expansion of traditional shrimp farming instead of extensive, semi-intensive or intensive farming, faces constraints. Moreover, it has given rise to many socio-economic and environmental problems as discussed below with necessary mitigation measures.

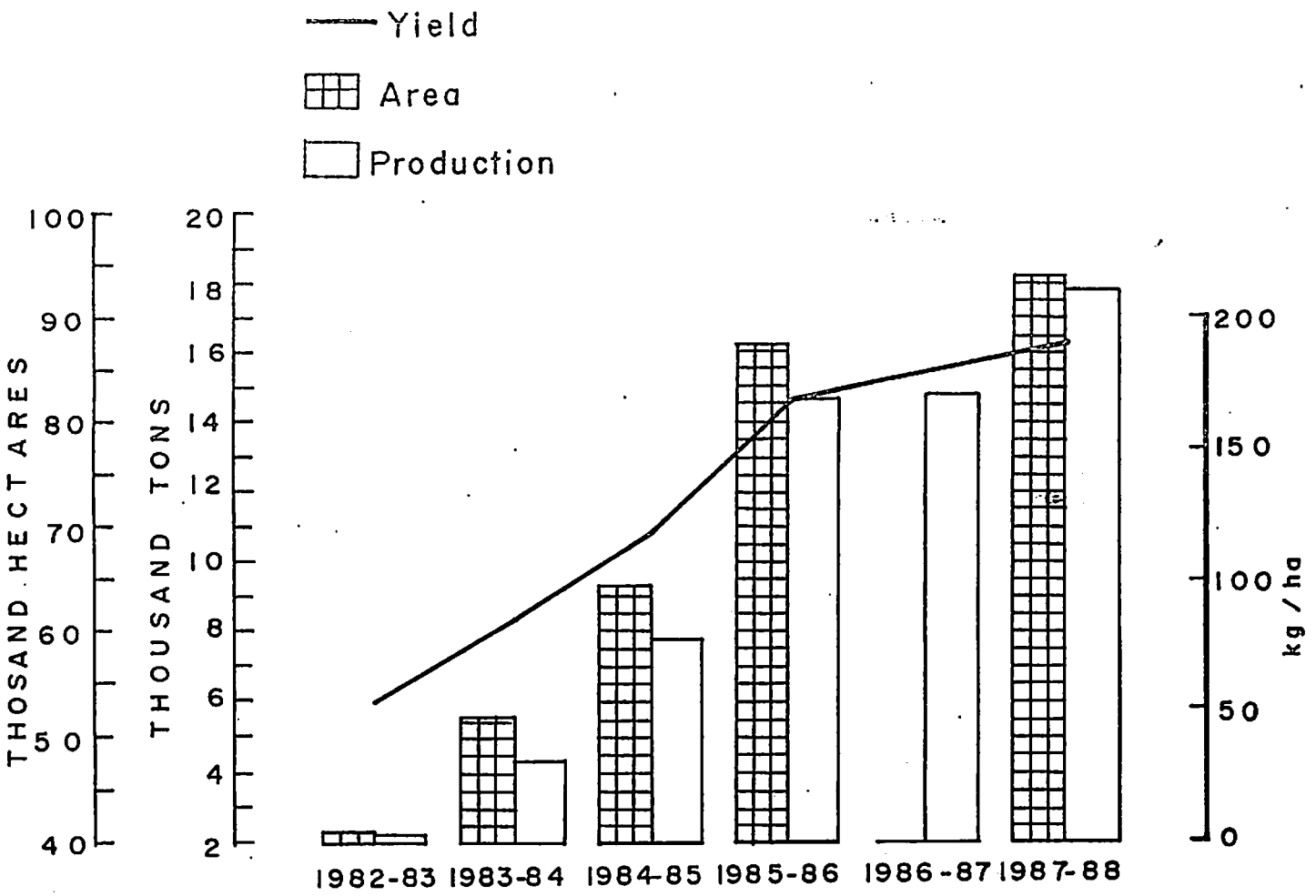

Fig. 1 .Showing yearly increase in shrimp production and coastal brackishwater aquaculture area of Bangladesh

Pond layout and construction

Most of the growout ponds are constructed in a unplanned way using every bit of land available without considering the ideal pond conditions, tidal regimes and water source. One shallow canal is used for both water supply and drainage, which is usually long, narrow and not straight. Some times, main inlet comes from rivers which is wide at the beginning and narrow towards the end after many farmers along the area shift it as required. This situation is common in Polder area of Khulna-Satkhira region, where it is 'illegal' to cut WDB's (Water Development Board) embankment. The direct effect of these conditions has resulted in problem of watering the ponds. As long as this problem remains, it will be difficult to develop shrimp farming, since water is the main factor and is necessary to have a large quantity of good quality water from the source, to have a good yield of shrimp from the growout ponds.

Development of planned canal system (irrigation network for development of shrimp farming) will solve this problem. The canals may be widened, and straightened to shorten the length. This responsibility lies entirely with the government and demands inter ministerial cooperation with the objective of promoting shrimp farming.

The uneven bottom restricts maintenance of uniform depth throughout the 'pond' (enclosure) whose net productive area is relatively small compared to its total (gross) area. There are many large ponds as big as even >100 acres, where it is difficult to take necessary management measures. Pests and predators of shrimps abound in growout ponds, proper pond preparation procedure prior to stocking is not possible.

By having smaller ponds (1-3 ha), these difficulties can be reduced to a great extent, pests and predators can be controlled, cleaning and water management can be done at ease.

Most of the growout ponds, particularly those in the vicinity of estuaries draw water heavily laden with sediments which gradually settle on the bottom of the pond, more rapidly near the inlets, necessitating continuous excavation. Otherwise, filling of the ponds, will reduce the water exchange capacity and eventually making the pond unsuitable useless for shrimp farming.

Provision of a sediment tank i.e., a reservoir will help solve this problem. A reservoir allows the stored water to have a 'settlement period' during which suspended sediment can settle and then the clear water can be drawn to the growout ponds.

Most of our coastal aquaculture ponds are roughly constructed, not based on the local hydrography and as such, quite elevated (about 0-2m above the tidal datum). Moreover, seasonally unequal high tides in the Bay of Bengal, place a strong limitation on water exchange potential of the ponds.

This difficulty may be overcome by having adequate number of high efficiency water pumps (e.g. axial flow pumps) to satisfy the need.

The process of drying out of the pond bottom is a very important factor for shrimp farming. This is usually not done in some areas e.g. in most of the ponds of the Chakaria Sundarbans. Complete drying, and if possible ploughing is done to turn over the top soil (10-15 cm) and expose the underlying layer, laden with organic material to oxidize and mineralize upon exposure to air and sun light.

Farm Management Practices

There exists a thick layer of mud usually at the bottom of the canal, having high content of H_2S and low dissolved oxygen and thus making it stressful and dangerous for shrimp during growth period. Water column in most of the ponds being very shallow (<30 cm), water gets heated reaching high temperatures (>30^{o}C) during day.

To minimize effect of this situation, proper management measures may be undertaken. Prior to stocking, mud should be removed and pond bottom completely dried. Water depth between 50-75 cm should be maintained throughout the growing period. Maintenance of ideal salinity conditions (15-25 ppt) during growing period is a very important factor for growth of bagda shrimp. Salinity usually falls to very low levels during the rainy season and limits growth of bgda, even causing mortality in some cases e.g. *Penaeus indicus*. In the ponds of Chakaria, low salinity due to rainfall is further aggravated by the flood water of the Mathamuhuri river which reduces salinity over the entire area of its delta to very low levels for a period of 2-3 months coinciding with the post-stocking growth phase of bagda.

To overcome this situation, stocking and growth period may be intelligently planned to follow the higher salinity regime of the annual cycle.

Leaching acidity is a great problem in the growout ponds (e.g. in most of the shrimp farms of the Chakaria Sundarbans),

causing softening of the shell and even mortality to shrimps. The formation of acid is due to the presence of pyrite (iron sulphide) in the soil which is usually inert if not disturbed, and is evident only when exposed to air.

Removal of soil from deep layers for construction of dyke should be avoided, since this can activate oxidation of pyrite in the soil. Repeated draining and replenishment of water should be done daily for two weeks prior to stocking of shrimp fry, in order to wash away most of the acid that has leached out at the bottom. This is carried out until the pond bottom is covered with a layer of sediment accumulating through incoming water. This helps prevent further oxidation of pyrites, thus preventing formation of acid at the bottom. Storing water in the growout pond at the maximum level of the dyke when fries are stocked can reduce acidity, because large volume of pond water can dilute the acid seeping out of the dyke. In extreme cases, lime may be applied as per requirement.

In the traditional growout ponds, undesirable hatchlings of predatory finfishes like *Lates calcarifer, Eleutheronema tetradactylum*, etc. also enter during tidal water intake along with those desired. These carnivorous fishes grow rapidly and become predators. Recently, some farmers have started taking measures to control predators by screening tidal water during intake.

Support Facilities

Timely and dependable supply of fry (postlarvae) is a very important factor for successful shrimp farming. The stocking period of our farms is entirely dependent on seasonal supply of wild fry between February and April which forms a big constraint to the shrimp farmers. Being the only source, demand increases with simultaneous increase of price, whereas the supply is limited. Moreover, with the rising demand for bagda shrimp fry, intense fishing of zooplankton is done in our estuaries, and nearshore waters by fine meshed nets. It has been estimated that for fishing a single individual of bagda, fry of 14 other shrimp and 21 finfish postlarvae, and 1631 other zooplankton are wasted (Mahmood, 1990 a). This causes a great loss to fishery and other resources at the planktonic stage, which is to be deplored as it will almost certainly have major repercussions on the traditional capture fishery and offshore trawl fishery.

To solve this problem, hatcheries may be set up with topmost priority. Emphasis may be given on establishing small scale hatcheries which proved to be very useful in Thailand (Kongkeo, 1989).

Our traditional farming system depends only on natural food in the pond, and the yields are very low in comparison to the potentials achievable. To boost up production per unit area necessitates provision of 'supplementary feed' to the growing stock which enhances production to the tune of 800-2500 kg/ha/crop, even far more (upto 20 tons/ha/crop !) with the use of 'complete feed' (Akiyama and Chwang, 1989). Therefore, feed industries should be set up immediately to combat this shortcoming.

Environmental and socio-economic consequences

Unplanned horizontal expansion of shrimp farming in our country has given rise to many environmental and socio-economic problems.

The most note-worthy feature of the environmental degradation is the destruction of valuable mangroves for expansion of shrimp farming (e.g. those in Chakaria). Once, the Chakaria Sundarban was occupied by dense mangroves and had the status of a mangrove forest reserve with an area of 18,200 ha (Cowan, 1926). It was one of the oldest natural mangrove forests in the subcontinent and was subjected to human interferences of different nature with simultaneous reduction of the vegetative cover (Mahmood, 1990). However, with the recent introduction of shrimp farming, most of the mangroves (>50%) were rapidly cleared for preparation of shrimp ponds, and now only a small patch of forest remains in the interior, where a few sundary trees, *Heritiear fomes* can be seen as remnants of an old luxuriant forest vegetation (Karim and Khan, 1980). According to Katebi and Habib (1988), this forest reserve used to occupy an area of about 8,510 ha till 1977 and leasing out land for expansion of shrimp farming started here from the same year, the lease holders ruthlessly cleared the forest not only in their leased land but also in the unleased area. According to them, the damage done to the forest was colossal and irreparable. The area still retained by the Department of Forestry is also exploited for brackishwater aquaculture by the local people through 'undeclared' cooperation with the officials of this Department. Practically, the whole area is in the process of decay. The fishery significance of the

mangroves ecosystem is either not realized or ignored even by the government officials under different ministries. The importance of mangroves as nursery grounds of larval and juvenile stages of shrimps and finfishes was highlighted by many workers round the world, and emphasized taking necessary measures for protection of this ecosystem. A recent investigation (Mahmood, 1990b) in the Mathamuhuri estaury of Chakaria also echoed and underline this view. To face the rapid destruction of mangroves of the Chakaria Sundarbans in the name of shrimp farming, some conservative measures are suggested.

In order to compensate the loss of mangroves at least partially, it is recommended that in future, planting of appropriate species be undertaken as a condition of lease of government land for aquaculture. Private land owners practising aquaculture should be encouraged to plant mangroves in the vicinity of their farms. No further expansion of shrimp farming in the mangrove swamps of Chakaria be permitted.

Excellent information on many other environmental and socio-economic consequences as a result of irrational expansion of shrimp farming is available from three independent investigations made by Hart and Nandy (1990) in Khulna region. Rahman et al., (1984), and Roy (1984) in the Satkhira region, which are summarized as follows :

- The government regulations with respect to dyke and inlet structure of Polders (protected island type areas in the coast) are grossly ignored.

- Necessity of intake of saline water in shrimp ponds of the polder areas, and existing ban on doing so, has resulted in a sort of 'undeclared cooperation' between the shrimp farmers and the WDB's officials, amidst the government, is deprived of approriate revenue.

- Having no other option, small land owners are compelled to lease out their land for shrimp farming to non-local entrepreneurs having no ownership rights, or to the groups formed by outsiders, absentee land owners and big land owners. Lease agreements put them in a situation that they do not have access to their own land for 7-8 months in a year (during shrimp culture period).

- Local landless people, who used to be the share croppers and/or agricultural wage labourers are left

with very little or no scope for earnings with reduction in area under paddy cultivation. Although some new employment options have been generated as a result of expansion of shrimp farming, qualitatively it indicates that poor people in the region have been affected adversely, and on this issue, the people of the polder areas got polarized into two groups, pro and anti shrimp farming groups.

- Prolonged inundation of land (virtually year-round) by saline water increased soil salinity which in turn halted the process of mineralisation and decreased soil fertility.

- Public health hazards are obvious, created as saline environment deposits salt on the human skin which needs frequent bathing, the incidence of water borne diseases is high as well.

- Inundated polder areas not only presented lack of living space to the inhabitants but also chased snakes, rats and cockroaches from the inundated fields to homesteads.

- Salinity increased in freshwater ponds, resulting in scarcity of fresh water for cooking, washing and drinking. Women have to fetch drinking water (of acceptable standard) from far away places.

- Salinization of the kitchen gardens has prevented growth of vegetables. Perennial trees like coconut, mango, date etc. are dying and new plantations are failing completely.

- Shrimp farming eventually has eliminated traditional robi crops like sesame, aus paddy etc.

- Shrinking of agricultural and grazing lands makes it impossible to raise cattle and poultry.

- All sorts of commodities (e.g. milk, vegetables, fish, wood, cowdung etc.) have to be bought from out side source.

- The over all ecology is changing and in the long run, it might effect the region's very carrying capacity for human habitation !

Now it stands that shrimp farming has evolved as a profitable venture in the polder areas Khulna-Satkhira region, but the cost which the society pays through deterioration of the government embankment and the human ecology as a whole, makes it an effort to make a small number of rich people richer and the benefits are being eaten up by them. In the Chakaria Sundarban area, government land has been leased out to many individuals who are actually not involved in shrimp farming, some absentee land lords are created in the name of expansion of shrimp farming and at the cost of valuable natural mangroves, here also interest of the local people has been ignored.

STRATEGY FOR FUTURE DEVELOPMENT

The price of shrimp has dropped due to a combination of factors and the rapid increase in world production is certain to lower the shrimp prices permanently in future. This suggests a strategy of reducing production costs by adopting improved and more efficient culture techniques.

As I mentioned earlier, most of our shrimp farms are traditional, which can be converted to extensive type to increase yield to the range of 600 to 1,000 kg/ha/crop with low additional input (without utilization of aerators and pelleted feed). This kind of aquaculture will still survive against a price drop and a hard competition, even with low production.

RECOMMENDATIONS

The government would certainly like to promote shrimp farming to augment much needed export earnings. However, its indiscriminate expansion leading to serious environmental and socio-economic consequences for benefit of the few at the cost of many, especially the poor, can not be supported. The way it is practiced now keeps little change to ensure equity. At this stage, government should regulate shrimp farming with a clear policy decision aiming at a 'ecology conscious development plan' to address the betterment of the local population at large. In my opinion, the following may be considered :

- No more land should be brought under shrimp farming; suitable areas in polders should be clearly defined to extend support facilities like development of efficient

canal system to facilitate legal exchange of saline water in the growout ponds, and extension of electricity line, etc. Interest of the local people should be honoured;

- Shrimp farming may be intensified in areas where paddy cultivation is difficult, and in order to mitigate conflict, reintroduce these two in sequence wherever possible;

- Environmental and socio-economic consequences should be considered with seriousness;

- Our present traditional farming system incorporates lot of constraints as discussed earlier along with mitigation measures. To boost up production, facilities may be developed accordingly;

- Demonstration farms may be set up by the government and NGO's in different areas to impart practical training and provide extension services to shrimp farmers;

- To rehabilitate local displaced labourers, and land less people promote cooperative ventures in government owned land and depressions, hitherto forcibly, illegally or legally occupied by big shrimp farmers;

- Reclaim those government lands leased out to fake shrimp (created absentee land lords) in the Chakaria Sundarbans and redistribute among the landless farmers and professional experts having no land to establish model farms;

- To encourage shrimp farmers formulate a generous policy for importing aquaculture and hatchery machinery and equipment such as axial flow pumps, aerators, soil and water testing apparatus, feed mixing and pelleting machines etc.

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RESEARCH NEEDS FOR BRACKISHWATER AQUACULTURE DEVELOPMENT

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RESEARCH NEEDS FOR BRACKISHWATER AQUACULTURE DEVELOPMENT

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Brackishwater area having potential for aquaculture is estimated at around 200,000 ha in Bangladesh. Brackishwater aquaculture was almost unknown in the late sixties in Bangladesh, but culture based brackishwater fisheries in coastal areas now contributes lion's share to foreign exchange earnings of the country. With its high economic rates of return, farmers gets needed incentives for brackishwater aquaculture. The increasing demand and steadily rising price of shrimp has caused vigorous economic activities in the remotest part of the rural Bangladesh. Brackishwater aquafarming sector, what was merely an insignificant activity of little economic significance in the early seventies has now emerged as a multi-billion taka farming industry.

Bangladesh is gifted with favourable environmental conditions for brackishwater aquaculture in general and brackishwwater shrimp culture in particular. Though low cost production of shrimp makes it competitive with other Asian producers, Bangladesh's share accounts only 2.5% of world shrimp trade, but has considerable potential to increase export. The main source of increased growth should be increases in yield per unit area, but expansion of area under aquaculture can also make an important contribution. The scope of further development of shrimp farming both in area and in intensity with resultant increased production for export and rural employment is tremendous. Adaptive research is needed to increase production in brackishwater farming. At present brackishwater shrimp farming area in Bangladesh is reportedly far exceeds the third five year plan target. Presently, some 120,000 - 125,000 ha area is under shrimp farming. The need for increasing production through intensification is being emphasized. The brackishwater aquaculturists (here means shrimp farmers in Bangladesh) are

facing a number of technical problems, that need systematic analysis, investigation and appropriate solution. A land scarce country like Bangladesh, can't afford indiscriminate land use for a particular purpose, how much profitable it be, without considering other interrelated socio-economic and environmental factors.

Before going to pin-point research needs in the field of brackishwater aquafarming, it is essential to know the present state of farming itself. Farming practices followed are basically traditional with the resultant low production, except for a few farms where so called improved traditional or semi-intensive farming methods are used. There are many problems-biological, technical, environmental, socio-economic and others that need to be solved through research for development of this sector. As brackishwater aquafarming specially, that of shrimp is an well established industry in some of our neighbouring countries, basic and fundamental research in this field is not needed, only applied and adaptive research may be helpful.

Brackishwater aquaculture in Bangladesh is mostly practiced in low lying tidal flood plains within BWDB (Bangladesh Water Development Board) polders, that were originally constructed to reclaim land for agriculture. Besides these, seasonally abandoned salt beds are also used for shrimp farming. In many cases the private farmers have constructed light dykes on the narrow strip of land between BWDB dykes and river banks for dual purpose of agriculture and aquaculture. Some farms are located within low dykes privately constructed along with tidal river courses or creeks. In some cases, mangrove forest areas have been converted into shrimp farms. Farms are diverse in nature in terms of topography, vegetation, water salinity, physico-chemical conditions of water, soil quality, tidal inundation and culture practices. In fact, almost all brackishwater farms in Bangladesh are involved in shrimp production. Some farms are vast in area, some are small. Culture practices followed by some of the farms involve trapping of shrimp larvae coming along with tidal water, allow tham to grow for a certain period. Some farmers supplement the natural stocking with shrimp post larvae (PL), mainly *Penaeus monodon*, collected from natural sources. Other practices followed include predator control by placing suitable screens in sluice gates, resting *P. monodon* PLs in nursery ponds inside farming area and selective stocking. Seldom farmers use supplementary feeds or practice fertilization, except during nursing period. A few farms constructed embankments to have manageable sized ponds with a good water circulation system. Monoculture of*P. monodon*

with pond preparation, fertilization selective stocking, water intake through proper screening and occasional supplementary feeding prepared from indigenous materials are practiced by some with increased production. Few farms follow semi-intensive practices, to raise shrimp production upto 5 ton/ha/year (two crops/year) using 100% quality grade pelleted feeds, selective high density stocking of PLs, water intake by filtration and pumping, aeration by paddle wheels, drying of pond bottom and mannual waste disposal after every harvest.

Under such varied farming conditions, productions in general are low and research needs to be undertaken for solving problems faced by farmers and for increasing productions.

Wild Seed Supply

Brackishwater shrimp farming in Bangladesh is totally dependent on seed of *P. monodon* and *Macrobractium rosenbergii* collected from nature. A portion of seed i.e., PLs are naturally carried to the culture ghers or ponds. This practice allows small sized or larval predators to enter with PLs, resulting in low survived and production of shrimp. This type of culture system should be either discontinued or permitted till such time that the collected PLs are able to meet the demand. For such a system to be productive, it is suggested that

i) availability of PL in good numbers at the mouth of water intake system be ascertained, before taking in tidal water through a suitable mesh sieve to prevent entry of predators as much as possible.

ii) incoming PLs be trapped in a small enclosure at the mouth of polder or ghers at first, then sort out desirable species for stocking, and the undesirable species should be released back. PLs trapped at the mouth of farming area should have sufficient space and water for their survival and sorting.

PLs are generally harvested by crude methods from sea, mangrove areas, rivers and creeks of coastal area and sold to prospective buyers either directly or through middle men. Quantity of larvae trapped in ghers or ponds, is not known. About 2-3 billion PLs are harvested each year and shocked. This practice needs much improvement. Research is needed for better

management and exploitation of wild PLs of *P. monodon* and *M. rosenbergii*. Following aspects of wild PL collection needs to be investigated :

1) A detail survey to assess needed on the availability of *P. monodon* seed in coastal areas, sea beach, mangrove areas,, coastal rivers, during different times of the year. Relationship between availability of PLs and salinity, temperature, tidal condition, new moon, full moon etc., needs to be established;

2) study the feasibility of collecting of *P. monodon* and other prospective marine shrimp PLs from pelagic areas of open sea;

3) develop methods for collection of PLs without endangering other marine life.

4) develop devices or methods for attracting wild PLs of shrimp to a particular area specially when needed most;

5) prospect for seed collection of *M. rosenbergii*, specially for post larvae and juveniles, and their effective collection methods.

6) easy and improved methods for transportation of live post larvae;

7) determine amount of PLs that could be harvested from wild without endangering natural stock.

Shrimp Hatchery

Dependence on wild PLs of shrimp for brackishwater aquaculture will remain for a considerable period of time. However, as wild seed supply is unpredictable seed production in hatcheries is necessary. There are many constraints for successful establishment of hatcheries both for marine and freshwater shrimps which need to be solved. Some of these constraints are listed below :

1) Availability of brood shrimp is the main constraint for establishment of *P. monodon* hatcheries in Bangladesh. Brood maturation under captivity and their subsequent breeding is not yet developed in Bangladesh. In view of this, it is necessary to find ways to collect females from their natural

breeding grounds. For this purpose, experimental night bottom gill netting should be undertaken prospective breeding grounds of *P. monodon*.

2) Due to heavy rainfall, required salinity for *P. monodon* breeding is available for a short period of time. A detailed study is necessary to find out locations where turbidity free, high salinity (30 ppt or above) is available for a considerably longer period of time, with minimum rate of siltration at the beach for establishment of *P. monodon* hatcheries.

3) Though cultured *P. monodon* grow faster compared to wild ones, they don't attain sexual maturity within a year. Research needs to be undertaken for raising *P. monodon* under high salinity conditions for 2-3 years, and their subsequent use for artificial breeding.

4) Establishment of *M. rosenbergii* hatcheries are more promising as brood of it and required salinity for its breeding are available almost round the year. However, further investigations are necessary to reduce larval mortality during 7 to 30 days after hatching.

5) For successful hatchery operations, methods for culture of suitable planktonic feed on mass scale, should be developed.

6) Micro-bound and micro-capsulated diets using indigenous feed materials, should be developed for shrimp larvae.

Nursery Management

Nursing the larvae before stocking in growout pond is necessary. Seed of *P. monodon* and *M. rosenbergii* is available almost round the year in nature. Transformation of present day traditional brackishwater shrimp farming into planned aquafarming will necessitate large quality of PLs from wild. Since seed resources from wild are limited it would be necessary to reduce mortality of PLs through nursing to juvenile stage, before stocking. It is a common observation that sometimes PLs are in scarcity, while other times, they are abundant and discouraging the seed collectors, to catch from natural sources. Therefore, investigations need to be undertaken in the following aspects :

1) Methods need to be developed for nursing PLs in nurseries for a longer period of time, with in expensive feeds to enable their use in grow out ponds at a later time;

2) Commercial nurseries already established in and around PL collection areas are in need of artificial diets and proper water quality maintenance to retain PLs for a considerable period of time. Improvements in long distance transportation of PLs are urgently needed.

3) Nursery operations for shrimp PLs in a large farm or a group of small farms are necessary for planned stocking and culture. Nursery pond construction, preparation, fertilization, water quality maintenance etc. needs to be investigated for successful running of a farm based nursery operation.

4) Optimum of water depth, salinity and stocking densities in nursery ponds should be determined for maximizing growth and survival of PLs.

5) Enhancing growth of natural food organisms, and artificial feeding in earthen nurseries need to be investigated.

Planned Farm Construction and Management

Large brackishwater areas were developed into shrimp farms without a plan. It would be possible to increase productions through proper culture and management practices. In this connection, the following aspects need to be investigated :

1) Determination of size of growout ponds for improved traditional (extensive) and semi-intensive farming.

2) Identify needs and develop designs for construction of pond dykes and sluice gates for water intake and discharge by gravitational force or pumping. Measures needed to prevent or reduce erosion of pond dykes.

3) Selection of fast growing mangroves for planting at out side of pond dikes to prevent erosion, and to create natural sanctuary for wild flora and fauna out side of farming area.

4) Develop designs for semi-intensive or possibly intensive shrimp farms for *P. monodon* and *M. rosenbergii* with facilities of artificial water intake and discharge systems, artificial aeration and waste disposal mechanisms.

5) If farming is to continue on a large farming area, devices need to be developed for proper water circulation using the advantage of gavitational force during high tide and low tide.

6) Develop methods raising for growout shrimp, along with raising of PLs or juveniles for the next crop in the same farming area. This would help in raising two crops a year, as against single crop presently being practiced in most of the farms.

Pond Preparation and Farming Methods

1) Due to the diverse nature of soil texture, top soil, soil acidity etc., pond preparation methods need to be area specific. Hence pond preparation techniques for different areas and different intensities of culture need to be developed.

2) Studies need to be undertaken in brackishwater areas where water salinity drops to zero during monsoon, for culture of *P. monodon* during dry season, and rice cum *M. rosenbergii* during raising season.

Water Supply and Management

In brackishwater aquafarming areas, seasonal fluctuation of salinity is very high, ranging from 0 - 25 ppt. Therefore investigations are needed to find out :

1) Optimum salinity requirements for PL, juvenile and growout *P. monodon*, and maximum-minimum critical points for commercial culture of this species under different stages;

2) Maximum salinity tolerance of *M. rosenbergii* under variable conditions. Study the feasibility of maintaining optimum salinity in the farms through supplementation of fresh or saline water from under ground or surface resources;

3) Optimum water depth needed for PL, Juvenile and growout shrimps under variable culture conditions.

4) Feasibility of maintaining different levels of salinity in different ponds of a farm for PL, juvenile and growout shrimps of *P. monodon*;

5) Technical and economical feasibility of storing saline water during dry season and utilizing it during monsoon to raise salinity level for better growth of *P. monodon*.

Supplementary Feeds

For successful shrimp farming, natural and artificial feeds are a prerequisite. Brackishwater shrimp farms in Bangladesh seldom use supplementary feeds. The following areas in feed and nutrition of shrimp, need to be investigated :

1) Ways to enhance planktonic feed particularly in nurseries;

2) Enhancement of growth of benthic food organisms for juvenile and grow out shrimp;

3) Shrimp grows by moulting. Proper feed and nutrition accelerates moulting frequency and helps rapid growth and reduces and danger of disease. However, overfeeding or supplementary feeding with less water stable feeds endanger water quality and helps growth of pests and pathogenic agents. Therefore proper feed and nutrition is necessary to ensure good harvest and disease control, which need detailed investigation.

4) Identification of local feed ingredients and formulation of feed. As shrimps are reared on artificial diets containing high levels of animal protein, attempts should be made to find out non-traditional animal protein sources for feed such as insects, worms and kitchen waste etc.

5) Dry pelleted feed preparations which can be stored under normal temperature without deteriorating its quality for atleast a growing season under rural conditions.

Predator Control

Predition is one of the main reasons for low production of shrimps in large extensive culture area. Practical measures are needed to control predators. Investigations in following areas needs to be under taken :

1) Designs of sluice gates and screens to inhibit entry of predatory species;

ure 4. Map of Torgaon union showing location of pond/ditch.

2) As physiology and respiratory mechanism of shrimp and fish are different, research is needed to find out agents which can kill only predators but not shrimp;

3) Selection of suitable feed or attractant, which will lure only fish to a particular area from where they can be harvested;

4) Effective measures to control crabs from farming area, which not only pray on shrimps, but also damages embankments.

Disease Control

Diseases are more problematic in semi-intensive and intensive farming. For disease control following research needs to be undertaken.

1) Identification of pathological agents and their effect under various environmental and culture conditions on shrimp.

2) Drugs or antibiotics necessary to control various diseases, for individual and pond treatment.

3) Some symptoms such as soft shell, spongy muscle and body cramp etc., appears to be more related to nutrition than disease. Studies should be undertaken for their control.

Species Diversification of Shrimp

Mono-culture of *P. monodon* in relatively higher saline water and *M. rosenbergii* culture in less saline areas are practiced in Bangladesh. But attempts should be made to culture various other shrimps specially those which have high market price and export potential. Depending on the availability of seed, *P. indicus, P. merguensis, Metapenaeus monoceros* and *M. brevicornis* may be raised on a pilot scale for both export and local consumption.

Harvesting

Though harvesting of shrimp from farms is not a problem, much time and energy are needed to harvest farm raised product. Furthermore, as shrimps are benthic in habit and tend to hide in mud and holes, a considerable portion of farmed shrimp are wasted in every crop. Moreover, as all shrimps do not moult at the same time, harvesting of all crops at a time together with newly

moulted ones, though does not reduce the total production of biomass, but significantly reduces average price of the product. Planned harvesting of farmed product may give more economic return. For this reason following studies need to be undertaken :

1) Selective harvesting of larger sized shrimp with suitable gear;

2) Methods for attracting hard shelled shrimp to harvesting area leaving soft shelled, newly moulted ones undisturbed.

3) Investigations for to arresting moulting of shrimp for a limited period of time, to assist in harvesting period.

Environmental Factors

Environmental factors which affect brackishwater shrimp farming, need close monitoring. Culture practices either should be modified to fit with environmental factors or environmental factors should be manipulated for the culture practice.

1) Determination of minimum salinity level for culture of all commercially important shrimps and fish;

2) Lower temperature during winter retards the growth of shrimp. Therefore pond preparation, dyke repairing etc., can be done during winter and culture of small shrimps may be tried, for local consumption.

3) Trials may be taken to stock PLs during winter months. Due to lower temperature Pls or juveniles stocked for months will have little size differences and beginning of summer will stimulate the growth and a rapid crop may be be ensured.

4) Pilot scale trials may be taken during winter season for nursing of PLs and juveniles utilizing green house technology with the help of indigenous materials.

5) Determination of the effect of sudden drop in both salinity and temperature on the growth of brackish water shrimps.

6) During night and cloudy days, artificial aeration using cheap technology should be tested in high density brackishwater aquafarming.

Mixed Culture Practice

Shrimps at larval and early stage PLs, feed on planktonic food. In subsequent stages, they feed - on benthos and thus planktonic feed remains unutilized in the grow out ponds. Therefore, trials may be taken to have polyculture of shrimp together with non-carnivore plankton feeding fish.

1) *P. monodon* may be cultured with mullets (*Liza or Mugil* spp.), to utilize planktonic feeds in growout ponds.

2) In less saline areas trials should be under taken to culture *M. rosenbergii* with chinese or Indian major carps.

Brackishwater Aquafarming other than Shrimp

Though at present shrimp culture is far more profitable than fish culture in brackishwater areas, finfish culture may be promoted in areas where shrimp culture is not suitable. Investigations are needed to judge areas suitable for fishfish culture and shrimp culture.

1) Among non-carnivore finfish, mullets, *liza* and *Mugil* spp. are most desired genera which may be cultured in brackish water. Their biology and optimum culture conditions needs to be investigated.

2) In intensive shrimp or fish farming, particular disease or pests becomes dominant to a particular culture area, therefore, crop rotation may be practiced for biological eradication of disease and pests.

3) The predatory finfish which are considered enemy to shrimps, but have high demand and command a good price in local markets such as *Lates calcarifer, Eleutheronema tetradactylum, Glossogobius giuris* and *Mystus menoda*, may be cultured with supplementary feeding utilizing waste of shrimp farming.

4) Outside the poldered area and dykes, specially in canals, creeks and rivers in brackishwater zone, mollusk culture needs some attention. Pearl culture may be encouraged which will provide shell meat and hard shell as by product, which can be utilized as shrimp feed and lime, respectively.

5) Salinity tolerance level for *Catla catla, Labeo rohita, Cirrhina mrigala, Hypophthalmichthys molitrix, Oreochromis nilotica, O. mossambica Ctenopharyngodon idella* should be determined and their possible culture in less saline area together with shrimp or rice may be investigated.

Ecological Studies

As brackishwater region is vital for some migratory species of fish and crustacea both freshwater and marine, ecological studies are essential to determine the effect of shrimp farming on brackishwater flora and fanna.

1) Measures to be taken to protect mangrove forests which are vital for brackishwater eco-system and natural sanctuary for many aquatic life.

2) It is essential to know how many species of shrimp uses brackishwater zone in Bangladesh for their breeding, nursery and feeding grounds and what is happening to their population due to shrimp farming.

3) Does frequent exchange of water creates siltation problems in the canals and creeks ? If so what measures should be taken to counter the problem.

4) What are the effect of confinement of salt water inside poldered area with under ground water level, and on flora and fauna inside poldered area ?

5) Studies may be under taken to designate portions of rivers, creeks or canal as wild life sanctuaries inside brackishwater zones, to save natural brackishwater species.

Socio-economic Studies

As a land scarce country, Bangladesh accommodates nearly 110 million people in only 144,00 km^2. There is hardly any scope for further expansion of culturable area in the country. The poldered

area in the south which was basically developed for agriculture is now gradually going for shrimp culture. Bangladesh is achieving self sufficiency in rice production, therefore, divercification of land use both for agriculture and brackishwater aquaculture needs social adjustments. Socio-economic studies related to brackishwater aquafarming needs careful observation for the sound development of this sector. Since brackishwater aquafarming is becoming popular, some local people not only are alienated from this profit earning enterprise, but began to face economic pressure for various other related reasons listed below which need careful investigation and considerations.

1) Local small farmers can't organize planned dykes and water management system, due to lack of capital. So, they are forced to lease their land often to outside lease holders which creates conflicts between locals and outsiders.

2) Brackishwater aquafarming creates fodder problem for livestock in poldered area, thus livestock has to shift outside of brackishwater aquafarming area, which deprives local people for cowdung used for manure and fuel.

3) Stagnation of saline water greatly affects conventional trees in the area, thus creating problem for firewood in poldered area.

4) Stagnation of saline water creates problem for drinking water and water for house hold use.

5) Open fishing in the rivers and creeks of brackish water region is getting reduced due to lease system, which creates dissatisfaction among local fishermen.

6) Due to contradiction, large lease holders engaged in brackishwater aquafarming, hire people from outside of farming area resulting in social problems.

Some of the problems faced by brackishwater aquafarming in Bangladesh listed above, should be solved through careful studies for the sound development of this sector.

INTER-SECTORAL CONFLICTS AND ENVIRONMENTAL ISSUES IN BRACKISHWATER AQUACULTURE

By

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Inter-Sectoral Conflicts and Environmental Issues in Brackish water Aquaculture

By
Dr. M. Youssouf Ali

1. Introduction :

Brackish water aquaculture of fin fish and shrimp had been going on in Satkhera region of Bangladesh from time immemorial. Ahmad (1956)_1/ reported that over 100 brackishwater fish-cum-paddy farms were in operation in the then Satkhira subdivision of Khulna district around the year, 1950. During the past, such brackishwater aquaculture operations were known as "Bhasha-Bada Fishery" or "Bheri fish culture". Such Bheri fish culture was also extensive in the coastal areas of the 24 parganas district, in West Bengal. Which is contiguous to Satkhira sub-division. The Bheri fish culture in those days involved the practice of the procedures as narrated below:

A large chunk of land area on the banks of tidal rivers used to be encircle with dwarf embankments. These embankments were provided with inlets and outlets to allow entry of saltwater during high tide and drainage of water from within the gher during low tide. Water flow through these inlets and outlets used to be controlled with the help of small wooden sluice boxes. During the dry months, particularly during February-April, sluice gates were opened to allow the entry of tidal water carrying the juveniles of various saltwater species of fish, such as Bhetki (Lates calcarifer), Mullets (Mugilidae), Bele (Gobidae), Tengra (Mystus sp.), etc and post-larvae of brackish water shrimps such as Bagda chingree (Penaeus monodon), chaka chingree,(P. indicus), Horina chingree (Metapenaeus monoceros) etc. After such natural stocking of the gher, these juveniles and post-larvae were reared within the gher for 4-5 months. During these 4-5 month period, old water inside the gher used to be exchanged with brackish water from the tidal rivers through the sluice gates. Such water exchanges used to be carried out

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_1/. Ahmed, Nazir - 1956 - Paddy - cum - fish culture. Agri. Pakistan, vol VII, No. 1 1956.

twice in a month during the full moon and new moon periods. All marketable sized shrimp and prawn would be harvested in June-July period. With the onset of monsoon, the land inundated with brackish or salt water would be repeatedly washed with accumulated rain water to make the land fit for paddy cultivation. During this period, the left-over brackishwater fin fishes would be kept congregated in the small channels within the gher. Around end July or early August, the land within the ghers would be redried for planting paddy plants and the paddy crops were harvested by November-December.

In this system of brackishwater aquaculture during the dry months alternated with rice cultivation during the monsoon months within the gher, the embankments and sluice gates were constructed by land-lords or people owning large tracts of land. Costs for aquacultural operations were also met by land-lords. In lieu, the land lords and land owners would be the owner of fish and shrimp crops while the paddy cultivation on lands protected by the gher were required to pay the land lords/large land owners one-eighth of the paddy grown as rent.

2. Evolution of conflicts:

During the past there was no conflict between brackishwater aquaculturists and rice farmers. In the 1960s, Government started building up Coastal Embankments to prevent brackish water incursion on to the lands with view to ensuring year-round agricultural crop production. Construction of coastal embankments brought an end to the traditional 'Bhasha-bada' or 'gher fish culture' practices. The authorities responsible for construction and maintenance of the embankments,i.e., the EPWAPDA did lease out land on the riverside of the embankments for Bheri fish culture. Some brackishwater aquaculturists did carry out fish and shrimp farming on such lands on a very modest scale.

During the late sixties, however, export of frozen shrimp, fish and froglegs from the then East Pakistan (now Bangladesh) started and shrimp freezing plants were set up in Chittagong and Khulna. This had resulted in the generation of demand for shrimp. In the Early seventies, demands for frozen brackishwater shrimp tails started increasing and as a consequence., the brackishwater shrimp culture got a big boost. Seeing the lucrative

business in shrimp export, lots of local influential people, went in for shrimp culture operations in suitable lands within the embanked polders in Satkhira, Bagerhat and Khulna regions in the south-west of the country.

These influential and moneyed people did make breaches across the embankments to bring in and drain out saline water into and out of their 'ghers' within the polders.

Since the breaches across the embankments of the polders were in violation of the existing rules, the EPWAPDA local authorities instituted criminal cases against all such shrimp gher owners with the local police. In many instances, the shrimp farmers were arrested by police for trial.

Inspite of the threat of institution of criminal cases against them, the shrimp farmers carried on with their shrimp culture operations within polders and more and more land within different polders were coming under brackishwater shrimp culture.

These led to the formation of an opinion both amongst officials particularly the EPWAPDA officials and the local elites that entering of saline water was rendering the protected lands saline making these unfit for rice cultivation, the primary purpose for which the embankments are constructed in the first place.

3. <u>Conflicts between shrimp culture and other activities:</u>

In the mid and late seventies, plenty of objections were raised against the use of land-both inside and outside of polders for brackishwater shrimp farming by people opposed to brackishwater shrimp farming. These people used to highlight the following deleterious impacts of brackishwater shrimp culture on coastal lands in Satkhira, Khulna and Bagerhat regions in the south western parts of the country.

(1) Shrimp gher (farm) owners take lease of land from small farmer owners but they hardly make payments of agreed rents to the land owners.

(2) Shrimp gher owners flood the land adjacent to their ghers with brackish water and thereby force

the owners of such adjacent lands to lease their land to them (shrimp gher owners).

(3) Introduction of brackishwater into shrimp ghers (farms) makes not only the shrimp farm land within ghers unfit for rice cultivation but also affects adversely the rice production in neighbouring lands.

(4) Shrimp culture results in the increase of surface soil salinity leading to the decline of rice production.

(5) Shrimp farming has resulted in the loss of unemployment for land-less labourers, share croppers and marginal farmers.

(6) Shrimp farming reduced availability of grazing grounds and fodder for cattle population through the reduction in the production of paddy straw, rice bran etc.

(7) As a result of shrimp farming, fresh drinkable water in ponds in the vicinity of shrimp farms or surrounded by shrimp farms turns saline. Thus, scarcity of drinking water for the villagers is created.

(8) Fruit and other trees in and around the shrimp ghers (farms) die out due to salinity and thereby shortage of fruits and timbers is created.

(9) Shrimp farming has distorted the income distribution pattern and encouraged accumulation of wealth by a few.

(10)Shrimp gher owners resort to violence in establishing and protecting their farms and stocks of shrimp and fish and thereby create law and order situation.

Recently, on the basis of a report dated August 29, 1991 from its own correspondent, the Daily Bangladesh Observer of September 2, 1991 reported that "28 kinds of indirect damages were being done to environment by shrimp cultivation". Some of the indirect damages, according to this news item, are : (a) expenses of legal

cases in connection with shrimp cultivation in ghers, (b) smoking of narcotics and drugs (c) obstacle to mass education (d) hindrance to development programmes (e) decline in the sustenance of living places infrastructure, (f) decline in agricultural production due to decrease of land fertility, (g) losing of moral character, (h) decrease of the number of trees and people becoming disinterested in planting trees, (i) increase of unemployment, (j) mob-station of basic human rights, social conditions, without games, sports and cultural activities, (k) increase in the number of 'mastaans' from urban areas, (l) increase of the influences of wealthy classes, (m) social structure without social values, (n) losing of social sanctity, (o) acute shortage of drinking water, (p) increase in various diseases including eye diseases, (q) environmental pollution, (r) increase of helpless condition of the landless people etc. The news item goes on to recommend planned and scientific shrimp farming with spontaneous participation of the rural people of the concerned areas.

Many of the conflicts listed above are not based on any quantitative and scientific study and analysis. For example, increase of soil salinity produced by shrimp farming does not appear to be coroborrated by the actual situation in the field.

4.Mangrove forest versus Brackishwater Shrimp Culture

The above is the situation in the south-western region. In the south-east, in the Cox's Bazar area, the identified conflict or objection is loss of mangrove forest plantation due to construction of shrimp ponds in areas covered by mangrove plantations. Many pro-mangrove environmentalists foresee a "dooms day" unless the mangrove plantations are restored.

5.Conclusion:

The conflicts envisioned by various interest groups do not seem to have been based on scientific studies and observations. It is suggested that conclusions be drawn in respect of each of the conflicts after a comprehensive scientific studies of the issues so that development can go on in a planned manner, causing least damage to different resources and groups of people.

POTENTIAL FOR CULTURE BASED FISHERIES IN BANGLADESH

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Paper for presentation at the Workshop on "Inland Aquaculture Development Strategies for Bangladesh," organized by BARC/ICLARM, 29 September - 01 October 1991, BARC, Dhaka

POTENTIAL FOR CULTURE BASED FISHERIES IN BANGLADESH

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INTRODUCTION

Fisheries is an important sector in Bangladesh, providing income, employment, nutrition and foreign exchange earnings. Traditionally, inland fisheries which cover an area of some 4.3 million ha, of which, 94% is under open water capture fisheries and 6% under closed water culture fisheries, has supported subsistence, artisanal and commercial fisheries. The rapid population growth, modification of water courses by damming, drainage and irrigation diversions and modification of environment by intensive deforestation and agriculture, leading to increased erosion rates, has resulted in increasing pressure on fish stocks and declining fish catches over a period of years. The situation has been further aggravated by pollution from agricultural, domestic and industrial sources. The totality of these human activities exerted a complex pressure on water resources with integrated consequences, which can be identified from changes in aquatic habitat. Aquatic organisms, including fish, are sensitive indicators of such integrated complex stresses and decline in fish and fisheries is an indicator of such stresses.

During 1988-89, inland fisheries has contributed some 607,645 tons or 72.3% to the total fish production, showing the importance of this sector. Of this, 50.5% was from inland capture and 21.8% from inland culture. In recent years, there has been a decline in production from inland capture fisheries. While inland capture fisheries contributed 471,591 tons or 62.6% of total catch in 1983-84, it declined to 50.4% in 1988-89 (Table 1). This along with increasing population, has resulted in

declining per caput availability of fish, which is the major source of animal protein to people of Bangladesh. Even to keep the present low consumption levels, it is estimated that by year 2,000, fish production has to be increasd to 1.2 million tons, to meet the requirements of increasing population. Available information indicates that marine fisheries has reached maximum sustainalbe yield (MSY) and further major increases may not be possible. This makes imperative that any efforts to increase production have to concentrate on inland fisheries. Increasing fish production from rivers and estuaries, would be difficult if not impossible. Hence, stress needs to be laid in increasing production through aquaculture. There is ample scope for intensification of aquaculture in closed waters (ponds), in view of the low productions being presently obtained, but this alone may not be able to meet the increasing demand. Hence, possibilities have to be looked at, and efforts made, to enhance production through stocking of artificially grown fingerlings and managed fish harvesting in large water bodies, known as culture-based fisheries or enhanced fisheries, to improve rational utilization of inland waters.

POTENTIAL FOR CULTURE BASED FISHERIES

Vast inland water resources in the form of 2.8 million ha of floodlands (haors), 114,161 ha of beels, 5,480 ha of ox-bow lakes (baors), offer opportunities for increasing production through stocking of appropriate species, accompanied by managed harvesting.

Ox-bow lakes (baors)

In the south-west region of the country, some of the rivers changed courses and in the process left ox-bow bends, which got cut off from the main rivers and became isolated, forming ox-bow lakes (baors). These ox-bow lakes, covering a total area of some 5,488 ha, are mainly located in the districts of Faridpur, Jessore, Khulna and Khustia. Some of these get connected to rivers or openwater system during monsoon period. Due to increasing fishing pressure, as a result of demographic growth and loss of fish migratory paths, fish production from ox-bow lakes has declined very much. Carps which formed the major component of catches along with predatory fish in the past, have declined, and this has led to increase in population of small fish, which cannot fully utilize the productivity of the lakes, resulting in low yields.

The ox-bow lakes development project implemented during 1980-85, in six ox-bow lakes covering a total area of 1,059 ha, has clearly demonstrated that the productivity of traditionally managed ox-bow lakes, could be substantially increased by application of lake management techniques, which include stocking with appropriate species of fish and managed fishing. Average pre-project productions of six lakes, have been increased from 143 kg in 1979-80, to 422 kg/ha, by 1987-88. There is wide variation in productions from different lakes, ranging from 87-642 kg/ha, which is probably due to different levels of management in different lakes. Also, the project has demonstrated that well being of fishermen could be improved through development of culture based fisheries. Income of fishermen has increased from Tk 750 (pre-project) to Tk. 3,509 (post-project).

With the assistance of IFAD/DANIDA, the Department of Fisheries (DOF) has embarked on culture-based fisheries development in 30 ox-bow lakes. While earlier, the lake's management was done by DOF on 60:40 share basis with fishermen, the project presently under implementation envisages management of lakes by licensed fishermen groups.

Fish production from ox-bow lakes during 1988-89, has been estimated at 1,321 tons or 241 kg/ha. This production could be easily doubled in 3-4 years, through implementation of culture-based fisheries.

Floodlands (haors and beels)

Being situated in the delta of three major rivers, the Jamuna, Padma and Meghna, which drain a vast catchment area, Bangladesh has one of the largest floodplains in the world. At the height of rainy season, some 5.4 million ha of land or one third of the country goes under water. Of this, some 2.8 million ha are deeper and retain water for periods ranging from 4-7 months and contribute to fish production (DOF, 1986). These floodlands which are mainly located in the greater districts of Mymensingh, Sylhet, Faridpur and Rajshahi, act as repositories for mineral and organic matter washed down by seasonal flooding, resulting in high primary productivity and play a major role in providing breeding, nursing and grazing grounds, for commercially important fish species. Floodplains play a primary role in repopulating and increasing fish production in open water fishery system, including rivers and estuaries.

Estimatedly, 10 million rural households depend on floodlands for their subsistence fishing. Hence, floodplain fisheries play an important role in the nutrition and incomes of rural households. Various flood control, drainage and irrigation projects being implemented in recent years, has resulted in (i) reduction of habitat, (ii) inhibition of breeding and feeding migrations of fish, (iii) reduction in productivity of floodplains and (iv) decline in fish production. As migration of fish is made difficult, if not impossible, the composition of species in floodplains, is changing in favour of sedentary species, which are of little economic value. The beels in Sunamganj area, where major carps constituted 66.4% of total catch in 1967, was reduced to a meagre 1.3% by 1984 (Tsai and Ali, 1985). Another example is the Chandpur Irrigation Development Project, where, within 2 years of completion of the project, fish production was reduced by 35% and major carps were replaced by small cyprinids and predatory cat fish (MPO, 1987).

Due to this, production of fish from floodlands and beels is on the decline, showing an annual decline of 2.4-2.9%, during the period 1983-84 to 1987-88. Fisheries from floodlands contributed some 200,616 tons or 26.6% of total fish catch during 1983-84, which has declined to 182,037 tons or 22% of the total catch, by 1988-89 (Table 1). This decline from floodlands, which form the breeding and nursing grounds of commercially important species, is resulting in reduced recruitment to the riverine fisheries, as evident from the declining trend in riverine catches, in parallel with floodland catches. River and estuarine catches have shown an annual decline of 2.9% (Table 1). Thus, any effort at developing fisheries in floodlands, is likely to result in enhancement of riverine fisheries.

Floodlands with their associated beels, are rich in nutrients and combined with optimum temperature and intensive radiation available for primary productivity, should result in high fish productions. Presently, production from floodlands has been estimated at 64 kg/ha. As detailed earlier, this low productivity is due to decline in population of fast growing carps and replacement by uneconomical small sized fish, which cannot fully utilize productivity of these waters. It would be possible to increase fish productions, if the floodlands and beels are stocked with appropriate mix of fast growing speices, that could utilize full productivity of these waters.

In the absence of any experience in stocking floodlands in Bangladesh, it is difficult to accurately predict the productions

from these waters. While management practices have been developed for increasing fish productions 2-3 times from perennial water bodies like ox-bow lakes, through stocking of fish fingerlings that use unutilized niches, the same management practices may not hold good for seasonal flooplains, which have a different ecosystem, necessitating development of a different management system. Production from floodlands is not only dictated by productivity of the waters and food availability to fish, but also by many other extraneous factors. Rainfall, water retention time and fertility of watershed, survival of stocked fish from natural and human predation etc., determine the production potential of different floodlands. Even if a production of 250 kg/ha could be achieved, it would mean an incremental production of 186 kg/ha. If 25% of floodlands (of total 2.8 million ha) could be stocked, theoretically, it could result in an increased annual production of 130,200 tons of fish, valued at some Tk. 3,906 million. One should not get carried away by these figures, since stocking large areas of floodlands would be feasible, if only management problems involved in such a massive operation, are taken care of. As against a production of 182,000 tons of fish from floodlands during 1987-88, the Government has set a target production of 237,000 tons by the end of Fourth Plan, which means an anuual growth of 3.8% which might be difficult, if not impossible. For the floodplain fisheries development to be successful through stocking of fingerlings, it would be necessary to assess the bio-technical feasibility, economic viability, equitability and sustainability of the operations.

MANAGEMENT ISSUES

i) Bio-technical feasibility

The main input required for culture-based fisheries, like in any other culture operations, is fingerlings. While stocking of 2-3" size fingerlings is a common practice in pond culture operations, advanced fingerlings of 4-5" size would be needed to survive the vagaries of nature in openwaters. Stocking in perennial water bodies like ox-bow lakes and beels, can be done any time of the year, depending on availability of fingerlings. However, in case of floodlands, stocking needs to be initiated by May, when the flooding of low lying areas begin, in order to make maximum utilization of flooding time, for the growth of fish, before the

floodwaters recede. If the fingerlings are to be available by May, nursery operations have to start by March. Considering the vast area of floodlands, fingerlings requirement would be enormous. The Second Aquaculture Development Project funded by Asian Development Bank and the Third Fisheries Project funded by the World Bank, which propose to stock around 100,000 ha of floodlands during 1992, would alone require over 520 million or 1,300 kg of *spawn* (hatchlings) (ADB, 1989; World Bank, 1990). Since riverine *spawn*, which still is a major contributor to fingerlings production, will not be available till April-May, entire requirement for floodplain stocking will have to come from hatchery produced *spawn*.

Spawn production from public and private hatcheries during 1988 has been estimated at around 6,849 kg* - 1,152 kg from Government hatcheries and 5,697 kg from private hatcheries (DOF, 1990). An analysis of spawn production during different months, in Fisheries Research Institute hatchery during 1991, indicates, that, of total 407 kg produced, only 57.9 kg or 14.2% was produced till March (Fig. 1). If this is the general trend in all hatcheries, then of the total 6,849 kg spawn produced by public and private hatcheries during 1988 (the year for which, production figures are available from DOF),only 972 kg would have been produced by March. This indicates that the entire spawn production till March in 1988, would not be enough even to meet the requirements of stocking 100,000 ha of floodlands being developed during 1992 by two projects funded by the Asian Development Bank and the World Development Bank. If necessary steps are not taken to increase production, it is likely that small scale aquaculture will suffer at the cost of floodplain fisheries development. Further, all carps do not breed by March and even if they do, their percentage will be low. Hence, brood fish management, for inducing early maturity in carps, is necessary.

While establishing hatcheries to meet the demand of floodplain stocking, one should take into consideration the demand for *spawn* beyond March/April in the area, as floodplain fisheries requirement beyond that period will be almost nil. If this is not done, the newly established hatcheries would turn out to be white elephants, in the absence of demand for *spawn*.

Species and number of fingerlings to be stocked in a given area, for optimun production, depends on the productivity of the water body, in terms of plankton and benthos, and length of flooding time. Each floodplain has a different ecosystem and productivty; hence, it would be necessary to have atleast a preliminary understanding of the dynamics of these waters, so that, species, number of fingerlings required for stocking, time and place of release, could be assessed.

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* 1 kg carp spawn = Approximately 0.4 million hatchlings.

Since floodlands are widely dispersed and located away from fingerling producing centres,, stocking necessitates transportation of fingerlings over long distances by road and water ways. Transportation of millions of fingerlings of 4-5" size, would pose a major problem, unless, the fingerlings are produced within or near to the floodlands to be stocked. If the fingerlings are raised within or near floodlands, it could (i) create employment for local people/fishermen and (ii) will not compete with fingerlings requirement of other small-scale aquaculture activities. There is no experience of raising fingerlings in beels within floodplains (some of which are as big as 20-30 ha); hence, suitable management techniques/tools need to be developed.

Some of the fingerlings stocked in floodlands are likely to escape to rivers, extent of which is difficult to assess. Though, escape of fingerlings from floodlands will be a gain to the riverine fisheries, floodplain fisheries management by private sector would not be sustainable, if the escapes are considerable.

While selecting species, effect of exotics, on the native species, needs to be given due consideration. For example, tilapia which accidentally escaped into Kaptai Lake, forms 7.5% of the catch, within 5 years of its getting into the lake. In an Indian reservoir, silver carp got accidentally introduced; and forms 92% of the total catch, replacing native carps (A.G. Jhingran, personal communication).

ii) Equitability

Equitable distribution of benefits should be given due consideration, if culture-based fisheries development has to be successful. Estimatedly, 10 million households are involved in subsistence fishing in the floodplains, in addition to large number of full-time and part-time fishermen. Culture-based fisheries development would involve restricting/prohibiting fishing for 2-3 months after stocking. This could result in (i) lowering of fish intake and nutrition of households along floodplains during certain period, (ii) increased expenditure to rural households from buying fish from other sources and (iii) seasonal unemployment of full-time fishermen. Displaced fishermen could be beneficially employed in fingerlings production, for stocking. Management of floodlands should involve participation and equitable distribution of benefits, to the depressed fishing community and rural poor.

Also a question arises whether the establishment of additional hatcheries and nurseries needed to meet the demand, should be in

public or private sector. Since private sector has amply demonstrated its capabilities in meeting the demand, with very low investment, the Government should consider leaving this to private sector.

iii) Economic viability and sustainability

For the culture-based fisheries enhancement to be sustainable, it is imperative that the development programs are self financing, on a recurrent cost basis. Taking into consideration the vast area involved, investment costs are expected to be high. It is necessary to establish the economic viability of the operation and develop a mechanism for management of the operations by the private sector, especially the weaker section of the community - fishermen.

CONCLUSIONS

Vast potential exists for increasing productions from ox-bow lakes, beels and floodlands, to meet the increasing demand for fish. In the absence of experience in culture-based fisheries development in floodlands, and vast area and investment involved, it would be necessary to develop management techniques, in the process of the implementation of the two floodplain fisheries development projects presently in operation, to make the operations bio-technically feasible, economically viable, socially acceptable and sustainable.

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Table 1. Fish production, growth achieved and target growth by end of Fourth Five Year Plan (FFYP) (1994-95)

Type of fisheries	Fish Production 1983-84	1987-88	FFYP Target (1994-95)	Annual growth rate % 1983-84 to 1987-88	FFYP target annual growth rate % (1987-88 to 1994-95)
Inland capture					
River and estuaries	215,549	191,883	246,000	-2.9	3.6
Floodlands	200,616	182,037	237,500	-2.4	3.8
Beels	51,373	45,610	67,600	-2.9	5.8
Kaptai Lake	4,057	4,068	7,500	0.1	9.1
Subtotal	471,591	423,598	558,600	-2.7	4.0
Inland culture					
Ponds	107,944	149,423	308,400	8.5	10.9
Baors	862	1,254	5,500	9.8	23.5
Shrimp farms	8,219	25,248	46,650	32.4	8.8
Subtotal	117,025	175,925	359,550	10.7	10.8
Marine					
Industrial	14,500	10,395	15,600	-8.0	6.0
Artisanal	150,382	217,187	255,300	9.6	2.3
Subtotal	164,882	227,582	270,900	8.4	2.5
Inland total	588,620	599,523	918,100	0.5	6.3
Marine total	164,882	227,582	270,900	8.4	2.5
Bangladesh total	753,502	827,105	1,189,000	2.4	5.3

Fig. 1 – Spawn production during different months at FRI hatchery

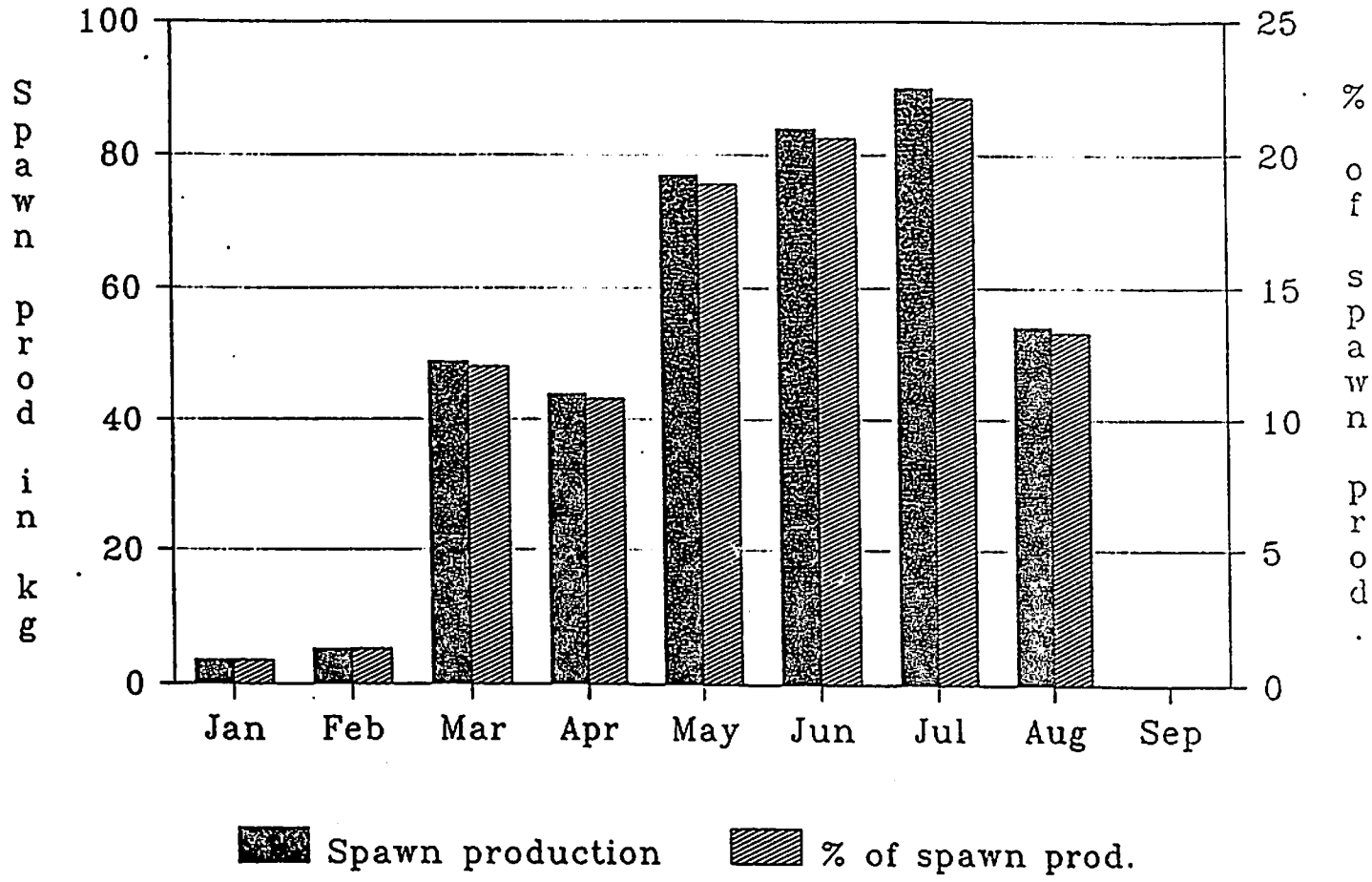
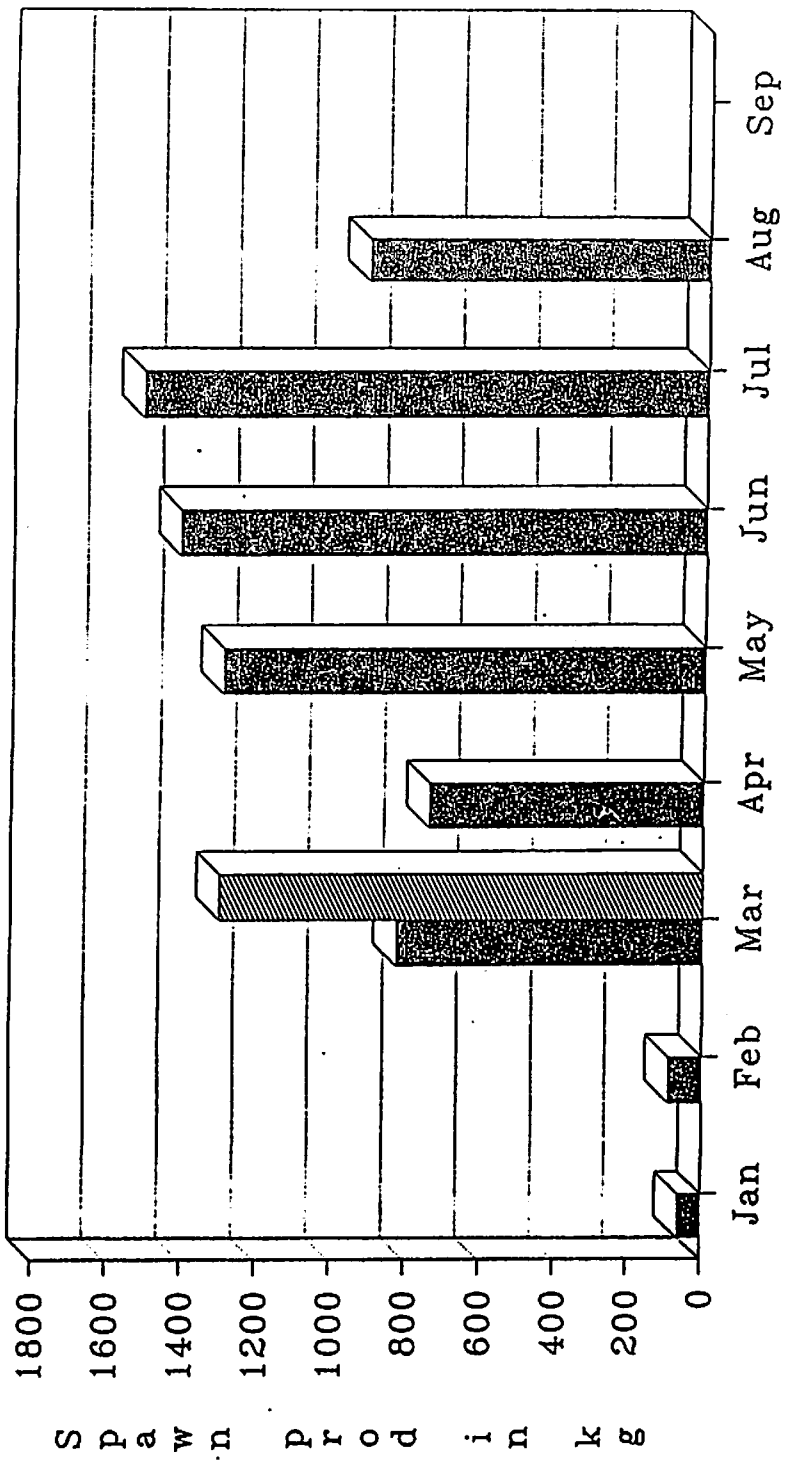


Fig. 2 – National hatchery produced spawn during 1988



Institutional Arrangements and Management Needs for Culture-based Fisheries in Bangladesh

by

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(ICLARM)

Paper for presentation at the Workshop on Inland Aquaculture Development Startegies for Bangladesh, organized by BARC/ICLARM/USAID, 29 September - 1 October 1991, BARC, Dhaka.

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Introduction

Utilization of hatchery spawned fish seed for building up populations of selected species or for enhancing existing populations in openwaters such as streams, lakes, reservoirs, lagoons and sea areas are increasingly considered for improving the productivity and profitability of capture fisheries around the world. Popularly known as culture based fisheries this type of program is a stage intermediate between ordinary fishing from natural stocks and extensive fish culture in impounded waters (Pillay 1990). In Bangladesh the value of such human intervention in enhancing its inland fishery resources have been demonstrated by the degraded state of natural stocks of a number of aquatic species. Population of carps in many floodlands, beels and rivers which were decimated by excessive fishing or environmental degradation could possibly be rehabilitated through continued stocking of hatchery reared young fish (World Bank 1991).

Earlier, application of this concept in six oxbow lakes in the western part of the country has shown that production could be increased by about three times (350 kg/ha/year) from the level normally obtained from ordinary fishing from natural stocks (GOB/IFAD/DANIDA 1991). Recently, the government through the support from IFAD and DANIDA has taken initiatives to replicate the concept to as many as 35 oxbow lakes covering over 2,200 ha of water area. Extending the concept for development and enhancement of fisheries in the floodlands where actual productive season is about six months a year, the government has also undertaken massive stocking programs in selected beels within the floodplains under two separate projects supported by ADB and IDA (World Bank), respectively. These programs will cover more than 400,000 ha of floodplain areas in five to six years time and are expected to raise yield to 300-700 kg/ha/year from floodland and oxbow lakes from the present level of 60-200 kg/ha/year.

It is assumed that once significant production increases are demonstrated through project initiated stocking programs, private sector and fishermen will undertake its continued operations on

a profitable basis. The key to the success of such intervention is that stock can be located and harvested in sufficient quantities to give good economic returns, and that the returns reach the intended beneficiaries. There are a number of constraints to be overcome, however. Broadly, they can be grouped into a) bio-technological, b) environmental and ecological, c) legal and institutional and d) management and socioeconomic.

Bio-technological constraints relate to the relatively high cost of producing juveniles, the competing demands of the aquaculture industry and the uncertainty of recovery of fish once they have been released into open waters. Environmental and ecological problems include limited critical habitats, loss of stocks by predation, competition for food, spread of parasites and pathogens, loss of biodiversity and changes in natural aquatic habitat. Legal problems arise out of the dispersed nature of the water bodies whose sizes and shapes as well as use and ownership rights change temporally or seasonally. Regulatory management of culture-based fishery uses of the floodlands and lake environments will also be constrained by the presence of customary use rights of multisectoral users and problems associated with subsistence fishing by occasional and part-time fishermen. Similarly, present instututional arrangements are inadequate and may take a long time to delineate inter institutional responsibilities and line-up needed institutional inputs.

Nevertheless, it is assumed that basic technology is productive enough to encourage private operators to participate in the experimentations, and government research and extension activities will be directed toward the identification of major environment types and on-site pilot studies (IFAD/DANIDA, 1991; World Bank 1990).

Besdies the bio-technological considerations the success of this new fisheries regime will need the support of political and social interest groups as well as public sector coordinations. Similarly, widespread dissemination of the technology through participation of private sector and fishermen will require a strong institutional assistance and a sound management mechanism.

The purpose of this paper is thus twofold: (1) identify areas of institutional support for culture-based fisheries; and (2) discuss management strategies for the development and sustenance of culture-based fisheries.

Institutional Support Needs of Culture-based Fisheries

Culture-based fisheries are more comprehensive than either land-based aquaculture practices or traditional fishing on the naturally available stocks, for it needs to deal with far more complex issues of socio-cultural, bio-technological, economic (including distribution and equity), legal and institutional factors. Stocking programs in the large bodies of water will not only present greatly improved opportunities in terms of larger catches and increased income, it will also mean a siginificant pre-harvesting investment expenses to both public authority and private sector participants and fishermen. The risks involved in investing capital in fingerling stocking and its protection prior to harvesting, are also quite high. In this respect institutions government departments, development NGOs, financial institutions and community organizations of fishermen and farmers can play a significant role. Building of necessary infrastructures, providing of technical, physical, financial and organisational inputs, implementation of management guidelines and protection of user rights are many functions that these institutions can undertake (Figure 1).

1. Integrated Development and Management

Mutiple uses and user conflict as well as interdependence of various lake or floodplain based activites underscores the need to view culture-based fishery as part of the entire lake or basin system. As such, development and management of culture-based fisheries in inland open-waters will need to follow a basin-wise approach, integrating fisheries management with the development of other lake/floodplain dependent operations as well as with those of upstream and downstream activities. Institutional assistance will be needed to create alternative livelihood and supplementary income sources for the displaced groups (e.g., occasional fishermen, landless and marginal farmer class) and opportunities for involvement by rural women within the lake or basin system.

2. Infrastructure Support

Institutional support will be needed for systems modifications, e.g., building of initial structures for control of mass migration and escape of fish as well as for building of roads, electricity, landing platforms, coldstorage, etc.

3. Extension and Training Services

Such services will be required in stocking and harvesting of floodplains as well as in the upstream (e.g., hatchery and nursery operations) and in the down stream (e.g., processing, transporting and marketing). There will be a need, at least in the formative stage of culture-based fisheries regime, for institutional assistance for awareness creation, motivation and group formation to undertake community level management responsibilities.

4. Financial Support

Adequate financial assistance package for investment in hatchery, nursery and stocking, gear and equipment, processing, transporting and marketing should come from institutional sources.

5. Regulatory Protection and Management

This is essential for limiting the undesirable entry and operations in the culture-based fishery environments as well as to ensure the security of tenure of the private sector or fishermen who would make direct investment into the culture-based fishery environment.

5. Multi-sectoral Use Rights

Institutional backing (for instance, support of community organizations) will be needed in dealing with multi-sectoral use rights. In order for joint multiple use by different user groups of the floodplains and lakes to co-exist community (users) defined delineation of use rights should evolve through institutional support.

6. Distribution of Benefits and Equity

To enable poor fishermen to avail improved opportunties and realize the stream of benefit generated from culture-based fisheries adequate institutional support and protection will be necessary. Assurance of due share of catch, rights to catch fish and protect investment, access to inputs, credits, extension advice, better price, all will require substantial instiutional support and assistance.

Functional Role of Institutions

1. Government Departments

Public sector or government departments will play a key in the dissemination of culture-based fisheries technology, at least in the early stage of its development. Again, it is through the assistance of public departments that legal impediments to the user rights and their protection can be removed. Thus, the role of governemnt departments will be to develop infrastructure, provide technical services, trainings and extension assistance as well as to implement regulatory provisions for the protections to the resources and to ensure guranteed access to the user groups. However, such functions of the government departments should be tied of with NGO activities as well as with the active involvement of the community.

2. Development NGOs

Group formation. NGOs will be useful in formation of management groups and other groups interested in upstream and downstream activities. Groups are viable entities than individuals in performing many necessary functions of this new fisheries regime. Groups can be financed with credits, provided trainings and extension, issued licenses, and made to perform production management functions and implement self regulations.

Credit and marketing assistance. Since NGOs work in non-conventional credit disbursements they should be encouraged to organize fishermen and provide them with necessary credit facilities and marketing assistance. Generally, non-institutional credits are tied with collection, transport and marketing arrangements for fish. When such credit lines are cut-off these arrangements are also affected. Thus credit services by NGOs should be integrated with alternative arrangements for marketing services.

Extension and Training. Given the limited capacity of public extension department NGOs can be made an important source of extension and training services. Creating awareness and motivating and promoting sense of collective responsibility and resolution of conflicts through advises and trainings should become part of NGO operations in fishermen communities.

Assistance in Management. Implementation of programs such as license limitations to genuine fishermen can benefit from NGO involvement. NGOs can assist in the identification of fishermen and act as a catalystic agent or go between in the process of regular issuance of license (by the public department) and compliance of license requirements (by the fishermen). Fishermen should be organized, through NGO assistance, to increase environmental consciousness and to participate directly in the licensing and traditional auction system used to allocate fishing rights.

3. Financial Institutions

Requirements of investment for hatchery and nursery operations, fingerling stocking and their protections, gear and equipment acquisitions, processing, transporting and marketing activities will place higher demands on financing. Credit facilities of the banking institutions should be available to private fishermen and private investors for these activites.

4. Community Institutions

Community institutions will include all formal or informal organizationsand groups, local body or leaderships of fishermen, non-fishermen, farmer or any other social or economic entity. Such groups of fishermen would take responsibility of organizing stocking, harvesting and marketing. The protection of stock during critical stage from poaching and other damages through persuasive agreements with other groups and imposition of self regulations amongst the fishermen group will be an important role of community institutions. Other advantage of having organized fishermen group will be its ability to enforce production management rules (e.g., fishing quota, size limitations, seasonal closure and gear restrictions) and minimize conflicts amongst co-fishermen.

Fishermen's organizations can enhance the communication process between public fisheries managers and the industry, which becomes difficult due to the fact that individuals in the industry are often scattered all along the floodplains, often in communities lacking all weather roads resulting in their isolation during the rainy season.

The presence of organization of other user groups will help arriving a consensus on an optimum, equitable and conflict-free utilization of resources through inter community dialogues or other peaceful means.

Management Strategies for Culture-based Fisheries

Fishery management commonly refers to various kinds of controls and measures that would regulate exploitation and use rights in open-access waters. The type and intensity of management measures will depend on the objectives toward the use of the resource or its products. Traditionally, fishery was viewed as a source of revenue to the government and such revenue was earned through auctions mainly to non-fishermen bidders.

The new fisheries management policy (NFMP) contemplates to improve the productivity and sustainability of fisheries and improve equity for fishermen by providing fishing rights directly to fishermen. Focusing its attention on ensuring social welfare and environmental and resource sustainability NFMP has been casted as a long term scheme for development and management of fisheries. Its main elements have been to a) identify the target group (genuine fishermen), b) organize them into groups, c) provide needed technical, marketing and credit facilities, and d) issue licenses, to allow fishing in well-defined water bodies (Jalmohals). Development of fish sanctuaries, and strict enforcement of Fish Act 1950 are also an essential element in NFMP..

With the emergence of culture-based fishery the need for management will become indispensable, for management will not only institute a new property regime, it will also create conditions for a new sustainable system of production. Further more, its benefits should also be equitably distributed.

It may be necessary to follow NFMP guidelines in the management of culture-based fisheries with reinforced arrangements for institutional support and community involvement. The objectives of the management would be to: 1) establish protected rights of culture-based fishery operators, 2) protect customary use rights of other users, 3) enforcement of production management rules for

sustained production and profit, 4) ensure an equitable distribution of benefits, and 5) recovery of public investment and resource cost.

Several of the following approaches will be necessary to adopt in order to realize the above mentioned objectives by the management.

1. Community (user) defined delineation of use rights

Floodlands and other lake environments of Bangladesh are multiple resource systems. It already furnishes local communities consisting of fishermen, farmers etc. with consumable products and provide critical inputs to local agriculture. Farmers and fishermen, all have acquired customary or local rights to use and benefit from the floodlands or lake environments.

Culture-based fishery operators who will be a sub-group within the community will definitely need to establish a protected claim on the appropriation of fish from the floodlands and lake environments for their continued operations and investments. This will create a new property regime into the already existing ones. Public sanction for this may not be difficult as there is already the NFMP in-force that proposes mechanisms for such exclusive claims (e.g., issuance of licenses to genuine fishermen).

But the success of this regime will depend on the degree to which its rights are recognised by the others who do not have such rights but would enjoy other use-rights. It will also depend on the extent to which the exercise of culture-based fishery operators' right in stocking and harvesting is not detrimental to the exercise of established customary rights and vice versa.

Thus, local users are the ultimate managers and protectors of multiple resources of the floodlands and lakes. In order for joint multiple use by different user groups of the floodplains to co-exist, community (users) defined delineation of the use rights should evolve.

2. Collective union of culture-based fishery operators

Fishery operators of a particular floodlands or lake area should function as one collective unit. Collective authority, self discipline and technical capacity are essential requirements for

carrying out timely stocking, instituting harvesting restraints during critical growth periods, maintaining of fish migration control structure or other facilities related to stocking and post-stocking protection, and planned harvesting and marketing to maximize production, and to minimise user conflict.

3. Management committee of user groups

Multiple use by diffferent users (simultaneously and periodically), e.g., for fishing, irrigation, jute retting and crop planting, should be taken into account in the management of artifically stocked waterbodies. There should be an effective mechanism through which all uses and rights of all users are protected. Licensing may provide fishing rights only to the culture-based fishery operators. But this can not over turn the rights of other user groups, which are customarily or locally recognized. Issues to be resolved are determination of deeper floodplain/lake area during different seasons, fishing rights of farmers whose land is subject to seasonal flooding and access to seasonally flooded land. Persons who would not qualify as fishermen for license may still access miscellaneous fish and partake in upstream and downstream and productive level activities. A management committee comprising members from various interest groups would help arrive at decisions amongst groups to achieve an optimum, equitable and conflict free utilization of resources.

4. Self regulation of culture-based fishery operators

Enforcement of production management rules will be part of group responsibilities. Number and type of fishermen participating in the harvesting should be based on the concept of permissible/allowable harvest. If stocking, protecting, harvesting become a group activity rather than individual functions it is possible to reduce fishing pressure by group consensus and shifting labour and capital to upstream (hatchery and nursery) and downstream (processing, transporting, distributing, and marketing) activities. Sustainability of the industry will depend on the capacity of the group to organize stocking, enforce production management rules and maintain and service the structures related to culture-based fishery.

5. Licensing and leasing limitation to genuine fishermen

This appears to be a sound mechanism to ensure entry into the fishery by deserving user-groups, provided its implementation is linked with NGO activities and community involvements. This kind of restriction has positive distributive and equity impacts, for benefits arising out of culture-based fisheries can be derived directly by the licensed fishermen. Also, where possible, by introducing limited and selective licensing scheme uneconomic efforts and resources wastage can be reduced. With guaranteed use rights, communities themselves can develop mechanisms for protection of resources. It establishes a sense of ownership of fishery resources to specific areas by the tenure holders and therefore, eliminates problems associated with common property resources. It is in the best interest of the fishermen who control specific area not to overharvest or early-harvest in order to maintain a sustained catch.

Licensing or leasing can also be a means of recovering public investment and resource cost by attaching the provision of appropriate fees with the license or lease requirements.

Conclusion

Some of the management concepts and institutional assistance discussed in the previous sections are being applied through the ongoing floodplain and oxbow lake fishery development programs of the department of fisheries. Learning by doing at this stage of technological development has high pay-offs, and the government research and extension activities should be closely coordinated. Emphasis should be on the identification of major environment types and on-site pilot studies with alternative institutional arrangements for support services and management. The extension process itself should be rationalized. There might be large gains if public extension programs (with their limited resources) can tie-up NGO activities.

Overall, as a measure of success management and development institutions have to ensure that fishing effort has been restricted, conflict and competition among the fishermen and those with the other user groups has been reduced, cooperation amongst fishermen has been encouraged,

equitable distribution of fishing opportunities has resulted, individual benefits has increased, and production has increased without further depleting the stock.

DOF will need to expand its investment in support services to perform its managerial, extension and technology transfer responsibilities over the fisheries. Recovery of public costs should not be an immediate concern. If an effective institutional framework can be developed and a direct beneficiary group established with their rights secured and protected, proper amount of taxation should not be a problem to recover public costs through the leasing or licensing mechanisms. Inter-agency cooperation is a prerequisite to the development and management of culture-based fisheries which stress on socioeconomic and institutional factors as well as technology transfer.

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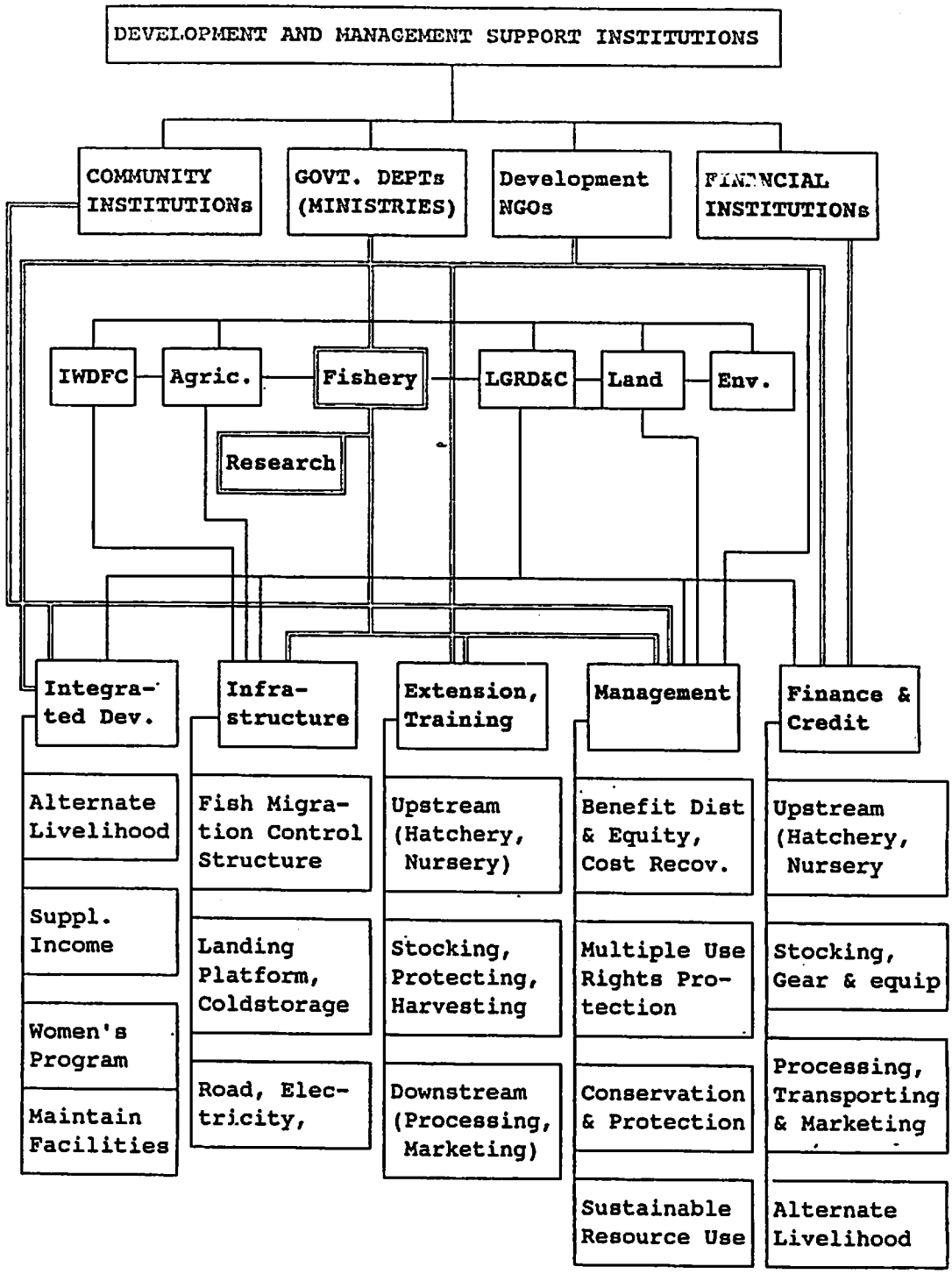

Figure 1. Institutional Arrangement for Development and Management of Culture-based Fisheries

OX-BOW LAKE FISHERIES DEVELOPMENT IN BANGLADESH AND LESSONS LEARNT

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INTRODUCTION:

Bangladesh has considerable inland aquatic resources in the form of rivers, canals, baors(ox-bow lakes) haor, beels, lakes, floodplain and ponds in addition to marine aquatic resources. Contribution of inland fisheries is 72 % in the total fish production of the country (8.41 m. tons). Annual increase of fish production in recent decades can not cope with the rate of population growth of the country, thus reducing the per capita fish consumption from 13 kg in mid 1960s to 8.3 kg at present. The Ox-bow lake fisheries development is one of the several measures adopted by the government of Bangladesh to restrict the declining trend.

OX-BOW LAKES :

Ox-bow lakes are mainly found in the south-west part of the country i.e. in the districts of Jessore, Jhinaidah, Choadanga, Khustia and Faridpur. There are more than 100 ox-bow lakes in this area comprising a water area of 5,488 hectares. Ox-bow lake is one of the important and managable inland fisheries resources of the country. It is locally termed as Baor. These are the remaining parts of the dead rivers, generally horse-shoe shaped. They were created by the delta-building activities of the rivers thousand years ago. Most of the ox-bow lakes form the natural drainage system of the

locality and water is collected during rainy season through the canals and through seepage from the sorrounding area. These are the age-old water bodies, many of the lakes are covered with floating weeds mainly water hyacinth which occupy 20-80 % of the total water area. The transperancy of lake water is generally high (1.5-2.5 m) due to heavy infestation of aquatic weeds which reduces the plankton and other algal growth in the lakes, eventually it affects the fish production in the lakes. Ox-bow lakes do not represent the profile of lake, but a large, seasonally over-flooded ponds. Due to its large water area it can not be managed intensively as that of pond. The non-developed lakes have their larger connection through channels with other larger water bodies or even with rivers during monsoon. At that time an insignificant natural recruitment of fish fingerlings (carp) takes place. Due to above condition fish production in the non-developed lakes are as low as 50 - 60 kg/ha per year. Total fish production in all the lakes was 1,254 m.tons in the year 1989-90.

Since time immemorial fishermen community has been maintaining their livelihood on fishing in the lakes. With the increase of the fishing pressure and decrease of fish population their socio-economic condition declining sharply. The non-developed lakes are usually given on lease to individuals or rarely to fishermen co-operatives. As a result the fishermen are exploited by the lessee during fishing. Some of the small lakes are stocked with a few number of fingerlings by the lessee or owner.

OX-BOW LAKES DEVELOPMENT IN BANGLADESH :

With a view to increase fish production in the lakes, communiy development in the lake area, uplift socio-economic condition of the poor people in that area and to develop lake management technology and technical man-power an Ox-bow Lake Development Project

came into operation in 1980-86 to achieve those objectives.

During the 1st ox-bow lakes development project period six lakes of 1,059 ha were developed, which are as follows:

Name of lakes	Area (in ha)
Baluhar	282
Joydia	189
Fatepur	47
Katgora	71
Morjat	253
Bergobindapur	217
Total	1,059

During the project period the activities such as construction of lake embankment, in-let,outlet culvert work, installation of bamboo fencing at the outlets, cleaning of floatigg weeds, construction of rearing ponds for fingerling raising, lake-fishery station, access roads etc. were undertaken very successfully. At the same time fishermen community was being organised to get them involved in the lake management practices. A trained DOF man-power on lake-management was developed by providing training to the staff and doing lake management work by themselves. Training and extension services were also extended to the fishermen.

FISH PRODUCTION:

All the above activities were aimed to increase fish production in the lakes and to give benefit to the poor fishermen. In the year 1990-91 a total of 452 m. tons of fish (carp) was produced in six lakes(developed lakes). Annual fish production in the six developed lakes are given in Annex- 1.

FISHERMEN'S INCOME :

It is noted that the total fish production in six lakes have increased 3-4 times than those were before the installation of the project.This development has played role not only in the field of fish production but also in the income of the fishermen community. Fishermen's income has increased substantially after the completion of the development of the lakes. About 786 fishermen are involved in the fishing activities in those lakes.Their income has increased to Tk. 3,509.00 from Tk. 750.00 . Fishermen's income is shown in Annex-2.

LAKE MANAGEMENT PRACTICES :

Lake management activities are mainly, (a) implementation of physical facilities (b) fingerling production (c) lake preparation (d) stocking with fingerlings (e) determination of harvesting quantity and period. Every year necessary physical development or repairing of infrastructure is done before stocking of fingerlings. Required quantity of fingerling for a lake is produced near the lake site to avoid unwanted hazards during transportation. Usually 1,800 - 2,500 fingerlings of 12-15 cm size are stocked per hectare annually. A substantial number of Silver carp (40 % or above) and Grass carp fingerlings are stocked, which contribute a remarkable quantity in production. Grass carp is playing an important role by controlling the growth of aquatic weeds in the lakes. Fingerlings were being stocked in the lakes during the period September - November but now stocked in January- October. This practice needs to be modified to a better system including appropriate time schedule. Harvesting of fish in the lakes remain suspended from July- October. Other fishes except carps are caught throughout the year.

The development project had introduced modern lake management technique by introducing six species i.e. Catla , Rui,

Mrigal, Silver carp, Grass carp , Mirror carp with different feeding habits. The introduction of this polyculture system is a major technological innovation in lake management in the country, although this technology still to develop further , which needs research on it. The lake management technology has played an important role on the private entrepreneurs who are trying to manage their lakes following this method.

FISHERMEN'S SHARE IN CATCH :

About a hundred of fishermen are involved in catching fish in each lake. They are grouped into a few goups headed by a team leader. The fishermen get 40% of the catch, remaining 60% is the DOF's share. The sale proceeds of 60% catch goes to the government fund. Other fishes except carps are caught by the fishermen throughout the year by paying Tk. 100.00 as license fee for a year.

MARKETING OF FISH :

Marketing of carp catches is done in Jessore and nearby districts. BFDC is also involved in fish marketing of the lakes. This organisation buy fish from the lakes at a pre-fixed price and provides direct link with the major urban markets of Dhaka and Khulna. The main determinant should be to get maximum price of fish to maximise the return of fishing groups. The main feature of the marketing policy should be to involve the fishermen in the marketing decision as to where, when and to whom to sale fish. Landless fish dealing people are already involved in small scale fish marketing. As the fish production in the lakes increases, other landless people will be drawn into this marketing profession.

SOCIAL IMPACT:

The 1st phase ox-bow lakes development project has shown a cosiderable impact on the society in the lake area. About 800 landless fishermen families' income has risen substantially from

Tk. 750.00 to Tk. 3,509.00 annually. (Annex-2)

As the road net-work has been established connecting the lakes for easy access, it is playing an possitive role in rural area around the lakes. It contributes significantly to the development of trade of agricultural and fisheries products in that area.

Poor landless non-fishermen people have got opportunity to get themselves in the fish selling in small scale level in the area to earn their livelihood.

SECOND PHASE DEVELOPMENT OF THE OX-BOW LAKES:

Under the 1st Ox-bow lakes development project only six lakes of 1,859 ha area were developed out of about 100 lakes of total 5,488 ha area. As the over all impact ofthe lake development is possitive, a Second phase ox-bow lakes development project is being implemented in 30 lakes of 2,160 ha area. Selection of terget groups with firm selection criteria for project support, credit facility to the fishermen and fish dealers, better marketing facilities, better lake management techniques, introduction of integrated aquaculture in the lakes, extension activities etc. are the main features of the 2nd phase of development. It is expected that on successful implementation of the project 6,500 fishermen families, 2,850 fish farmers and more than a thousand of women may be benefited with full time or part-time activeties.

OBSERVATIONS:

The technical validity of the lake management technique introduced in the lakes has been confirmed through the experiences. The yields from the six lakes have risen substantially.

More liberal organisational and financial systems need to be introduced for economic and physical viability of the lake operation and management.

Lake management system may be further developed. Present cost benefit ratio on lake management varies from 1:1.5 to 1: 1.7 . (expenditure including pay and allowances).

CONCLUSION:

Ox-bow lakes are well defined managable water bodies in the country comprising 5,488 ha of water area. Development of these water bodies and introduction of modern lake management techniques not only can contribute estimated 4,000 m.tons of fish inthe national production but also can uplift the socio-economic condition of a few thousand of poor people in the area. A sincere effort with financial and technical support can help in achieving the targeted goal.

ANNEX - 1

Lakes, Area, Production and Yield

(in fiscal year)

Lake	Area (ha)		79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	Remarks
Baluhar	282	m.ton	64	29	33	115	155	268	198	201	181	103	134	
		kg/ha	226	89	116	408	549	951	702	712	642	365	475	
Joydia	189	m.ton	21	7	13	56	24	72	77	95	119	73	110	
		kg/ha	109	39	72	294	126	376	403	499	630	386	582	
Fatepur	47	m.ton	2	2	4	4	3	9	10	8	7	15	22	
		kg/ha	52	42	86	86	72	200	205	161	158	319	468	
Katgora	71	m.ton	-	-	1	2	0.5	6	8	8	20	22	14	
		kg/ha	-	-	15	30	7.5	89	111	111	284	310	197	
Morjat	253	m.ton	19	15	16	22	11	25	14	22	22	23	30	
		kg/ha	74	59	62	86	43	99	55	86	86	91	119	
Bergobindapur	217	m.ton	36	21	28	21	23	32	21	87	97	80	60	
		kg/ha	166	94	128	94	104	148	94	400	447	369	276	
Total	1,059	m.ton	142	74	95	220	216	412	328	421	446	316	370	
		kg/ha	134	69	90	208	204	389	310	397	421	298	349	

ANNEX - 2

Fishermen's Income from Carp Production

Lakes	Without Project		At Completion	
	Carp production (m.ton)	Average income (Taka)	Carp production (m.ton)	Average income (Taka)
Baluhar	48.1	1,146	197.72	6850
Joydia	31.1	600	76.75	6,000
Fatapur	3.8	253	9.55	1,800
Morjat	14.4	462	14.22	485
Bergobindapur	32.1	1,100	20.53	1,450
Katgora	7.8	427	7.81	1,500
Total	137.3	750 /1/	326.59	3,509 /2/

/1/ Number of fishermen 600

/2/ Number of fishermen 786

ROLE OF PUBLIC AND PRIVATE SECTOR IN AQUACULTURE DEVELOPMENT

By

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Paper for presentation at the Workshop on "Inland Aquaculture Development Strategies for Bangladesh", organized by BARC/ICLARM, 29 September - Ø1 October 1991, BARC, Dhaka.

Paper 10

ROLE OF PUBLIC AND PRIVATE SECTOR IN AQUACULTURE DEVELOPMENT

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Abstract

Bangladesh has a great potentiality in inland and coastal aquaculture. However, coastal aquaculture is yet to be established on a scientific basis and even fresh water fish farming can be further intensified.

The role of various public and private sectors related to aquaculture development has been discussed. Some recommendations regarding avoiding complexities of all institution have been made.

INTRODUCTION

Aquaculture in Bangladesh is not without problems. Culture fisheries exhibit several unique characteristics and complexities which make their management very difficult but also very interesting for those involved in aquaculture management and research.

In the following paper, a brief account of the public and private agencies involved in aquaculture development is discussed.

Background

Bangladesh is uniquely rich in water bodies and offers tremendous inland fish production. However, advanced coastal aquaculture techniques have not yet been fully adopted. In overall production, over half a million tones are generated by the freshwater fishery resources, while only China, India and USSR produce more freshwater fish than Bangladesh.

The latest available data (1988-89) showed that the annual fish production from both inland and marine was 840,926 mt of which 72.3% originate from inland production. However, the culture based fishery contributed about 21.8% of the total production. The culture based fishery included ponds, baors and shrimp farms covering about 260,658 ha area of the country (BFRSS 1988-89). The large number of irrigation canals, road side ditches and enclosures also have great potential for aquaculture but still have to be included in

culture fisheries. Recently Govt. has undertaken some ambisions programmes of initiating culture based managed fisheries in flood plains and beels and baors.

Role of different Organization in aquaculture :

The key institutions involved in aquaculture development may be classified under various criteria in the country (Table 2). However, the fishery sector, are mainly menaged and owned by the public sector. Government agencies are involved in planning, research, promotion, development, management and conservation of fisheries. The participation of the private-sector in aquaculture development has increased in recent years.

Government Organizations

Ministry of Fisheries and Livestock (MFL) : It has overall responsibilities for fisheries development of the country. Administratively it has control over the government and autonomous agencies, such as the Directorate of Fisheries (DOF), Fisheries Research Institute (FRI) and Bangladesh Fisheries Development Corporation (BFDC).

Ministry of Land (ML) : ML is the owner of all large water bodies, including the rivers, beel's haors and baors. Our present interest in the permanent and seasonal beel or baors, termed as 'Jalmohal'. They are usually managed under a system of 'lease settlement - short time basis' by auctions to provide revenue to the Govt. The influential local lease holders usually donot take any measure for the improvement of the water body except exploitation of the aquatic resources. Indeed, the system now provides little or no inducement for them to do any thing else. Development requires that the water bodies should be properly managed for fish culture. Recently, under the New Fisheries Management Policies of MFL is providing longer term leasing and licencing arrangements which should encourage culture based fisheries with better management for such water bodies.

Ministry of Local Government, Rural Development and Cooperative (LGRDC) : It controls over the fishermen cooperatives through the Directorate of Cooperatives and Bangladesh Rural Development Board. Besides, it provides development policies of rual poor, collects revenue from small water bodies (upto 20 acres) and carry out fish culture activities in some these waters through cooperatives.

Ministry of Education : It is involved in the control of the fisheries-related education and research of Bangladesh.

Ministry of Youth and Sport's : It provides training and small scale loan to the youth in fish culture, through small projects. The ministry thus helping to develop fish culturists among the unemployed youths.

Directorate of Fisheries (DOF) : The Directorate of Fisheries is the prime organization responsible for the development and management of fisheries, inland and marine, in four administrative divisions of the country. It was set up in 1943 during British Rule as the Department of Fisheries and later redesigned in 1947 as the Directorate of Fisheries. Despite its acquite shortage of skilled manpower and intense institutional weakness the organization has been carrying a vital role in the introduction of improved aquaculture in the country. To make available or quality fingerlings in desired time the DOF operates 78 Fish Seed Multiplication Farms and 7 Hatchery. Several new approaches like, New Jahmohal Management Policy; openwater fish stocking; extension Shrimp culture still donot show any positive trend. Moreover, the extensioo programme for the improved fish culture is very poor in the organization. This may be due to the shortage of adequate trained manpower.

Semi Government Organizations

Fisheries Research Institute (FRI) : Since FRI was established in early 80's many of their research programmes are still to be completed and transfered to farm level. Financially it is linked with Bangladesh Agricultural Research Council (BARC), but for administrative purposes it is under MFL. It is hoped that a few integrated systems, as modified by FRI can now be offered to the country. Some joint venture programmes on aquaculture with BARC and DANIDA have been undertaken.

Bangladesh Fisheries Development Corporation (BFDC) : BFDC is administratively controlled by MFL, and is mainly involved in fish preservation and marketing sector. BFDC manages the Kaptai Lake and some of the other lakes of the country. Recently the DOF, handed over the Gulshan Lake to BFDC. However, this organization has had little experience of aquaculture in the past decade.

Bangladesh Agricultural Research Council (BARC) : BARC coordinates institutional contact and agricultural sector research in the country. As regards fisheries, most of the BARC funds were involved in the establishment and operation of FRI in its efforts to improve aquaculture practices. The origin of the fund was USAID, IDA and other

doner agencies. BARC also provides funds for training, higher study and seminars for improving the quality of research personnels engaged in aquaculture and other discipline of applied science.

Banks : Bangladesh Bank, Bangladesh Krishi Bank and some of the commercial banks of the country provide financial support for aquaculture.

Institutions : The great role on the development of the skill manpower is done by some universities of the country. A separate fisheries faculty has been founded at the Bangladesh Agricultural University at Mymensingh. However, the oldest institution in the study of fisheries is the Zoology Department of Dhaka University. Fisheries is also studied in the Zoology Department of the Rajshahi and Chittagong Universities. The only Marine Science Institute at present is in the Chittagong University. Some problems of funding and the availability of research facilities in aquaculture are evident in these institutions.

Non-Government Organizations : There are a number of NGO's operating in fisheries in the country. They can be classified into two types on the basis of their origin. The international organizations include Save the Children Fund, USA (SCF). Mennonite Central Committee (MCC), CARITAS, Oxfam,

etc. The local NGO's include BARC, Proshikha M.O.S., Gramin Bank, Comilla ROTARY etc. Many of the NGO's are now maintaining a positive approach to initiate improve aquaculture practice in rural areas. Thus they contribute and support in developing modern aquaculture in the country. Substantial and long term programmes on fisheries are being made by Gramin Bank, CARITAS, BARC, Proshikha M.O.S., and Comilla ROTARY etc. This includes hatchery development, seed and fingerling supply, pond improvement etc.

Achievement of GO's and NGO's in Aquaculture

The production of fish from culture fisheries has been slowly increasing in recent past. The national average yield of inland culture fisheries was 573 kg/ha in 1983-83. An increase by 23% (704 kg/ha) is withnessed in 1988-89. Among these culture fisheries the production level of ponds has increased by 44% (from 503 kg/ha in 1983-84 to 1055 kg/ha in 1988-89) whereas the baor fisheries has showed an enhancement by 54% (from 157 kg/ha in 1983-84 to 241 kg/ha in 1988-89). The shrimp production has also increased from 159 kg/ha in 1983-84 to 251 kg/ha in 1988-89). The above increase in production level showes that some betterment has been made towards culture fisheries through the introduction of improved aquaculture practices. But in comparison to

other countries like China, Thailand, India the aquired production level is meager and this achievement may be termed as a "Limited success".

Weakness of GO's and NGO's involved in aquaculture

A. Government Organizations :

The Directorate of Fisheries is the principle organization which is involved in aquaculture development. Despite the contineous developmental efforts those are undertaken by this organization toward aquacultural activities, the optimum production level from various waters is yet to be achieved. This failure is due to following flaws of various Govt. organizations entrusted with aquacultural development.

1. Lack of due priority in National planning :

Aquaculture sector does not get its due importance in national planning. The vast flood plain, which contributes the major protion of inland fisheries, has been contineously declining through flood control, drainage and irrigation projects with a view to enhance cereal production. The planners have not given enough importance to mimigate losses of fisheries through the development of improved aquaculture practices.

2. Lack of Enough Funds :

Aquaculture needs substantial investment for fish production, harvesting, extension and trainings. So enough fund should be pumped in to this sector.

3. Inadequate Support Services :

The aquacultural programmes should be supported by the development of other sectors such as improvement of access road, internal canals, processing and marketing facilities, fish landing centres, auction,shed etc. But the coordination and linkage among the various organizations entrusted with providing support services are not adequate which necessary for introduction of improved aquaculture practices

4. Shortage of Skilled Manpower :

There is an acquite shortage of trained and skilled manpowers in DOF to carry out the various aquaculture programmes. However, has taken up an ODA sponsored scheme to strengthen the skill and capability of its staff through training.

5. Limited Extension Service :

Introduction of improved aquaculture practice depends largely on the efficiency of extension service. Unfortunately

this section of DOF is very weak. As a result introduction of improved aquaculture practices through transfer of technology to farmer level is being zeopardised to a great extent.

6. Inadequate control over public waters :

There is no adequate Government control over public waters, such as beels, haors and other large water bodies. So it is difficult to initiate aquaculture practices in such waters.

7. Inadequate knowledge on the status of fisheries :

Govt. Organization occasionally do not have enough knowledge of the existing status of the fisheries where they intend to introduce aquaculture

8. Lack of enough fund for aquacultural research :

There is no adequate fund available for aquaculture research. Moreover the available fund is alloted to FRI only. So other organizations which have abilities to perform aquacultural fesearches do not have approach to this fund.

8. Weakness of NGO's involved in Aquaculture :

The NGO's have been putting substantial efforts for the improvement of aquaculture practices at farmer level. However, the NGO's also have some weaknesses to carryout the programmes. These are as follows :

(1) Lack of Enough Fund :

Aquaculture requires high investment. The NGO's are facing problems in arranging credits for their groups to initiate aquacultural programmes.

(2) High Rate of Interest :

The high rate of interest for a credit in various financial institutions are putting hinderance to initiate aquaculture in farmer level.

(3) Lack of technical manpower :

NGO's donot have enough trained and skilled manpower for initiating and monitoring the improved aquacultural practices.

(4) Lack of coordination and linkage with GOS's:

NGO's do not have desired coordination and linkage with the GOS which are responsible for aquacultural development. There is hardly any coordination among the various NGO's involving in aquaculture. Thus various NGO's involving in aquaculture fal to exchange their experiences among them and with GO's as well.

(6) Lack of any insurance cover against sudden loss of fish :

NGO's are not yet able to arrange insurance coverage against sudden loss of fishes due to natural calamity. Thus their groups engaged in fish culture are not interested to use improved aquaculture practice which requires high investment.

RECOMMENDATIONS

a) For Government Organizations

(1) More institutional strengthening, co-ordination and linkage among the various agencies involved in aquaculture.

(2) Allotment of more fund for initiating aquaculture programme

(3) Development of skilled manpower with intensive training on aquaculture.

(4) Strengthening of extension services with increasing manpower in the extension service.

(5) Arrangement of quick transfer of technology to farmer level.

(6) More fund for research in aquaculture.

(7) Alloted research fund for aquaculture should be available to all organizations engaged in aquacultural research.

b) For NGO's :

(1) More coordination and linkage among NGO's and concerning GO's.

(2) Arranging more funds for aquaculture with soft loan.

(3) Strengthening aquacultural activities with trained and skilled manpowers.

(4) Arranging more training on aquaculture to fish farmers.

(5) Popularise the integrated farming system to rural people.

Table 1. Trends, and growth in fish production and area of culture, capture and annual production

	1983 - 84	1984 - 85	1985 - 86	1986 - 87	1987- 88	Actual annual growth rate (%)	1988 -89	Target (FFYP) 1994 - 95	Estimated annual growth rate (%
CULTURE									
a. Ponds :									
Water Area (ha)	146,850	-do-	-do-	-do-	-do-		-do-	-do-	
Total production (mt)	107,944	111,567	123,804	142,876	149,423	8.5	155,012	308.900	10.9
Production/area (kg/ha)	735	760	853	973	1,017		1,055		
b. Baors :									
Water Area (ha)	5,468	-do-	-do-	do	-do-		-do-	-do-	
Total Production (mt)	862	962	968	1,174	1,254	9.8	1,321	5,500	23.5
Production / area (kg/ha)	157	175	176	214	228		241		
c. Shrimp farm									
Water area (ha)	51,812	64,246	87,300	87,300	87,300		108,280		
Total production (mt)	8,219	11,282	19,951	22,050	25,248	32.4	27,172	81,000	8.8
Production / area (kg/ha)	159	176	229	253	289		251		
d. Irrigation canal, road side ditches water enclosures (Total estd. production under culture)	*	*	*	*	*			20,000	
Culture sub-total (mt)	117,025	123,811	144,723	166,100	175,925	10.7	183.505	415.400	10.8
Contribution (%)	(15.5%)	(16.0%)	(18.2%)	(20.4%)	(21.3%)		(21.8%)	(34.6%.)	
CAPTURE									
Water area (ha)	4,047,316								
Total production (mt)	471,595	462,605	441,799	431,006	423,598	-2.7	424.140	558.600	4.0
Contribution (%)	(62.6%)	(59.8%)	(55.7%)	(52.9%)	(51.2%)		(50.5%)		
COUNTRY TOTAL (mt)	753,502	773,979	793,923	814,685	827,105	2.4	840,926	1,189,050	5.3
Contribution (%)	(100%)	(100%)	(100%)	(100%)					

Table 2. Some private and public institutions and their activities.

Organization(s)	Activities (see below for interpretation)
PUBLIC	
Ministry of Fisheries and Livestock	1, 2, 5
Ministry of Land	1, 3, 5
Ministry of local Government, Rural Development and Cooperative	1,6,15
Ministry of Forest and Environment	1,3, 5
Ministry of Agriculture	1, 3, 5
Ministry of Flood Control, Water Development & Irrigation	- 3, 5
Ministry of Commerce	16
Ministry of Youth and Sports	- 5, 7
Directorate of Fisheries	- 2, 3, 5, 6
Youth Directorate	- 5, 7
SEMI-GOVERNMENT /AUTONOMOUS	
Fisheries Research Institute	- 4, 5, 6
Bangladesh Fisheries Development Corporation	- 3, 13, 10
Bangladesh Agricultural Research Council	- 4, 5, 12
Bangladesh Rural Development Board	6.7
Bangladesh Water Development Board	.- 3,5
BANK's	
Bangladesh Bank	- 7
Bangladesh Krishi Bank	- 7

Table - 2. Continued

INSTITUTIONS

Bangladesh Agricultural University 4,8,17

University of Dhaka 4,9,17
Rajshahi University 4,9,17
Chittagong University 4,9,10,17

NON GOVERNMENT ORGANIGATION'S

Save the Children Fund, USA (SCF) 6
Mennonite Central Committee (MCC) 4,5,6
Bangladesh Centre for Advance Studies 4,5
CARITAS 6,7
Proshika Manobik Unnayan Kendra 6,7
Comilla Rotary 6,7
Bangladesh Rural Advancement Committee (BRAC) 4,5,7
Gramin Bank 7

INTERNATIONAL AGENCIES

Danish International Development Agencies (DANIDA) 4,5,11
Food and Agricultural Organization of the United Nations (FAO) 5,11
Ford Foundation 5,11
International Development Association (IDA) 5,11
International Center for Living Aquatic Resources Management (ICLARM) 4
International Development Research Center (Canada) IDRC 5,11
International Fund for Agricultural Development (IFAD) 5,11
Overseas Development Adminstration of the United Kingdom (ODA) 5,11
United Nations Development Programme (UNDP) 5,11
United States Agency for International Development (USAID) 5,11
World Food Programme (WFP) 11
World Bank 5,11
Bay of Bengal Programme (BOBP) 4,5,11
Canadian International Development Agency (CIDA) 5,11
Sweedish International Development Agency (SIDA) 5,11
many others..

Table contd...

1. Policy making 2. Adminstration 3. Law enforcing agency within its area 4. Research 5. Evaluation 6. Extension /trainning 7. Fishery loan 8. Fisheires Faculty 9. Zoology department 10. Marine biology institute 11. Fund/ aid/ doner 12. Conductibg contact research 13. Management of its area. 14. Fish marketing and distribut n 15. Licencing 16, Promote export.

- the end -

AQUACULTURE POLICY EFFICACY AND FUTURE DIRECTIONS

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INTRODUCTION

Current practices of aquaculture are spread within the domain of both public and private Lands stretching over the inland freshwater as well as brackishwater environments. The legal regime confronting aquaculture in public lands are the water resources laws and environmental laws, on the other hand, aquaculture in private lands is mainly governed by traditional Land laws. The purpose of this paper is to examine the existing legal regime, laws and regulations concerning aquaculture development in Bangladesh. Policies governing access to and use of water and land, environmental impacts, fish disease, import of live fish and introduction of exotic species and the *Zonation of Aquaculture* Areas are also discussed, as these will determine the future direction of the sector.

The objective of Aquaculture Development Policy should be to raise aquaculture, aquaculture-based capture fisheries to the level of an organized industry from the existing semi-subsistence level of activities. This has also to establish a mechanism by which the advance made in the technology of fish culture could be effectively disseminated for the purpose of increasing fish production both in larger water bodies by adopting uniform leasing and licensing policy suited to local fishermen/fish farmers.

POLICY CONSTRAINTS TO AQUACULTURE DEVELOPMENT

Aquaculture development are impeded in Bangladesh due to the following constraints: They are concisely - technological, environmental and socio-economical factors. Socio-economical factors may be short-termed leasing system of *Jalmohals* improper management plans, Fisheries done by irrevalent ministries/agencies, Multiple ownership of ponds and Jalmohals, lack of proper co-operatives, lack of awareness of the people about the valuable aquatic resources, poaching, non-existence of laws and regulations and policy, control of fishing rights in inland waters done by various agencies, and many others.

This National Workshop emphasizes the desperate need for a National Policy and appropriate legal framework to facilitate the development of aquaculture enterprizes. Land Reform and Land Consolidation acts should be reviewed and designed afresh and made effectively beneficial to aquaculture development. Where the existing laws limit the area of land that can be owned by the farmer, it is necessary to examine the limitations against the minimum size of aquafarms for higher economic production. There is a close similarity between the requirements of agriculture and aquaculture in so far as legal provisions and incentives are concerned, and efforts should, therefore, be made to extend relevant clause of laws relating to aquaculture developments in Bangladesh.

AQUACULTURE IN THE LEGAL FRAMEWORK

The activity of aquaculture is by nature multidisciplinary and multiform; this reality is to be reflected in the Legal approach. The legal instruments on aquaculture should incorporate on the legal problems raised by aquaculture. To formulate a viable aquaculture policy, it would be relevant to define the aquaculture which always tend to create more complex problems. In order to avoid confusion, a definition of Aquaculture is suggested: "Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some from of intervention in the rearing process to enhance production, such as regular stocking, feeding, production from predators, etc. Farming also implies individual or corporate ownership of the land and the stock. Aquatic organisms which are harvested by an individual or corporate ownership and were owned throughout their rearing period also contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries". The question of ownership and use rights of water bodies is a central concern in the context of Aquaculture development.

The Zonational or Demarcational laws are apt to be almost as important to aquaculture for providing authorization for aquacultural activities it is for agriculture in some potential areas under definite legal system. In order to have a comprehensive view of with aquaculture. The next issue will be devoted to the question of Access and Use of Land and Water and the importance of environmental laws and regulations on aquaculture. However, before this, it is necessary to examine the legal conditions which surround the setting up of an aquaculture farm. This has to be clearly distinguished from the authorization, permit, concession or license required to have access to the water and land.

PUBLICITY OWNED LAND VERSUS PRIVATELY OWNED LAND

Despite the fact that in Bangladesh there is no clear government regulation on the use of land for aquaculture the laws regarding private and public property rights, agricultural development policy and land Reform acts, environment protection policy and finally national security and defense considerations are the ones most likely to regulate the access and use of land for aquacultural purpose.

It is well known that fish culture operations are often carried out in coastal areas, or in riparian lands and in some cases on forest lands and in large water bodies (Jalmohals). Access to and use of the sites, where they fall within the public domain, are most likely to be subject to special concessions or authorizations granted to farmers/fishermen by concerned authority i.e. the Department of Fisheries.

However, public lands suitable for fish culture operation can preferably be leased to qualified persons, farmers associations, cooperatives, NGOs, Colleges & Schools, Rotary & Lion's Clubs, Village Clubs for Youths, for certain duration based on the productivity performances, site improvements etc. At the same time, there must be regulations pertaining to use of public forest lands and the MANGROVE areas for fish pond development. No person, individual or corporation shall occupy or use any portion of public forest lands, including tidal, mangrove and other swamp, and streams within public forest lands or proclaimed timber lands, or established forest reserves, for fish pond purposes. No license or permit should be issued by the government in this regard.

ACCESS TO AND USE OF WATER

Water, together with land, is one of the major and basic natural resources for which the GOB should plan orderly policies at the local level. The legislation on water resources must deal with its beneficial and harmful effects of water, the uncontrolled waste and misuse of water, and finally the quality and environmental aspects. Each of these subjects often seem to be administered by various ministries/departments without any proper coordination. No regulation concerning discharge of waste water and effluent, and more rarely quality aspects, can be found. Whether adhering to water law principles of the common law system, the civil law system, or others, the availability of a water area for aquaculture should consider the following:

- Legal status of ownership of water;
- Explicit reference to the need of a license for aquaculture; and
- Place of aquaculture in the order of priority established among beneficial uses.

Priorities could be determined on zonal basis in the light of ecological, economic, resource use suitability and social considerations. Furthermore, like any other constituent part of the environment or renewable natural resource, water resources must be used in an efficient manner so that the maximum gain may accrue, compatible with the general interest of the community and with the laws comtempleted by the envisaged National Code of Renewable Naturable Resources and Environment Protection, in such a way that no further interference from any corner shall occur with any of these resources.

The regulation of the use of water is strictly related to establishment of a distinct place for Aquaculture. Moreover, the use of waters should not adversely affect the Ecological Balance. Rather, water should be used to protect the soil, forests and also to maintain the flow and the volume of watercourses and the preserve the aquifers. Thus, aquaculture policy in particular and the Fisheries policy in general should be designed as follow:

- to afford special protection to the aquatic flora and fauna of such fisheries area or part thereof and to protect, preserve and manage the natural breeding grounds and habitat of aquatic life, with particular regard to species of rare or endangered species of fish; and

- to protect mangrove areas which act as natural buffers against shore erosion, strong winds, tidal bore, storms and floods, should be strongly incorporated in the policy as a CAUTION.

Aquaculture development should not be allowed to the destruction of mangroves in Bangladesh. Fisheries license holders shall be responsible for the protection and conservation of contiguous areas.

FISH DISEASES

The government shall make regulations against new introductions that may cause fish diseases. Import of live fish should be banned without a license or permit from the competent authority consisting of a group of leading scientists in the country. The introduction of exotics may include such conditions as to avoid "The spread of communicable fish disease" and this should regulated through promulgation of laws in the proposed Fisheries Act or Animal Health Protection Act of Bangladesh.

RIVERS, CANALS, IRRIGATION CANALS, BACKWATERS AND LAKES

Fishery exploitation of almost from all the Bangladesh rivers has been in practice since the time of immemorial. Fishing in the largely unmanaged riverine systems, has been going on indiscriminately. The fish yield from the rivers has, therefore, not been commensurates with the productivity of the systems. Measures should be taken to replenish the degraded productivity through supplementary stoking provided it is not harmful to the existing ecosystem.

CONSERVATION AND REGULATORY MEASURES

Fishing rights in reservoirs, haors, beels and rivers are usually vested in government agencies. One of the conservatory measures that is never followed is the continuance of fishing operations during the breeding season. It is well recognized by everyone in the fishery system that these practices existed in everywhere in the country to gain immediate short-term returns. It implies that no Closed Season is observed. The fishermen do never consider the fetal consequence on the fish population. They identify breeding grounds by their experiences and catch easily the mother-fishes in a bulk. One example is cited here that the indiscriminate killing of thousands of Pangus-mother in Chapai Nawabgonj during the breeding season of this precious riverine cat fish which has been referd the policy makers as the silver wealth of rivers are now being exhausted year in year out. Another destructive way of killing hilsa fish in Juvenile stage i.e. the killing of Jhatka mercilessly for a little profit by the fishermen due to lack of motivation and awareness for future economic returns.

TANKS AND PONDS

Numerous tanks popularly known as *Dighies* or *Sagar* available in the country were dug during the British rule under faudal system for drinking water storage and irrigation purposes, most of them now remain in derelict conditions and remain public proprietorship. The legislation should be in favour of leasing out all

these ponds for longer period for fish culture. The rule should be imposed in such a way that no *Dighies* should remain unutilized. Many more water bodies also remain unutilized under Municipalities of various cities/towns including Dhaka city. They should be strictly taken under fish raising programmes. If any pond produces less than 1000 kg/ha of fish, the leasee or ownership must be cancelled henceforth through laws.

DATA BASE FOR POLICY PLANNING

A pre-requisite for formulating a rational Aquaculture Policy Planning is thorough survey of the existing resources and the extent of their exploitation so as to have a base for future projections. Unfortunately, the fishery sector in general and inland aquaculture in particular suffered largely due to almost non-existent data base for control and policy planning in respect of statistics pertaining to production, marketing intelligence and potential and utilization of aquacultural produces in foreign trade. There is a need for developing a sound data acquisition systems with cooperation from various agencies. Data base for aquaculture suffers from the following limitations:

i. Lack of data on socio-economic aspects.

ii. Available data are usually aggregated form becomes often unusable and remain at dumping stage.

iii. Market data on arrivals and prices are almost non-existent, even the landing of fish in Dhaka city is unknown.

iv. Incomplete production data, lack of data on potentialities fingerlings raising, and extend to their production level.

There is a need to strengthen, streamline and improve data base but our success in this direction is largely circumscribed owing to our negligence and ignorance as to how much resources in times of finance and manpower we can commit to the task of data collection, is also unknown.

STRATEGIES OF AQUACULTURE DEVELOPMENT - AN APPRAISAL

Despite massive aquaculture development efforts funded by various donor agencies including the World Bank and the Asian Development Bank, fishery economy is still having a sea-sawed Journey during last plan periods. Inspite of having immense development potentials for exportable fisheries from Bangladesh, but very unfortunately due to political motives and due to lack of policy, our share in the international trades is shattered beyond our expectation over years and the domestic fish markets continued to starve. Further, ever firming fish prices have resulted in reduced availabilities. Whereas exporters earned huge profits but the producers have received unremunerative prices for their produce for the varieties that had no export market. According to my findings during visits of various places, that the fishermen's share in consumer price was maximum upto 90% in direct sales to the consumers and lowest even upto the extent of 10% in sales involving Multi-Distributional Channels. However, the produce of pond-reared fish in the country is placed in better conditions i.e. they receive 70-80% of the actual price. Nursery rearing upto the fingerlings size seem to provide a higher returns to the farmers who are engaged in fingerlings production. In this case, farmers have burgaining capacity.

AREAS PERTAINING TO POLICY INTERVENTION

The labour surplus countries like ours may improve employment prospects but capital intensive nature of investment besets the task with serious limitations. The research needs to be speeded up with regard to availability of commercially exploitable species and to their end uses both in respect of domestic and overseas markets. For realistic investment appraisal, elaborate feasibility studies should be undertaken clearly outlining the technological inputs and post-harvest technology for the final disposal of the produce. Besides information inputs, financial assistance in the form of subsidies and soft loans is a condition precedent for giving initial *big push* to investment area unexplored so far. They investment in the fisheries sector may be largely induced by public sector allocations in infrastructure comprising landing, berthing and outfitting and repair facilities for handling, processing, storage and marketing network.

Using Aquaculture technology investment and output from inland openwaters can also be increased. However, it's ability to attract loanable funds depends largely on evaluation and identifying risk elements by funding agencies after duly discussing with National Exprts.

ENVISAGED MANAGEMENT POLICIES

Conventional prescriptions for regulations of fisheries comprises limited Access, Leasing and Auctioning, Closure of Seasons and Areas, Licensing of Gears, Gear restrictions, Aquacultural practices for enrichment of national streams, rivers, ponds, haors and boars and the security measures. The past experiences show that it is uncommon for government to apply limited access concepts to communities utilizing inland fisheries resources. The main exceptions are leasing and Auctioning of "Jalmohals", rivers, boars, etc. to local cooperatives as are widely practiced in neighboring countries. If the government enforces mechanism for licensing gear will be very effective measure to conserve the resources.

Furthermore, if the production and living standards of fishing communities are to rise without affecting adversely fish stock, management strategies should be well designed at per the policy, and be implemented and periodically be evaluated. Their effectiveness should be the subject matter of constant review by multi-disciplinary team of national experts who shall take cognizance of relevant data on commercial fishing, fluctuations in production based on seasonal criteria, productivity, environmental and meteriological factors. In this case, DOF should not be sole authority, they shall do their jobs in collaboration with available fishery scientists from Institute, Universities and BARC.

LEGISLATIVE SUPPORT

The Bangladesh Fishery Act, 1952 modified in 1985, to frame rules for regulations of fisheries. By and large, this act has been devoid of sharp teeth at implementation level. It is too anachronistic to subserve the objectives of Bangladesh fishery development. There is a need to have second thoughts with regard to its provisions. In inland openwater fisheries rules relating to mesh size and gear restrictions should be strictly implemented. There is a need for better coordination between fishery regulations and anti-pollution measures.

To sum up the pace of fishery development can be accelerated by an ideal blend of regulatory measures and production incentives such as selective subsides soft loans for private sector and remurative returns to producers. The prevailing ambivalence among government agencies, departments and organizations, research institutes, planners and administrators must be replaced by firm commitment to the ideals of economic planning. Any conceivable scheme of fishery development should have a strong bias in favour of small-scale fishermen and fish farmers who have been denied the fair deal so far due to excessive reliance placed on the development of industrial fisheries in policy planning.

CONCLUSION

The aquaculture development in Bangladesh must cope with laws and regulations which deal with lands tenure, water use, environment protection, pollution prevention, lack of policy, is creating problems because aquaculture represents special sensitive resource use conflicts, ownership conflicts, and many others.

The aquaculture development policy should not focus solely on industrial activities, which are generally under the control of private enterprize, but should also include socially - oriented small-scale production by rural farmers through regular stocking of all water bodies whatever available in the country. The formulation of this policy requires a concurrent reshapping and possible integration of relevant legislation. This process should not only include specific aquaculture prescriptions, but also other legislations that indirectly affects aquaculture development, for example, land tenure, ownership, access to and use of inland water and above all, inter-ministerial coordination in which BARC can play a pivotal role.

NATIONAL CREDIT POLICY

FOR AQUACULTURE DEVELOPMENT

BY

DR. SALEEMUL HUQ

Bangladesh Centre for Advanced Studies

presented at the

Workshop on Inland Aquaculture Development

in Bangladesh

Organized by

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BARC, Dhaka.

NATIONAL CREDIT POLICY FOR AQUACULTURE DEVELOPMENT

by
Dr. Saleemul Huq
Bangladesh Centre For Advanced Studies

Summary

The importance of inland aquaculture, both pond as well as shrimp is highlighted, particularly emphasizing its potential for increased production. The importance of credit availability as one of the most important elements needed to realize the remaining untapped potential for aquaculture is demonstrated. The existing levels of credit in the institutional sector, both from banks as well as NGOs and by projects directly are briefly described and the different credit needs for different intermediaries in the aquaculture chain are summarized. The importance and role of shrimp farming is briefly analyzed and the role of credit described. Finally some guidelines are suggested for an integrated approach to developing a sound system of credit for the fisheries sector as a whole including inland aquaculture.

Acknowledgements

The author would like to acknowledge with thanks the help of Dr. Nuruzaman of BARC, Dr. Mahfuz Ahmed of ICLARM, Dr. Gupta of ICLARM, Mr. Derrel Deppert of DANIDA, Mr. Imtiazuddin Ahmed of World Bank, CARITAS, BRAC, PROSHIKA, BKB, Bangladesh Bank, Grameen Bank and the Department of Fisheries for kindly providing some of the information used in the paper. The author is, however, solely responsible for any errors or opinions expressed.

NATIONAL CREDIT POLICY FOR AQUACULTURE DEVELOPMENT

by
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Introduction

The role of inland aquaculture (which is taken to include both fresh water fish culture as well as shrimp culture) within the fisheries sector in Bangladesh is a critical one. Not only OK it already account for over 20% of total fish production in 1987/88 but the rate of growth from 1983 to 88 was 10.7% per year, and projected to 1995 at 10.8% per year, compared to negative growth for inland capture fisheries (Table 1).

A further analysis of the different components of the inland fisheries of the country (see Table 2) shows that the total area, and overall production (per unit area) of fish is decreasing for the inland capture fisheries whereas it is increasing for the inland culture fisheries, particularly the ponds and shrimp farms. Making some projections of production upto the year 2010 under two different scenarios, namely under either a slow or a moderate rate of adoption of future improved production systems show that average yields of 2000 kg/ha for low intensity, 2,500 kg/ha for semi-intensive and 3,500 kg/ha for intensive culture can boost the total annual production from pond culture alone to well above 300,000 MT per year compared to current production levels of about 175,000 MT (Table 3).

It is also quite evident that under conditions of an efficient integrated management the financial returns from each unit area of pond are many times higher compared with each unit area of land used for paddy cultivation (Table 4). This is also true for shrimp cultivation which is why there has been such a large scale shift in land use from paddy to shrimp in almost all the coastal areas where it is feasible to do so. It is also interesting to note that even in the deeply flooded floodplain

Table 1 : Share of Inland Aquaculture in Total Fish Production

Type of Fishing	Production in 1987/88 (MT)	% of Total	Annual Production Growth(%)	
			1983-88	1988-95 (Projected)
1. Inland Capture	423,598	51.2	-2.7	4.0
2. Inland Culture	175,925	21.3	10.7	10.8
3. Marine Industrial	10,395	1.3	-8.0	6.0
4. Marine Artisanal	217,187	26.2	9.6	2.3
Total	827,105	100	2.4	5.3

Source : World Bank, 1991

Table 2 : Area, Yield and Production Trends of Inland Fisheries

Type of Fishery	Area	Yield	Production
Inland Capture	Decreasing	Decreasing	Decreasing
o River & estuaries	Stable	Decreasing	Decreasing
o Floodlands	Decreasing	Decreasing	Decreasing
o Beels	Stable	Decreasing	Decreasing
o Kaptai Lake	Stable	Decreasing	Decreasing
Inland Culture	Increasing	Increasing	Increasing
o Ponds	Stable	Increasing	Increasing
o Baors	Stable	Increasing	Increasing
o Shrimp farms	Increasing	Increasing	Increasing
Inland Total	Decreasing	Stable	Stable

Source : World Bank, 1991

Table 3 : Production Potential for Pond Fishery by the Year 2010

Pond Fishery	Average Yield (Kg/ha)	Development Scenario A		Development Scenario B	
		Area (x1000ha)	Production (MT)	Area (x1000ha)	Production (MT)
Present system					
o Derelict	400	15	6,000	10	4,000
o Culturable	600	25	15,000	15	9,000
o Cultured (low intensity)	2,000	50	100,000	50	100,000
Future Improved System					
o Cultured (semi intensive)	2,500	35	87,500	40	100,000
o Cultured (Intensive)	3,500	25	87,500	35	122,500
Total		150	296,000	150	335,500

Source : World Bank, 1991

Scenario A : Slow adoption of future improved systems

Scenario B : Moderate adoption of future improved system

Table 4 : Comparative Net returns to Aquaculture and Rice Cultivation

Enterprise	Average Net Returns (Tk/ha)
1. Pond Aquaculture	43,587
2. Pond fish/broiler farming	90,000
3. Aman rice (HYV)	8,763
4. Aman rice (irrigated)	3,619
5. Aman rice (rain fed)	3,168
6. Shrimp farming	10,350

Source : World Bank, 1991

where deep water Aman rice is the major crop the farmers often dig ditches and keep them as fish aggregating ponds for harvesting after the flood waters have receded around January to March. The relative financial return per unit area of such ponds in Chanda Beel in Gopalganj District have been shown to be upto 5.8 times the return from Aman rice (BCAS, 1991).

It is quite clear, therefore, that inland aquaculture has both the technical as well as financial potential to increase fish production of the country in the coming decades.

Fish and Prawn Aquacultural practices and credit needs

The different stages involved in the fish culture process along with different people involved, their capital needs for land and other inputs, level of technology and sources of credit are shown in summary form in Table 5. A similar schematic for the different players involved in the shrimp culture cycle is shown in Table 6.

It is clear from both these tables that there ar quite a number of different categories of people involved in the fish culture cycle ranging from the poorest wild fry collector who spends upto 12 hours a day in chest deep water collecting wild fry worth only 20-50 taka a day, to the frozen fish exporten at the other end of the shrimp chain who exports millions of dollars worth of shrimp each year and whose capital costs are easily over several crore Taka. It is also equally clear that only a small number of the categories of people involved have access to institutionalized credit. The poor wild fry collectors and traders in particular are almost totally dependent on non-institutional credit (usually from their buyer) which can be at rates of interest of upto 10% per month (Mc Gregor J.A. and Alam, S.S.1990).

Table 5 : Credit needs & sources for different stages of pond aquaculture

Stages :	1		2	3	4	5	6
	Hatchlings		Trade	Nursery	Trade	Food fish	Trade
People involved :	Hatcheries Owner/operator	Wild fry Collectors	Fry Traders	Nursury pond owners/oper.	Fingerling Traders	Pond owners/ Operators	Fisherman/ fish traders
Cycle of activity:	5-7 days	Daily	3-5 days	4-6 weeks	1-3 days	6-24 months	1-2 days
Period/season :	Apr.-Aug.	Apr.-Jun	Apr.-Jun	May-Sep.	May-Sep.	May/June onwards	May/June onwards
Land requirement:	Small	Nil	Nil	3-30 decimals	Nil	above 30 decimals	Nil
Relative level of Tecnology needed:	High	Low	Low	Medium	Medium	Low	Low
Main inputs/cost: (Excluding labour)	o Equipment o Brood fish o Hormones o Oxygen	o Nets o	o Hatchlings o Pots o Oxygen o Transport	o Hatchlings o Fertilizer o Fish feed o Insecticide	o Fingerlings o Drums/pots o Nets o Transport	o Fingerlings o Fertilizer o Fish feed	o Fish o Nets o Transport
Relative Initial Capital needs:	High	Low	Low	Medium	Low-Medium	Low-Medium	Low-Medium
Main sources of credit:	o Non-Institutional o NGOs o Bank	o Non-Institutional	o Non-Institutional	o Non-Institutional o Banks o NGOs	o Non-Institutional	o Non-Institutional o NGOs o Banks	o Non-Institutional

Source : Huq. S., 1991

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Table 6 : Credit needs and sources for different stages of shrimp aquaculture

Stages :	Post Larvae		Trade	Shrimp Pond	Trade	Shrimp Factory
	Hatchery	Wild collection				
People involved :	Hatchery owner/ operator	Wild post larvae collectors	Post larvae traders	Shrimp pond owner/Leaseholders	Shrimp Trader	Industry owner
Cycle of activity :	5-7 days	Daily	1-2 days	2-4 months	1 day	15-30 days
Period/Season :	Apr-June	Apr-Sep	Apr-Sep	o Apr-Sep o Whole year	o Apr-Sep	Whole year
Land requirement :	Small	Nil	Nil	Large (50-300 ha)	Nil	Medium
Relative level of Technology needed :	High	Low	Medium	Low-Medium	Low	High
Main inputs/ costs (excluding labour) :	o Equipment o Brood stock o Salt water o Feed	o Nets	o Post larvae o Pots	o Post larvae o Maintenance of embankments o Feed	o Ice o Transport o Baskets	o Electricity o Ice o Transport o Insurance
Type of activity :	Agriculture	Fishing	Trade	Agriculture	Trade	Industry
Relative Initial Capital Needs :	High	Low	Low	Medium-High	Medium	High
Main sources of credit :	o Bank o Non-Institutional	o Non-Institutional	o Non-Institutional	o Banks o Non-Institutional	o Non-Institutional	o Banks

Source : Hua, S., 1991

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There is therefore tremendous potential for stimulating the private sector traders by providing them institutional credit at reasonable interest rates. An example of this potential can be seen in the large trade of fish fingerlings from the hatcheries and nurseries that have come up in the private sector, mainly around Jessore which supply fingerlings all the way up to Dinajpur and Parbatipur through an elaborate network of traders (see Lewis and Gregory, 1989 for detailed description of this fish fingerling trade).

The critical points for institutional credit in the inland aquaculture cycle are at the hatchery, hatchling trade, nursery, fingerling trade, food fish rearing and fish trade points none of which are adequately served at present. In the shrimp sector the story is similar except for the frozen fish exporters which are classified as industries and are therefore able to get industrial loans more easily and at preferential rates of interest. Thus the country is now faced with a large over capacity of freezing plants with insufficient production of shrimps to supply them. On the other hard the shrimp pond owners find it difficult to obtain institutional credit, mainly due to the need for collateral which they find difficult to provide (there is a move to make the loans free from collateral which is still under consideration). The hatcheries in the private sector, also have found it practically impossible to obtain institutional credit despite there being funds earmarked for this purpose by Bangladesh Bank under the Shrimp Culture Project financed by the World Bank. As of June 1991 not one single Taka had been disbursed for this purpose despite the project being nearly over (World Bank, 1991).

Credit Needs

The importance of credit in the unlocking of the largely untapped potential for inland aquaculture production has been highlighted over and over again.

Table 7 shows the results of a survey of pond owners in Rangpur and Mymensingh where the single most important reason for not carrying out aquaculture was the lack of credit. This point has been reiterated by different authors; e.g.:

"Inadequate Credit appears to be an important problem for everyone involved in the fisheries sector, including fish farmers and fishermen. Fisheries' relative share in agricultural credit disbursement is small (about 1.5%). Institutional sources of credit are reluctant to lend to the fisheries sector because of high risks, low recovery rates, and lack of collateral. A lack of knowledge about fisheries and complicated credit disbursement rules also contribute to low credit disbursement. Fishermen and fish farmers are forced to borrow from money lenders at high interest rates - an estimated 10% to 12% a month". (World Bank, 1991).

Also:

"One of the constraints identified early on to the development of aquaculture has been the lack of financing or easily available credit for farming families who want to establish an aquaculture operation. In a 1989 study completed for the AEP on fisheries credit in Bangladesh, it was found in Mymensingh as well as in other parts of Bangladesh, fisheries credit programs had largely failed. Since about 1983, very few if any fisheries loans have been given out". (Deppert, D, Khaleque, MA, and Jensen, R., 1991).

This picture of lack of institutional credit availability and disbursement in the fisheries sector is verified when we look at the relative size of credit availability in fisheries compared to other sectors such as agriculture. Since 1981 the relative share of fisheries credit has always been less than 5% and usually around 1.5% only (Table 8).

Table 7 : Fish Pond Owners Response about Major Problems in Fish Culture

Nature of Problem	Percent response (%)	
	Rangpur	Mymensingh
1. Lack of Capital	27%	17%
2. Joint Ownership	15%	11%
3. Problems of Jute retting	12%	7%
4. Over flooding in rainy season	11%	4%
5. Fear of theft	7%	3%
6. Problems of Supervision	11%	4%

Source : Rahman, M.L. and Ali M.H., 1986.

Table 8 : Fisheries Credit as a Proportion of Agricultural Sector Credit

Year	%
1981	2.20
1982	1.90
1983	1.20
1984	2.34
1985	2.12
1986	4.52
1987	1.50

Source : World Bank, 1991

This institutional credit for the fisheries sector is allocated to a number of banks for different activities as shown in Table 9. Amongst the banks the largest recipient is the Bangladesh Krishi Bank and the major subsectoral allocation is for pond fish culture followed by shrimp culture.

Even though the allocation of institutional credit for the fisheries sector is relatively low as shown above, even this allocation has seldom been disbursed fully by any of the banks, particularly BKB (Table 10).

There are, of course, a number of reasons why institutional credit is not accessed by the fish and prawn culturists and the problems are not peculiar to the fisheries sector either. One study which tried to itemize the real costs involved in obtaining a loan from the bank found that the costs (other than interest on the loan) of getting a loan of Tk. 1000 was about Tk. 125 or in other words 12.5% of the loan amount had to be spent even before obtaining the loan (Table 11). Interestingly, the major components of this cost were the time involved in pursuing the loan (in terms of the opportunity cost of labour) and bribes needed to obtain the loan.

It is quite clear that some way around the bottle necks involved in institutional credit through the traditional banking system need to be found. Some encouraging results have been achieved in recent years by organizations like NGOs and the Grameen Bank. The Department of Fisheries through various donor funded projects have also started some credit related activities. A selection (by no means exhaustive) of some such banks, NGOs and DOF project activities are shown in Table 12. It is clear that both the Grameen Bank and the NGOs, whose target group are mainly the poor, have been able to successfully diversify their credit portfolio within the fisheries sector to include hatcheries, nurseries, food fish rearing, fish trading, net making, boat making as well as others. They have also been able to increase their credit allocation and disbursement over time. Such innovative approaches will be necessary if the potential for increased production through aquaculture is to be realized.

Table 9 : Bangladesh Bank Credit Allocation for Fish Culture for 1989/90 (Million Taka)

Fish Culture	Sonali	Janata	Agrani	Rupali	BKB	Rakub	BRDB	BSBL	Total
Short Term Loans									
o Shrimp culture	30	20	40	25	25	-	5	-	145
o Aquaculture	-	-	-	-	5	-	5	-	10
Long Term Loans									
o Pond fish culture	45	15	5	7.5	70	25	10	20	197.5
o Shrimp culture	35	-	45	-	30	-	-	-	110
o Aquaculture	-	-	-	7.5	5	15	-	-	27.5
o Marine fish culture	-	-	-	-	15	-	-	-	15
Total	110	35	90	40	150	40	20	20	505

Source : World Bank, 1991.

Table 10 : Disbursemant of Fisheries Credit through Nationalized Commercial Banks and BKB

Fiscal Year	Amount (Million Taka)		
	BKB	Others	Total
1981	73.7	11.2	84.9
1982	69.5	10.8	80.3
1983	55.4	25.3	80.7
1984	128.8	106.8	235.6
1985	165.1	78.9	244.0
1986	103.4	181.9	285.3
1987	52.2	52.1	104.3
1988	61.2	38.8	100.0
1989	64.2	48.4	113.0

Source : World Bank, 1991

Table 11 : Costs of Obtaining Fishery Credit from Banks in Rangpur

Cost Item	Cost of obtaining Tk 1000 Credit	
	(Tk)	(%)
1. Application form & loan fee	3.27	2.63
2. Documents, Stamps, Deeds	16.99	13.67
3. Writing & filling forms	4.82	3.88
4. Travel	13.03	10.49
5. Entertainment cost	3.12	2.51
6. Tips and bribes	26.69	21.48
7. Opportunity cost of lost labour days	36.34	45.34
Total cost of obtaining credit	124.26	100

Source : Rahman, M.L. and Ali, M.H., 1986.

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Some Guidelines for a Sectoral Credit Policy for the Fisheries Sector

Having reviewed, however briefly, the state of credit in the inland aquaculture sub-sector of the fisheries sector, it may be useful to put forward some tentative suggestions for a more broad based policy, oriented towards stimulating credit availability and disbursement in the fisheries sector as a whole, including inland aquaculture. A brief summary of the overall approach being suggested is shown schematically in Table 13.

The idea is to identify fisheries as a sector having sizeable, still untapped production potential and that availability of credit is one of the impediments to the harnessing of these potential resources. Having accepted this premise it should be recognized that a national policy on credit in the fisheries sector is necessary and a comprehensive set of guidelines should be prepared starting from the national level and working down through the regional and local levels of both the financial institutions to be involved as well as the sub-sectoral aspects of the overall fisheries sector including fish catching, hatcheries, fry trading, nurseries, fingerling trading food fish growing, fish trading, net making, boat making, ice making and various other related activities. Each of the sub-sectors should be examined in detail to identify potential participants, beneficiaries, projects and financing needs. If such an approach is started now at the beginning of the last decade of this millennium then we can hope that by the beginning of the next millennium the fisheries sector of Bangladesh would grow out of its period of relative decline and be well on the way to realizing its potential for real growth over the coming decades.

Table 12 : Aquacuture Credit activities of some selected NGOs, Banks and Government Projects

Type of Organizatin	Name of Organization/ Project	Area of Operation	Activity Supported	Target Group	Average Loan	Total Loans Disbursed	Terms of Loans
Banks	Nationalized Commercial Banks	All Districts	Pond Aquaculture	Any one	25,000-75,000	1.00 million in 1988	16% for 5 years
	Grameen Bank	All Districts	o Food fish o Net making o Hatchery o Fish trading o Fish catching	Poor	1,500-2,000	87,387 upto Dec 1988	16% for 1-3 years
NGOs	BRAC	21 Districts	o Hatchery o Nursery o Food fish o Net making	Poor	3,000-6,000	6811885 upto Dec 1990	16% for 52 weeks
	CARITAS	6 Districts	o Hatchery o Nursery o Food fish o Net making o Fish catching o Fish processing	Poor	5,000-10,000	3700000 per year	12% for 1-7 years
	PROSHIKA	14 Districts	o Nursery o Food fish	Poor	25,000	3095000	12-14% for 1 year
DOF	Beel & Baor Development Project (IFAD/ DANIDA funded)	Oxbow Lakes in Jessore & Jhenaidah	o Fishing boats & nets o Marketing inputs o Fingerlings o Fish farming	Lake Fishermen	Not yet disbursed	25426000 allocated	12-14% for 1 year
	Shrimp Culture Project (World Bank funded)	Khulna, Satkhira & Cox's Bazar	o Hatchery o Shrimp farm	Any one	o Hatchery: 14-18 lac o Farm: 25,000/ha	o Hatchery: Nil o Farms: 100 lac	16% for 1-3 years
	Second Aquaculture Development Project (Asian Development Bank funded)	All Districts	o Hatchery o Nursery o Food fish	Any one	Not yet disbursed	Not yet started	Not yet finalized
	Mymensingh Aquaculture Extension Project (DANIDA funded)	6 Upazllas of Mymensingh District	o Hatchery o Nursery o Food fish	Pond owners/ operators	17,500	3156486 upto June 1991	16% for 1 year

Source : BCAS Survey, September 1991

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Table 13 : An approach to developing a National, Regional and project credit scheme for development of the fisheries sector

Level	Factors to be taken into account	Information needs (selected examples only)
National & Regional	o Environment	o Are there any adverse impacts? o How can any adverse impacts be mitigated?
	o Resources	o What is the status of aquatic resources? o How will aquatic resources be affected?
	o Macro-economic aspects	o Will national/regional employment be generated? o How will level of skills in the labour market be affected?
	o Socio-economic aspects	o How will the poor be affected? o How will women be affected?
	o Selection of Target groups	o Is there is a specific target group? o How are the target groups to be selected?
	o Assessment of Credit needs	o Are qualitative and quantitative assessments of credit needs available? o Can the credit needs of the different target groups be assessed?
	o Selection of Bankable activities	o Are there any bankable activities? o What are the different bankable activities?
	o Terms and conditions of lending	o What should be the rate of interest charged for loans? o What should be the collateral requirement? o What should be the loan repayment period?
	o Preparation of Lending Programme	o Have the bank staff received training on the sectoral lending programme? o Does the bank have access to sufficient information on the sector? o Have bankable programmes been identified?

Local/ Project Level	o Involvement of local level Bank Branches	o Have the Bank Branch Managers been given sufficient training/information on the sectoral credit programme? o Have the Bank Branch Officers been able to identify bankable projects?
	o Documentation	o Have the necessary forms been prepared? o Have the documentation requirements of the applicant been identified?
	o Appraisal	o Has the project technical and financial viability been checked? o Has the credit worthiness of the applicant been checked?
	o Disbursement	o Have the terms of disbursement been explained o How has disbursement been made?
	o Supervision	o Is there a regular schedule of loan supervision? o Are the regular payments and repayments being made?
	o Recovery	o Are repayments being made on schedule? o If repayments are in default are adequate sanctions being taken?

Source : Adapted from FAO, 1989

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THE BANGLADESH OBSERVER
TUESDAY SEPTEMBER

Workshop on aquaculture uplift strategy

Staff Correspondent

A three-day workshop on inland aquaculture development strategy in Bangladesh will be held on September 29 under the auspices of Bangladesh Agricultural Research Council (BARC) in collaboration with International Centre for Living Aquatic Resources Management (ICLARM) in Phlippines.

About one hundred researchers, fisheries experts, policy planners, economists, social scientists, extension workers including a number of foreign fisheries specialists are expected to participate in the workhop.

The Bangladesh Times
On 24-09-1991

. . . and tomorrow

BARC seminar

The inaugural session of a three-day seminar on 'Inland aquaculture development strategies for Bangladesh' will take place tomorrow (Sunday) at 10 am at the auditorium of Bangladesh Agricultural Research Council at Farmgate in the city.

Organised by the BARC in collaboration with the International Centre for Living Aquatic Resources Management (ICLARM), Minister for Agriculture and Irrigation Major General (retd) M Majed Ul Huq will attend the inaugural session on the chief guest.

Minister for Fisheries and Livestock Environment and Forests Abdullah Al Noman will be the special guest. K M Rabbani, Secretary of the Agriculture Ministry will preside over the session.

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ANGLADESH OBSERVER

...BER 30, 1991 Aswin 14, 1398 Rabiul Awal 20, 1412

Use of scientific techniques in sea fishing stressed

A three-day national workshop on "inland aquaculture development strategy in Bangladesh" began Sunday at the Bangladesh Agricultural Research Council (BARC) auditorium in Dhaka to review the present status and recommend future strategies for aquaculture research and development, reports BSS.

Inaugurating the workshop as the chief guest Agriculture and Irrigation, Water Development and Flood Control Minister M. Majid-Ul Haq underscored the need for use of scientific techniques in both sea fishing and development of inland aquaculture.

He said since independence, Bangladesh looked more to the sea to exploit the resources there instead of giving importance for developing inland pisciculture.

Mr. Haq said more emphasis should be given to make people aware about the modern techniques of pisciculture and urged the scientists to co-ordinate the activities in this sector with more attention to prevent the wrong doings.

Organised by BARC in collaboration with the Department of Fisheries, Fisheries Research Institute (FRI) and the International Centre for Living Aquatic Resources Management (ICLARM) located in Manila, the inaugural session was also addressed by Fisheries and Livestock Minister Abdullah Al-Noman, Joint Secretary of the Ministry Kazi Sirajul Hossain, Executive Vice-Chairman of BARC M. Sujayet Ullah Chowdhury, Member Director (Fisheries) of BARC Dr. A.K.M. Nuruzzaman, Fisheries Director A.K.M. Ataur Rahman and Chief Scientific Officer of FRI Dr. Abul Hossain. Agriculture Secretary K.M. Rabbani presided.

Mr. Haq urged the scientists to develop pisciculture techniques to enhance poroduction of fish in the country and said at least they should follow the developments made in some of the neighbouring countries in this sector.

Mr. Abdullah Al-Noman said a national fisheries policy would be announced by the government within next one month.

He suggested utilisation of the media to make the modern pisciculture technique popular to the people as well as to issue soft term loans to the aquaculturists.

Agriculture Secretary Rabbani said though a number of steps had been taken for development of aquaculture, production did not increase.

He said lack of coordination in undertaking joint research and development programmes was the main handicap in the development of this sector. In some cases it led to clashes between different institutions and organisations, he added.

About 100 researchers, fisheries experts, policy planners, economists, social scientists and extension workers from home and abroad are participating in the workshop.

The Morning Sun

Dhaka Tuesday September 24, 1991, Ashwin 8, 1398 Rabi-ul Awal 14, 1412 Hijri

Workshop on Aquaculture Sept 29

A three-day national workshop on "Inland Aquaculture Development Strategy in Bangladesh" will begin in Dhaka on September 29 according to a press release of Bangladesh Agricultural Research Council (BARC) Monday, reports BSS.

The main purpose of the workshop is to prepare an action plan for implementing new appropriate technologies towards overcoming the constraints in fish production in Bangladesh.

BARC will organize the workshop in collaboration with International Centre for Living Aquatic Resources Management (ICLARM) located in the Philippines.

About one hundred researchers, fisheries expert, policy planners, economists, social scientists, extension workers including a number of foeign fisheries specialists are expected to participate in the workshop.

দৈনিক বাংলা

ঢাকা ঃ সোমবার, ১৪ই আশ্বিন, ১৩৯৮ ঃ ২০শে রবিউল আউয়াল, হিজরী ১৪১২ ঃ ৩০শে সেপ্টেম্বর, ১৯৯১ ঃ মূল্য ঃ ৮ পৃষ্ঠা ৪.০০ টাকা

মাথাপিছু খাদ্যে মাছের পরিমাণ আশংকাজনক হারে কমে যাচ্ছে

।। স্টাফ রিপোর্টার ।।

বিশেষজ্ঞরা জানিয়েছেন, অভ্যন্তরীণ মৎস্য সম্পদ বিপুল হলেও বাংলাদেশে মাথাপিছু খাদ্যে মাছের পরিমাণ আশংকাজনক হারে কমে যাচ্ছে। (৫-এর পৃঃ দ্রঃ)

মাথাপিছু খাদ্যে (প্রথম পৃঃ পর)

বছর আগে মাথাপিছু মাছ খাওয়ার পরিমাণ ছিল ৩৩ গ্রাম। আর এখন তা নেমে এসেছে ২০ গ্রামে। উল্লেখ্য, আমাদের খাদ্যে দরকারী প্রাণীজ আমিষের শতকরা ৭১ ভাগের উৎস হচ্ছে মাছ। শুধু তাই নয় মোট জাতীয় রফতানী আয়ের ১৩ শতাংশ আসে মাছ থেকে। দেশের কর্মসংস্থানের ১২ শতাংশ পূরণ হচ্ছে মৎস্য সম্পদ থেকে।

দেশে মৎস্য উৎপাদন হ্রাস পেলেও স্বাধীনতার পর চিংড়ি মাছের চাষের সম্প্রসারণ ঘটেছে অবিশ্বাস্যভাবে। বর্তমানে ১ লাখ ৭ হাজার হেক্টর জমিতে চিংড়ি চাষ হয়। উৎপাদিত চিংড়ির প্রায় পুরো অংশই রফতানী হয়। চিংড়ি রফতানী করে দেশের অর্জিত হয় ৫০০ কোটি টাকা।

বর্তমানে দেশে বছরে প্রায় সাড়ে আট লাখ টন মাছ উৎপাদিত হয় বলে ধারণা করা হয়। সরকার চাইছেন আগামী ৫ বছরে এ পরিমাণকে ২০ লাখ টনে উন্নীত করতে। বাংলাদেশে ৬ লাখ পুকুরে জমির পরিমাণ হচ্ছে প্রায় দেড় লাখ হেক্টর (১ হেক্টর=৫ একর)। ৪৫ হাজার হেক্টর হাওর-বাওড় খাল-বিলে।

সরকারী উদ্যোগে মৎস্য চাষ বৃদ্ধির গত চার দশকের প্রয়াস বলতে গেলে ব্যর্থ হয়েছে। বিশেষজ্ঞরা মনে করেন, মৎস্য সম্পদ বৃদ্ধির অন্যতম উপায় হচ্ছে বেসরকারী উদ্যোক্তাদের পুঁজি, প্রযুক্তি প্রভৃতি দিয়ে সহযোগিতা করা।

উপরের তথ্যগুলো জানা যায়, গতকাল বিএআরসি মিলনায়তনে অনুষ্ঠানরত 'বাংলাদেশের অভ্যন্তরীণ মৎস্য সম্পদ বৃদ্ধির কৌশল উদ্ভাবন' শীর্ষক তিন দিনের জাতীয় সেমিনার থেকে।

Attachment-7/7
Page-6/41

The Morning Sun

aka Monday, September 30, 1991, Ashwin 14, 1398 Rabi-ul Awal 20, 1412 Hijri

National fisheries policy next month

Minister for Fisheries, Livestock, Environment and Forests Abdullah Al-Noman has said the Government would announce the national fisheries policy by next month, reports UNB.

He said the policy would promote the country's fish production and suggest adoption of modern techonologies in the sector, impart training and arrange soft term loan for the poor cultivators.

The Minister was addressing a three-day workshop on "Inland Aquaculture Strategies for Bangladesh" in Dhaka at the Bangladesh Agricultural research Council (BARC) auditorium Sunday morning.

Expressing his concern, Noman said the country's fish production has declined due to the unplanned erection of embankment, indiscrimination use of pesticide and water pollution.

Organised in collaboration with International Center for Living Aquatic Resources Management (ICLARM), the workshop was inaugurated by the Minister for Agriculture and Irrigation, Water Development and Flood Control M Majid Ul-Huq.

Agriculture Secretary KM Rabbani presided over the function which was also addressed by Executive Vice Chairman of BARC Dr. M Sujaet Ullah Chowdhurry and Director of Fisheries A K M Ataur Rahman.

The Agricultre Minister said the government has set a fish production target of 16 lakh metric tons by the end of the current Fourth Five Year Plan from the present production of 8.41 metric tons per annum.

He informed that the country earns about Taka 500 crore each year by exporting fish which is equivalent to 15 per cent of the total export earning.

Referring to indiscriminate fishing, Majid directed the law-enforcing agencies to take stringent measures against unlawful catching of fish fry uder nine inches.

He called upon the scientists and experts to adopt coordinated approach for the overall development of the aquatic resource of the country.

Agriculture Secretary in his speech stressed the need for rapid development in the fishing sector saying it would help in generating employment opportunities for the growing populace.

A number of technical papers including 12 key-note papers will be presented in the three-day workshop.

About 100 researchers, fisheries experts, policy planners, economists, social scientists and extension workers from home and abroad are attending the workshop.

Pollution of environment

Earlier a BSS report adds: Abdullah Al-Noman Saturday called for waging a social movement in combating the curse of pollution of environment.

Speaking as the chief guest at a seminar on "our role in resisting pollution of environment," organised by "Prochesta," a non-government social welfare organisation, Mr Noman said that there was no alternative to mass participation in maintaining environment against pollution.

He described the issue of environment pollution as a national problem and sought cooperation of the politial parties in mobilising and motivating people in maintaining environment.

Held at the auditorium of the National Book Centre, the seminar was presided over by Prof. KM Mohsin of the Depatment of History of Dhaka University who is also the chief patron of Prochesta.

The Morning Sun

haka Tuesday October 1, 1991, Ashwin 15, 1398 Rabi-ul Awal 21, 1412 Hijri

Scarcity of inputs hits aquaculture

Bangladesh produces little over 20,000 kgs of spawn annually which is not sufficient for expansio and internsification of aquaculture in the country, according to a scientific paper presented at a three-day national workshop on "Development of Inland Aquaculture" which began in Dhaka Sunday, reports BSS.

Out of the total spawn 12,000 kgs came from the natural sources like the riversand, their tributaries, 7000 kgs from private sector hatcheries and only 1350 kgs from 84 government own hatcheries, the paper said.

Additional Director of Fisheries Research Institute (FRI) DR MA Mazid and Associate professor of Fisheries Biology in Agricultural University in their joint paper on fresh water aquaculture development said only 15 percent of the requirement for pond culture operations could be met from the production of the hatcheries.

They said huge quantity of additional seeds of various culturable species were also required for government open water stocking programme for which renovation and expansion of the existing hatcheries and establishment of a number of new hatcheries were needed.

They pointed out that the natural seeds are of good quality, but they are not of appropriate sizes and species suitable for planned growth of aquaculture.

It was also pointed out in the paper that high cost and unavailability of inputs like seeds, fertilizers, hormones and drugs for diseases were hindering aquaculture development. On the other hand, a number of viable aquaculture technologies available in the country are not transferred to the farmers due to absence of proper extension mechanism of the government, they added.

The Bangladesh Times

DHAKA, TUESDAY, OCTOBER 1, 1991 RABI-UL-AWAL 21, 1412

Fisheries policy by next month

Modern techniques for pisciculture urged

A three-day national workshop on inland aquaculture development strategy in Bangladesh began Sunday at the Bangladesh Agricultural Research Council (BARC) auditorium in Dhaka to review the present status and recommend future strategies for aquaculture research and developments, reports BSS.

Inaugurating the workshop as chief guest Agriculture and Irrigation, Water, Development and Flood Control Minister M Majidul-Huq underscored the need for use of scientific techniques in both sea fishing and development of inland aquaculture.

He said, since independence Bangladesh looked more to the sea to exploit the resources there instead of giving importance for developing inland pisciculture.

Organised by BARC in collaboration with the Department of Fisheries, Fisheries Research Institute (FRI) and the International Centre for Living Aquatic Resources Management (ICLARM) located in Manila, the inaugural session was also addressed by Fisheries and Livestock Minister Abdullah-Al-Noman, Joint Secretary of the Ministry Kazi Sirajul Hossain, Executive Vice-Chairman of BARC M Sujayet Ullah Chowdhury, Member, Director Fisheries of BARC Dr. A K M Nuruzzaman, Fisheries Director A K M Ataur Rahman and Chief Scientific Officer of FRI Dr Abul Hossain. Agriculture Secretary K M Rabbani presided.

Mr. Abdullah-Al-Noman said a national fisheries policy would be announced by the government within next one month.

He suggested utilisation of the media to make the modern pisciculture technique popular to the people as well as to issue soft term loans to the aquaculturists.

About 100 researchers, fisheries experts, policy planners, economists, social scientists and extension workers from home and abroad are participating in the workshop.

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The Morning Sun

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The Bangladesh Times

IN 16, 1398 DHAKA, WEDNESDAY, OCTOBER 2, 1991 RABI-UL-AWAL 22, 1412

National aquaculture uplift plan urged

A national workshop on aquaculture which concluded in Dhaka on Tuesday recommended formulation of national aquaculture development plan considering the prospects and constraints, reports BSS.

It also suggested to attach topmost priority on aquaculture in the national development plan with a view to enhance fish production and create productive employment opportunities.

In a number of recommendations the workshop also suggested identification of research, technology transfer and policy support for development of aquaculture on the basis of current production and marketing systems of fry, fingerling, matured fish-feed and equipment related to aquaculture.

It said all aquaculture production and marketing should be made through the private sector and production and marketing policy should be formulated on the basis of marketing opportunities at home and abroad.

Jointly organised by Bangladesh Agricultural Research Council (BARC) Manila-based aquaculture specialist centre ICLARM amd USAID, the three-day workshop was inaugurated by the Agriculture Minister M Majidul Haq on September 29.

The concluding session Tuesday was presided over by Home Secretary M Lutfullahil Mazid. Among others BARC Acting Chairman Dr M Sujayetullah Chowdhury, Member-Secretary of the workshop Dr AKM Nuruzzaman, Fisheries Director AK Ataur Rahman spoke.

The workshop also recommended for setting up a national fisheries advisory committee to determine the research and development strategies in this sector, and formation of a national screening committee consisting of, competent scientists to examine the desirability of introduction of any new exotics. It demanded strict restriction on further introduction of new exotic species.

It said the indigenous species whose biology, production potential etc. are known should be extended for culture.

The workshop also suggested supporting development of fish-feed industries as cottage industry, tax relaxation on import of aquaculture inputs, special credit for aquaculture, strengthening of institutional facilities and linkages between different government organisations, conducting socio-economic research on fisheries and utilisation of the government farms and hatcheries as training, demonstration and technology transfer centres.

For brackish water aquaculture the workshop recommended classification of prospective shrimp farming areas on the basis of salinity and development of these farms with adequate water exchange facilities and disease control measures. It discouraged horizontal expansion of shripm farming and encouraged increase of production per unit area with due consideration to environmental, socio-economic consequences and market demands.

The workshop also suggested distribution of all public waters including ponds, road-side canals, borrow pits, development canals, dead rivers to fishermen, landless and marginal farmers, unemployed youths, people trained in aquaculture and interested entrepreneurs against convincing production projects. This distribution should be made through the upazila parishad, it added.

THE BANGLADESH OBSERVER

DHAKA, WEDNESDAY, OCTOBER 2, 1991

Aquaculture workshop concludes

A national workshop on Aquaculture which concluded in Dhaka Tuesday recommended formulation of national aquaculture development plan considering the prospects and constraints, reports BSS.

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Jointly organised by Bangladesh Agricultural Research Council (BARC), Manila based Aquaculture Specialist Centre ICLARM and USAID, the three-day workshop was inaugurated by the Agriculture Minister M. Majid-Ul Haq on September 29.

The concluding session Tuesday was presided over by Home Secretary M. Lutfullahil Mazid. Among others BARC Acting Chairman Dr. M. Sujayetullah Chowdhury, Member Secretary of the workshop Dr. A.K. Nuruzzaman, Fisheries Director A.K. Ataur Rahman spoke.

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Referring to environmental aspects, the workshop suggested giving priority on conservation and development of fisheries environment and habitat while planning or considering any development plan affecting that habitat.

Emphasising the need for stimulating private sector participation in aquaculture the workshop suggested providing institutional and financial support to create a positive investment climate.

The Morning Sun

Dhaka Wednesday October 2, 1991, Ashwin 16, 1398 Rabi-ul Awal 22, 1412 Hijr

Tk 100 crore for aquaculture development unutilized

A sum of Taka 100 crore under the second aquaculture development project remained undisbursed for the last three years and a half due to co-lateral guarantee and other institutional problems, Fisheries Director AK Ataur Rahman said at a workshop on aquaculture in Dhaka Monday, reports BSS.

He said there was no system or support service for interaction by the fisheries extension workers and the aquaculturists with the concerned bank officials to help simplification of the institutional procedure for disbursement of the loan.

On the second day of the three-day workshop on inland aquaculture development strategies for Bangladesh being held at the Bangladesh Agricultural Research Council (BARC) auditorium, lively discussions took place on different aspects of aquaculture potential, management, technology, credit disbursement and aquaculture policies.

The participants in the discussion suggested identifying the genuine aquaculturists and delivery of institutional loans to them on soft terms considering the land to be used for aquaculture as co-lateral guarantee.

World Bank representative at the workshop Dr Imtiazuddin said that credit recovery in agricultural as well as fishery sector was declining. He cautioned that if this trend continues the bankers would not be interested to advance loans.

Technical co-ordinator of International Centre for Living Aquatic Resources Management (ICLARM), based in Manila, said many fishery credits remained unutilised for cumbursome conditions set for disbursement of institutional loans.

A highly placed official in the fishery sector informed the workshop that about eight monofilament (a polypropylene product) indsutries were in operation in Munshiganj district during the last one year, which were producing current nets, capable of catching fish fry upto 20 millimetres in length.

He said some of the industries were producting polypropylene yarn only. He said the nylon net industries were hard hit by the manufacture of current nets.

Referring to this statement fisheries director Ataur Rahman said the existing law only prohibited the use of current nets whose size is below 4.5 centimetre, but it does not prohibit manufacture, storage and trading of current nets. He said import of current net also was not banned, but it was dropped from the import list as its use was banned.

He said, due to indiscriminate use of current nets, more than 4,000 tons of young hilsa (jaitka) were being caught annually from certain parts of the Meghna alone.

Fish culturist of Bangladesh Fisheries Development Corporation (BFDC) based at Rangamati, M Alamgir said, during case culture experiment of telapia by the fisheries department in 1984-85 some cases were cracked releasing the exhotic species in to the lake. He said multiplication of telapia was now threatening the existence of the indigenous species which are mainly ruhi, katal and chital.

Attachment-II
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The Daily Star

ASHWIN 16, 1398 BS, DHAKA WEDNESDAY OCTOBER 2, 1991 RABIUL AWAL 22, 1412 HI

Marketing facilities at home and abroad sought

Plea to formulate national aquaculture development plan

A national workshop on aquaculture which concluded in Dhaka Tuesday recommended formulation of national aquaculture development plan considering the prospects and constraints, reports BSS.

It also suggested to attach topmost priority on aquaculture in the national development plan with a view to enhancing fish production and create productive employment opportunities.

In a number of recommendations the workshop also suggested identification of research, technology transfer and policy support for development of aquaculture on the basis of current production and marketing systems of fry fingerling, matured fish, fish feed and equipment related to aquaculture.

It said all aquaculture production and marketing should be made through the private sector and production and marketing policy should be formulated on the basis of marketing opportunities at home and abroad.

Jointly organised by Bangladesh Agricultural Research Council (BARC), Manila-based Aquaculture Specialist Centre (ICLARM) and USAID, the three-day workshop was inaugurated by the Agriculture Minister M Majid-ul- Haq on September 29.

The concluding session was presided over by Home Secretary M. Lutfullahil Mazid. Among others BARC Acting Chairman Dr M Sujayetulah Chowdhury, Members Secretary of the workshop Dr A K M Nuruzzaman, Fisheries Director A K Ataur Rahman spoke.

The workshop also recommended for setting up a National Fisheries Advisory Committee to determine the research and development strategies in this sector, and formation of a National Screening Committee consisting of competent scientists to examine the desirability of introduction of any new exotics. It demanded strict restriction on further introduction of new exotic species.

It said the indigenous species whose biology, production potential etc are known should be extended for culture.

The workshop also suggested supporting development of fish feed industries as cottage industry, tax relaxation on import of aquaculture inputs, special credit for aquaculture, strengthening of institutional facilities and linkages between different Government organisations, conducting socio-economic research on fisheries and utilisation of the Government farms and hatcheries as training, demonstration and technology transfer centres.

For brackish water aquaculture the workshop recommended classification of prospective shrimp farming areas on the basis of salinity and development of these farms with adequate water exchange facilities and disease control measures.

It discouraged horizontal expansion of shrimp farming and encouraged increase of production per unit area with due consideration to environmental socio-economic consequences and market demands.

The workshop also suggested distribution of all public waters including ponds, roadside canals, borrow pits, development canals, dead rivers to fishermen, landless and marginal farmers, unemployed youths, people trained in aquaculture, and interested entrepreneurs against convincing production projects. This distribution should be made through the Upazila Parishad, it added.

Referring to environmental aspects, the workshop suggested giving priority on conservation and development of fisheries environment and habitat while planning or considering any development plan affecting that habitat.

Emphasising the need for encouraging private sector participation in aquaculture the workshop suggested providing institutional and financial support to create a positive investment climate.

It recommended adoption of technologies for intensive rearing fingerlings in nursery cases, pens and enclosures as well as study and monitoring of environmental and biological aspects of stocking of exotic species.

The workshop further recommended that floodplain stocking should be supported by effective programmes of conservation and protection with a view to over preventing over-fishing and fishing of undersized fish. The fishermen should be involved in these efforts, it concluded.

The Daily Star

Dhaka, Sunday, October 6, 1991

Developing Aquaculture

A wide range of issues related to the development of aquaculture were discussed recently at a workshop organised by several national and international research and aid agencies in Dhaka. The workshop concluded that a realistic national aquaculture development plan needed to be formulated, in order to increase production of fish and supply of protein.

The fish sector is of critical importance to this country since fish is a staple diet of the people of Bangladesh, which is also high in protein. Lack of protein is one of the major factors contributing to widespread malnutrition among the rural as well as urban population. Malnutrition is the single biggest reason why so many thousands of people, particularly children, die of such otherwise non-fatal diseases as pneumonia, diarrhoea etc. The four-digit death toll in September's flood in the north of the country would have been much lower, had the affected people not been sapped of strength through malnutrition, compounded by a wholly inadequate supply of emergency relief such as food, water and medicine.

Therefore the question of fish production is not only an academic or purely economic one. It is, in a very real sense, a matter of life and death. But considering the number of rivers, lakes and ponds that we have in this country, Bangladesh should really be a fish-exporting nation. Yet, people who live by rivers and lakes suffer from an acute lack of protein intake which should be alleviated by consumption of greater amount of fish. The paradox is not only tragic, it is downright obscene. We have the natural capacity to become one of the largest fish producing countries in the world, and meet the protein requirement of the people. The fact that we have not managed to do so is a demonstration of how we have failed to utilise available natural resources.

The workshop made a series of recommendations with the aim of turning aquaculture into a major industry, including more efficient use of existing production and marketing facilities. Utilisation of ponds and canals under local authority jurisdiction is now a must, with projects formulated to alleviate rural unemployment and poverty, rather than handing them over to absentee businessmen. Landlessness among the rural population and stagnation in rural economies are forcing an ever-increasing number of people to migrate to cities, particularly Dhaka, raising prospects of social tension, and deteriorating an already low standard of urban life. Fish farm projects under local authority or NGO supervision could reduce the migration by giving a moderate boost to rural economies.

Private sector entrepreneurs should also be encouraged to invest in aquaculture, with incentives given to those producing for the home market as well as the export market. In our rush to earn foreign exchange from fish, we must not lose sight of the fact that wealth from the rivers is primarily a national one, for which there is a great necessity at home. Like other staple food products, fish production should first meet the domestic requirement before being considered an exportable commodity.

Most crucially, however, utmost care must be taken at every level to preserve the natural balance of the local environment. No digging of new water preserves or building of barriers should be undertaken prior to a thorough investigation by competent authorities as to its possible impact on the surrounding environment. The question of environmental protection is particularly relevant to production of shrimp in the coastal areas where intrusion of saline water deep into the mainland can have devastating effect. Any new government plan for aquaculture development must have the environment as a special concern.