



AQUACULTURE CRSP 22ND ANNUAL TECHNICAL REPORT

TILAPIA (*Oreochromis niloticus*) PRODUCTION CONSTRAINTS IN BANGLADESH: WORKSHOP AND EXPERT PANEL MEETING ON TILAPIA CULTURE IN BANGLADESH

*Eleventh Work Plan, Sustainable Development and Food Security Research 2C (11SDFR2C)
Final Report*

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ABSTRACT

A one-day workshop was held on 4 April 2004 at BRAC Center in Dhaka of Bangladesh organized by Aquaculture CRSP, the Asian Institute of Technology, and Bangladesh Agricultural University (BAU). The objectives of this workshop were to bring together all stakeholders to an open discussion on the present status as well as future potentials and directions for tilapia production in Bangladesh, and to enhance cooperation among the stakeholders in order to set proper strategies to promote tilapia culture in Bangladesh.

Seventy-four participants, including government fishery officers, researchers, university teachers and students, NGO extension workers, and international project staff attended the workshop. During the workshop, speakers explained Aquaculture CRSP activities and achievements in the past two decades, overviewed the status of tilapia culture in Bangladesh, Nepal, Thailand, the Philippines, and Vietnam, and also presented strategies for Nile tilapia culture.

An expert panel meeting was held on 5 April 2004 at BRAC Center in Dhaka of Bangladesh to identify constraints to developing tilapia culture in Bangladesh, and to develop a list of researchable topics for development of tilapia culture. A total of 33 experts attended the meeting, which included CRSP experts, experts from neighboring countries facing problems similar to Bangladesh in promoting tilapia culture, experts from countries successful in adopting tilapia culture, and national experts working for universities, fisheries departments and also from NGOs working in Bangladesh. The expert panel members discussed local conditions that impact development of tilapia culture and identified the most important constraints to development of tilapia culture in Bangladesh. Then they moved to discuss researchable priorities arising from constraints and worked out a list of prioritized researchable topics for promotion of tilapia culture in Bangladesh.

INTRODUCTION

Nile tilapia (*Oreochromis niloticus*) is cultured worldwide and is a dominant component of aquaculture in many countries in Asia. Fisheries and aquaculture in particular are vital to Bangladesh's national economy in terms of nutrition, income, employment generation, and foreign exchange earning (Alam et al., 1996). Since the 1960s, per capita availability of fish dropped from 12 kg to only 7 kg,

and among lower income groups per capita consumption is only 4.4 kg. Unfortunately, for the poorest people, fish is simply unaffordable (O'Riordan, 1992). Tilapia culture is being promoted as a poor farmers' fish as well as one with export potential in many parts of Asia. Success in tilapia culture could serve one of the most challenged national causes by meeting the nutritional needs of Bangladesh people.

Nile tilapia was first introduced to Bangladesh by UNICEF in 1974, and later, in 1987, by the Bangladesh Fisheries Research Institute (BFRI) from Thailand (Gupta et al., 1992). Tilapia reaches market size (e.g., 100–150 g, preferred size for household consumption) within 4 months without feeding (BFRI, 1989). This allows for minimum of two crops per year, making this an excellent species for culture in Bangladesh. However, despite several favorable conditions for tilapia culture of Bangladesh, production has not expanded. In spite of nearly two decades of effort in breeding and culture of tilapia at BFRI and at Faculty of Fisheries, BAU (Hussain et al., 1989; 2000), adoption of this technology by rural farmers and commercial entrepreneurs has been extremely slow. Even the Department of Fisheries extension service has not been able to provide tilapia culture technology from well-developed systems in neighboring countries (e.g., the Philippines, Thailand, and Vietnam). Carp polyculture (4–7 species of Indian and Chinese carps) in manured or fertilized ponds is the most common aquaculture practice in Bangladesh (Wahab et al., 1993). Fish production in Bangladesh is quite low, averaging 2,800 kg ha⁻¹ yr⁻¹ (DOF, 1999). Successful adoption of tilapia culture has potential to boost fish production and may have a greater influence on the socioeconomic condition of fish culturists in Bangladesh, particularly for small-scale, resource-poor farmers.

Limited adoption of tilapia culture in Bangladesh could be ascribed to a number of reasons including lack of institutional support, limited knowledge of suitable culture technology, lack of seed, lack of trained personnel, and poor markets, as well as weakness in promotion and an incompatibility of this fish in the Bangladesh culture systems. Bangladesh has a variety of aquaculture and fishery projects that have been funded by international aid agencies. Many nongovernmental organizations (NGOs) such as PROSHIKA, BRAC, and CARITAS have been promoting aquaculture development independently through their own extension networks in Bangladesh. A lack of coordination among stakeholders, particularly in devising proper strategies to promote tilapia culture, has had a negative influence on development of tilapia culture in Bangladesh. Therefore, in order to have a better understanding of local conditions to promote tilapia culture and improve coordination among stakeholders, it is important to bring stakeholders to an open discussion on the present status as well as future potentials and directions for tilapia production in Bangladesh. Moreover, critical analysis of factors responsible for the slow growth of tilapia farming in Bangladesh is also important. Therefore, an attempt was made to determine constraints to developing tilapia culture in Bangladesh by organizing a one-day workshop, and then to set priorities and develop research and production strategies necessary to facilitate production of tilapia by holding an expert panel meeting.

The objectives of the study were to:

- 1) Bring together stakeholders from government agencies, academic institutions, NGOs, international organizations and farmers to an open discussion of the local conditions to promote tilapia culture in Bangladesh;
- 2) Discuss major constraints to developing tilapia culture in Bangladesh and to outline present status as well as future potentials and directions of tilapia production;
- 3) Enhance cooperation among Aquaculture CRSP, academic institutions, government agencies, NGOs, international organizations and farmers in order to set proper strategies to promote tilapia culture in Bangladesh;
- 4) Identify major constraints to developing tilapia culture in Bangladesh; and
- 5) Develop a list of ranked researchable priorities for development of tilapia culture in Bangladesh.

Workshop Organization and Participants

A one-day workshop was held on 4 April 2004 at BRAC Center in Dhaka, and was organized by Aquaculture CRSP, the Asian Institute of Technology and Bangladesh Agricultural University.

Seventy-four participants included government fishery officers, researchers, university teachers and students, NGO extension workers, international organization staff, and farmers. Representation included two government agencies, ten academic institutions (eight universities, one research institute, and one training institute), nine NGOs, six international organizations in Bangladesh, and farmers (Appendix; Table 1). The academic institutions included were Institute of Agriculture and Animal Science, Nepal; Central Luzon State University, Philippines; Can Tho University, Vietnam; BAU; Dhaka University; Chittagong University; Khulna University; Shre-Bangla Agriculture University; BFRI; and the Fisheries Training Institute. The two government agencies represented in the workshop were Department of Fisheries (DOF), Bangladesh and Nepal Agriculture Research Council, and Department of Agriculture, Nepal, while nine NGOs including three Aquaculture CRSP collaborators, (BRAC, CARITAS, and PROSHIKA) CARE, COAST Trust, JNDP, TARA, FHD, and GMF. The international organizations represented in the workshop were WorldFish Center; Asian Development Bank; Agro-based Technology Development Project, USAID; SUFER Project/DFID; Greater Noakhali Agriculture Extension Center; and Integrated Technology Development Group. In addition, one farmer and a representative of United

Aquaculture Farms Limited also attended the workshop. Among all participants, 22% were from NGOs, 44% from academic institutions, 15% from government agencies, 15% from international organizations, and 4% were farmers or corporate (Table 1). The gender composition of the workshop participants was male dominated, as males constituted 86% of the workshop attendees.

Workshop Presentations

The workshop opened with a recitation from the Holy Quran followed by a welcome address of M. A. Wahab. M. Amirul Islam, Vice Chancellor, BAU, delivered the inauguration speech followed by a speech of chief guest Iqbaluddin Ahmed Chowdhury, Secretary, Ministry of Fisheries and Livestock (MOFL). At the end of the inauguration session, Yang Yi presented a brief introduction of Aquaculture CRSP activities and achievements in the past two decades. Then, ten presentations were given in two technical sessions, chaired by M. Aminul Islam of BAU (Table 2).

The first technical session began with a joint presentation of Ganesh Shivakoty from AIT and Jibon Mazumder from MOFL on socioeconomic constraints to tilapia production in Bangladesh. Amrit Bart from AIT and M. A. Wahab from BAU presented technical constraints and future of tilapia culture in Bangladesh, which was followed by an open discussion among participants. Then, M.G. Hussain of BFRI overviewed the status and potential of tilapia culture in Bangladesh, while Shahidul Islam of DOF gave a presentation on government support and service for tilapia culture. Anwara Begum Shelly, Director of the CARITAS Fisheries Program, presented the NGO role in dissemination of tilapia culture technology to farmers. The session was then opened for discussion, followed by lunch.

In the second technical session, presentations were made on status of tilapia culture in Nepal, Thailand, The Philippines, and Vietnam. Madhav Kumar Shrestha, Institute of Animal and Agriculture Sciences, Nepal and Ash Kumar Rai of Nepal Agricultural Research Council presented the status of tilapia culture in Nepal. C. Kwei Lin of AIT presented the status of tilapia culture in Thailand. Remedios Bolivar, Central Luzon State University, and Nguyen T. Phuong, Can Tho University, presented the status of tilapia culture in the Philippines and Vietnam, respectively. In the last technical presentation, Yang Yi presented Aquaculture CRSP strategies for tilapia culture. The session was then opened for discussion. The presence of international experts in the workshop gave local participants a unique chance to discuss problems related to tilapia culture and analyze constraints to develop tilapia culture in Bangladesh from the perspective of other countries. Finally, the workshop ended with closing remarks by Amrit Bart.

Workshop Achievements

The workshop did not publish proceedings; however, the workshop was a great success as shown by the broad participation of stakeholders. Presentations and discussion in the workshop were focused to produce a better understanding of local conditions to promote tilapia culture in Bangladesh. The workshop provided an excellent opportunity for participants from academic institutions, government agencies, NGOs, and international organizations to come together and share their views on promoting tilapia culture in Bangladesh. The workshop proved vital in identifying constraints to develop tilapia culture in Bangladesh.

Expert Panel Meeting

The expert panel meeting was held on 5 April 2004 at BRAC in Dhaka, and was organized by Aquaculture CRSP, the Asian Institute of Technology, and Bangladesh Agricultural University. The expert panel meeting began at 0930 h. The goal of the expert panel meeting was to identify constraints to adopting tilapia culture in Bangladesh and to finalize a list of researchable priorities to develop tilapia culture. A total of 33 expert panel members (30 males and 3 females) from seven countries attended the expert panel meeting representing academics, international organizations, NGOs, and government agencies (Table 3). Amrit Bart, M. A. Wahab, and Yang Yi facilitated as moderators the expert panel meeting.

M. A. Wahab opened the meeting by extending a warm welcome to the expert panel members. He expressed optimism that the meeting would accelerate the pace of development for tilapia culture, and thus, will help with sustainable economic development in Bangladesh. Amrit Bart briefed the purpose of the meeting and engagement of the Aquaculture CRSP in Bangladesh. He asserted that the goal of the expert panel meeting was to identify constraints for development of tilapia culture in Bangladesh and to finalize a list of researchable priorities for the promotion of tilapia culture. Expert panel members were invited from different countries in the region that have been successful in tilapia farming or face problems similar to Bangladesh in the development of tilapia culture. The meeting was focused to promote understanding of local conditions that impact the development of tilapia culture in Bangladesh. He expressed hope that the expert panel meeting would lead to a better understanding of the research and extension needs for promotion of tilapia culture in Bangladesh.

Developing The List of Constraints

Each panel member was asked to list the top five most important constraints to tilapia culture in Bangladesh on note cards, incorporating stakeholder considerations, information from the literature, and their knowledge.

Amrit Bart then asked panel members to read and explain the constraints from their note cards. M. A. Wahab recorded all constraints on flip charts, while Yang Yi entered them into a computer.

Prioritizing the List of Constraints

Each panel member was given 8 dots for use in identifying which constraints had the most importance. As a result a list of 29 constraints in order of importance was prepared (Table 4). The major constraints identified by the experts were related to four broad topics: inadequate technology, lack of extension mechanisms, lack of coordination between agencies and stakeholders, and inadequate supply of seed and feed. As some constraints overlapped, the list was edited by the panel from 29 initial to 16 final constraints. Then each panel member was again given 8 dots for use in identifying which constraints had the most importance. The final list of prioritized constraints is presented in Table 5.

Researchable Priorities Arising from Constraints

Panel members were divided into four groups, and each group was asked to develop researchable topics on each constraint. Results were recorded on flip charts, and listed researchable topics were placed along with the constraints. The group then edited the researchable topic list shown in Table 6.

Ranked Researchable Priorities

Table 7 contains the final list of 54 ranked researchable priorities.

CONCLUSIONS

Md. A. Wahab thanked all panel members for their great efforts for tilapia culture development in Bangladesh, while Amrit Bart summarized the expert panel meeting. Kwei Lin, on behalf of Aquaculture CRSP, presented T-shirts to all Bangladeshi participants.

ANTICIPATED BENEFITS

This workshop will enhance knowledge and capabilities of the institutions involved in promoting tilapia culture in Bangladesh, and increase impacts of Aquaculture CRSP to Bangladesh. Bangladesh researchers, extension staff of government agencies and NGOs, and fish farmers will benefit from the experiences, research results, technologies, and approaches begun in this workshop.

The expert panel meeting successfully identified major constraints to develop tilapia culture in Bangladesh and listed researchable priorities arising from these con-

straints. The expert panel meeting was unique because it brought local stakeholders such as academicians, government officials, NGOs, international organizations, farmers, and international experts together to discuss the local conditions related to tilapia culture in Bangladesh. The discussion and views shared by the experts led to a better understanding of research and extension needs to develop tilapia culture in Bangladesh, and will help to develop tilapia culture in Bangladesh. In addition, the outcome of the expert panel meeting in the form of ranked researchable priorities will assist the CRSP in developing research proposals to promote tilapia culture in Bangladesh.

ACKNOWLEDGMENTS

The authors wish to acknowledge the support from Bangladesh Agricultural University, BRAC, and CARI-TAS. Special thanks are extended to BRAC for providing workshop venue and all logistic arrangements. The authors also wish to thank Dharendra P. Thakur for the report preparation.

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Table 1. Status of participants for the workshop on tilapia culture.

Category	Number	Percent (%)
INSTITUTIONS		
NGOs	9	31
Academic institutions	10	34
International organization/ projects	6	21
Government agency	2	7
Farmer (Individual & corporate)	2	7
Total	29	100
PARTICIPANTS		
NGOs	16	22
Academic institutions	33	44
Government agency	11	15
International organization/ projects	11	15
Farmer (Individual & corporate)	3	4
Total	74	100
GENDER OF PARTICIPANTS		
Male	64	86
Female	10	14
Total	74	100

Table 2. Topics presented in the workshop on tilapia culture.

Presenter	Institution	Topics
Yang Yi	AIT	Brief introduction of Aquaculture CRSP activities in the past two decades
Ganesh Shivakoty	AIT	Socioeconomic constraints of tilapia production in Bangladesh
Jibon Mazumder	MoFL	
Amrit Bart	AIT	Technological constraints and future of tilapia culture in Bangladesh
M. A. Wahab	BAU	Status and potential of tilapia culture in Bangladesh
M. G. Hussain	BFRI	
M. Shahidul Islam	DOF	Tilapia culture: Government support service and policies
Anwara Begum Shell	CARITAS	NGO's role in dissemination of tilapia culture technology at farmers level
Madhav K. Shrestha	IAAS, Nepal	Country status: Tilapia culture in Nepal
Ash K. Rai	NARC, Nepal	
C. K. Lin	AIT	Country status: Tilapia culture in Thailand
Remedios Boliver	CLSU, Philippines	Country status: Tilapia culture in Philippines
Nguyen T. Phuong	CTU, Vietnam	Country status: Tilapia culture in Vietnam
Yang Yi	AIT	Aquaculture CRSP strategies for Nile tilapia culture

Table 3. Expert panel members who attended the meeting on constraints to tilapia culture.

Name	Gender	Nationality	Institution
Md. Aminul Islam	M	Bangladeshi	Bangladesh Agriculture University
Md. Abdul Wahab	M	Bangladeshi	Bangladesh Agriculture University
ATA Ahmed	M	Bangladeshi	Dhaka University
M. Saifuddin Shah	M	Bangladeshi	Khulna University
Hossain Jamal	M	Bangladeshi	Chittagong University
Azadi	M	Bangladeshi	Chittagong University
Md. Akteruzzaman	M	Bangladeshi	SUFER (NGO)
C. Kwei Lin	M	American	AIT, Thailand
Amrit Bart	M	American	AIT, Thailand
Ganesh Shivakoti	M	Nepalese	AIT, Thailand
Yang Yi	M	Chinese	AIT, Thailand
Ash Kumar Rai	M	Nepalese	NARC, Nepal
Madhav K. Shrestha	M	Nepalese	IAAS, Nepal
Remedios Boliver	F	Philippines	CLSU, Philippines
Nyuyen Thanh Phuong	M	Vietnamese	CTU, Vietnam
Anwara Begum Shelly	F	Bangladeshi	CARITAS (NGO)
Md. Mujaffar Hossain	M	Bangladeshi	Grameen Matshya Foundation
Md. Shahidul Islam	M	Bangladeshi	Department of Fisheries
A.H.M.Kohinoor	M	Bangladeshi	BFRI
Md. Enamul Hoque	M	Bangladeshi	BFRI
Mostofa Ali Reja Hossain	M	Bangladeshi	Bangladesh Agriculture University
Mokarrom Hossain	M	Bangladeshi	BRAC (NGO)
Jiban Majumder	M	Bangladeshi	Department of Fisheries
Khabir Ahmed	M	Bangladeshi	BRAC (NGO)
Aminullah Bhuiya	M	Bangladeshi	Fourth Fisheries Project, DOF
Md. Naseem Alim	M	Bangladeshi	World Fish Center
Israt Zahura	F	Bangladeshi	World Fish Center
Harvey Demaine	M	British	Noakhali DANIDA Project
Md. Majharul Haque	M	Bangladeshi	Bangladesh Agriculture University
Md. Rafiqul Islam	M	Bangladeshi	Department of Fisheries
Saleh Ahmed Chowdhury	M	Bangladeshi	Midway Fisheries (NGO)
Shamsuddoha	M	Bangladeshi	Coast Trust (NGO)
Md. Shahabuddin	M	Bangladeshi	Bangladesh Agriculture University

Table 4. List of constraints to tilapia culture in Bangladesh finalized during the expert panel meeting.

Number	Constraints	Weight (dots)
1	Lack of unified recognition and government support to production sector	16
2	Lack of extension mechanism and organization to producers	18
3	Inadequate information on development of private sector I	8
4	Strong linkage of institutional politics with fish culture	2
5	Lack of strong leader in private sector	2
6	Inadequate culture technology package	17
7	Non-availability of quality seed	18
8	Uncertain fish ingredients, high market price	2
9	Deterioration of genetic status	
10	Lack of linkages among production components	3
11	Inadequate access to success story at home and region	3
12	Negative national official attitudes	3
13	Lack of niche in the overall farming system where tilapia fits in (suitable water bodies for tilapia culture?)	12
14	Negative image of tilapia because of mosambique	1
15	Sustainability post-project	0
16	Lack of seed distribution system, distribution hatcheries, quality and size of seeds	13
17	Prolific breeding	9
18	Inadequate knowledge of Know-how on tilapia monosex	7
19	Lack of expertise (extension, research and farmers)	4
20	Unknown market and poor linkages	11
21	Inefficient linkages among research bodies, extension bodies, (GOs and NGOs), and farmers	17
22	Lack of extension materials	3
23	Lack of capital	3
24	Impacts of tilapia on biodiversity	9
25	Strains	3
26	Lack of appropriate harvesting technology for perennial waters	12
27	Bias towards indigenous species	3
28	Lack of storage and processing	0
29	Production, statistics	13

Table 5. List of 16 prioritized constraints to tilapia culture in Bangladesh with ranking finalized in the expert panel.

Rank Number	Constraints	Numbering of constraints in Table 4	Weight (dots)
1	Appropriate technology package	#6 & 13	37
2	Seed	#7, 16, & 18	35
3	Extension	#2, 11, 21, & 22	26
4	Linkages	#10	20
5	Feed	#8	17
6	Policy and support services	#1, 4, & 12	15
7	Market	#20	13
8	Private sector (commercial)	#3 & 5	13
9	Biodiversity	#24	12
10	Trained man power	#19	12
11	Capital	#23	10
12	Statistics	#29	10
13	Negative image	#14 & 17	6
14	Genetics	#9 & 25	5
15	Harvesting	#26	1
16	Indigenous bias	#27	0

Table 6. List of identified researchable topics for Tilapia culture in Bangladesh.

Number	Researchable Topics
1	<p>APPROPRIATE TECHNOLOGY PACKAGE</p> <ul style="list-style-type: none"> • GIFT, monosex, Nile tilapia (ordinary), red tilapia • Validate the existing culture technologies under different context, mainly seasonal, ecological, different socio-economic conditions. • Monosex technology needs to be developed to ensure at least 97% male production. • Genetic modification concerns.
2	<p>SEED</p> <ul style="list-style-type: none"> • Investigation on existing seed production capacity of tilapia in Bangladesh. <i>Number of hatcheries</i> <i>Production system and capacity</i> <i>Monosex/mixed sex system and capacity</i> • Distribution and marketing of seed: <i>Techniques</i> <i>Packaging and transportation</i> • Present status of seed quality and its improvement in genetic purity, size uniformity, and health. • Brood-stock management, selection, and maintenance. • Establishment of protocols for appropriate technology of seed production and nursing.
3	<p>EXTENSION</p> <ul style="list-style-type: none"> • Study the existing extension mechanisms (approaches and tools) to assess their strengths and weaknesses. • Study the cost effectiveness of various extension approaches in terms of affordability from public and private budgets and farmer resource conditions. • Develop a sustainable extension approach for resource-poor farmers based on the findings of topic 1. • Identify constraints to tilapia farming based on multi-sector and multi-level stakeholders. • Study development of effective extension methodology for removing the negative attitude and relevant stakeholders towards tilapia.
4	<p>LINKAGES</p> <ul style="list-style-type: none"> • Study the present status of linkages among different stakeholders (seed producers, growers and marketing people). • Strengthen institutional linkages among tilapia farmers, researchers and entrepreneurs • Technology transfer from research institutions to production sectors.
5	<p>FEED</p> <ul style="list-style-type: none"> • Production rates for only fertilizer, only feed, supplemental feed with inorganic fertilizer, supplemental feed with organic fertilizer, and locally available ingredients • Imported feed: efficacy and environmental issues.
6	<p>POLICY AND SUPPORT SERVICES</p> <ul style="list-style-type: none"> • Identify gaps in the national fisheries policy and tilapia production practices in diversified settings. • Review and analyze current fisheries policy, programs, and implementation with regard to tilapia from multi-stakeholders perspectives. • Review and analyze gaps in provision of support services for tilapia production and marketing. • Assessment of the potentials and support services for integration of tilapia in existing farming systems. • Role of political decision making on economy of tilapia production and its effects on research, extension, and farmer adoption.

Table 6. Continued.

7	<p>MARKET</p> <ul style="list-style-type: none"> • Market potential: type, size, demand by geography / people, price level, competing species (if any). • Post harvest technology: quality control, value addition.
8	<p>PRIVATE SECTOR (COMMERCIAL)</p> <ul style="list-style-type: none"> • Identify the strength and weakness of tilapia production. • Investigate production system and technology used by private sector. • Technology transfer to newcomers.
9	<p>BIODIVERSITY</p> <ul style="list-style-type: none"> • Study the effects of tilapia on other cultivable and wild fish species. • Effects of tilapia farming on aquatic ecosystem and environment. • Study the effectiveness of tilapia and shrimp or crab polyculture.
10	<p>TRAINED WORK FORCE</p> <ul style="list-style-type: none"> • Training need assessment
11	<p>CAPITAL</p> <ul style="list-style-type: none"> • Study the cost-return of different types of tilapia culture systems. • Cost-effective modeling for small-scale, resource-poor tilapia farmers. • Study the role of micro credit in promotion of small-scale tilapia culture.
12	<p>STATISTICS</p> <ul style="list-style-type: none"> • Baseline survey to determine the present status of the strains of tilapia in production, consumption, and marketing. • Determine the contribution of tilapia in HHE. • Identify the areas (ponds, ditches, open waters, coastal areas and paddy fields) potential for tilapia farming. • Assess present supply-demand gap (in terms of seed, feed, and fertilizer) as well as projected future situation. • Study existing and future production economics of tilapia.
13	<p>NEGATIVE IMAGE</p> <ul style="list-style-type: none"> • Survey research involving GO-NGO extension service people. • Case studies on the negative impacts of tilapia farming systems. • Comparative studies on the socio-economics and marketing impacts among cultivable species. • Benefit-cost analysis of Nile tilapia farming (all systems). • Global comparison on relative position of Bangladesh for tilapia production. • Identify positive attributes of tilapia to overcome negative images.
14	<p>GENETICS</p> <ul style="list-style-type: none"> • Determine the genetic status of tilapia available in Bangladesh. • Comparative study of the growth, survival, adaptability, and the best strains available in Bangladesh. • Develop a cost-effective technique to produce monosex tilapia. • Comparative studies on performance of tilapia seeds produced through different hatchery systems. • Develop a methodology to quarantine and certify locally produced and imported tilapia, and to incorporate as a code of conduct for hatchery operations.
15	<p>HARVESTING</p> <ul style="list-style-type: none"> • Identify problems related to complete harvesting of un-drainable perennial ponds. • Study the possibility of using chemicals (rotenone, tea seed cake) and mechanical means (horra, seine) for complete harvesting. • Use of quicklime in dry season when water reaches the lowest level • Biological control by using predatory fish • Study the possibility of complete harvest by using nets of different mesh sizes.

Table 7. List of prioritized researchable topics for tilapia culture in Bangladesh.

Rank Number	Priorities of Researchable Topics	Weight (dots)
1	Study the existing extension mechanisms (approaches and tools) to assess their strengths and weaknesses.	13
2	Investigate existing seed production capacity of tilapia in Bangladesh. <i>Number of hatcheries</i> <i>Production system and capacity</i> <i>Monosex/mixed sex system and capacity</i>	10
3	Develop a cost-effective technique to produce monosex tilapia.	10
4	Establish protocols for appropriate technology of seed production and nursing	9
5	Brood-stock management, selection, and maintenance.	8
6	Assess the potentials and support services for integration of tilapia in existing farming systems.	8
7	Investigate production system and technology used by private sector.	8
8	Study the effects of tilapia on other cultivable and wild fish species.	8
9	Validate the existing culture technologies under different context, mainly seasonality, ecological, and different socio-economic conditions.	7
10	Monosex technology needs to be developed to ensure at least 97% male production.	7
11	Study the role of micro credit in promotion of small-scale tilapia culture.	7
12	Feed <ul style="list-style-type: none"> • Production rate for only fertilizer, only feed, supplemental feed with inorganic fertilizer, supplemental feed with organic fertilizer, and locally available ingredients. • Imported feed: efficacy and environmental issues. 	6
13	Distribution and marketing of seed <i>Techniques</i> <i>Packaging and transportation</i>	6
14	Present status of seed quality and its improvement in genetic purity, size uniformity, and health.	6
15	Study the cost effectiveness of various extension approaches in terms of affordability from public and private budgets, and farmer resource conditions.	6
16	Baseline survey to determine the present status of the strains of tilapia in production, consumption, and marketing.	6
17	Case studies on the negative impacts of tilapia farming systems.	6
18	Identify problems related to complete harvesting of un-drainable perennial ponds.	6
19	Strengthen institutional linkages among tilapia farmers, researchers, and entrepreneurs.	5
20	Market potential: type, size, demand by geography / people, price level, competing species (if any).	5
21	Identify gaps in the national fisheries policy and tilapia production practices in diversified settings.	5
22	Identify the areas (ponds, ditches, open waters, coastal areas and paddy fields) potential for tilapia farming.	4
23	Develop a sustainable extension approach for resource-poor farmers based on the findings of topic 1.	3
24	Study the present status of linkages among different stakeholders (seed producers, growers and marketing people)	3

Table 7. Continued.

25	Effects of tilapia farming on aquatic ecosystem and environment.	3
26	Study the effectiveness of tilapia and shrimp or crab polyculture.	2
27	Identify constraints to tilapia farming based on multi-sector and multi-level stakeholders.	1
28	Study development of effective extension methodology for removing the negative attitude towards tilapia.	1
29	Review and analysis of current fisheries policy, programs, and implementation with regard to tilapia from multi-stakeholder perspectives.	1
30	Role of political decision making on economy of tilapia production and its effects on research, extension, and farmer adoption.	1
31	Post harvest technology: quality control, value addition.	1
32	Identify the strength and weakness of tilapia production.	1
33	Study the cost-return of different types of tilapia culture systems.	1
34	Cost-effective modeling for small-scale, resource-poor tilapia farmers.	1
35	Assess present supply-demand gap (in terms of seed, feed, and fertilizer) as well as projected future situation.	1
36	Determine the genetic status of tilapia available in Bangladesh.	1
37	Comparative study of the growth, survival, adaptability, and the best strains available in Bangladesh.	1
38	Genetic modification concerns	0
39	Technology transfer from research institutions to production sectors.	0
40	Review and analyze gaps in provision of support services for tilapia production and marketing.	0
41	Technology transfer to newcomers.	0
42	Training need assessment	0
43	Study existing and future production economics of tilapia.	0
44	Determine the contribution of tilapia in HHE.	0
45	Survey research involving GO-NGO extension service people.	0
46	Comparative studies on the socio-economics and marketing impacts among cultivable species.	0
47	Identify positive attributes of tilapia to overcome negative images.	0
48	Global comparison on relative position of Bangladesh for tilapia production.	0
49	Benefit-cost analysis of Nile tilapia farming (all systems).	0
50	Comparative studies on performance of tilapia seeds produced through different hatchery systems.	0
51	Develop a methodology to quarantine and certify locally produced and imported tilapia, and to incorporate as a code of conduct for hatchery operations.	0
52	Study the possibility of using chemicals (rotenone, tea seed cake) and mechanical means (horra, seine) for complete harvesting.	0
53	Use of quicklime in dry season when water reaches the lowest level	0
54	Biological control by using predatory fish	0
55	Study the possibility of complete harvest by using nets of different mesh sizes.	0