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BASELINE STUDY ON ROOF TOP GARDENING IN DHAKA AND CHITTAGONG CITY OF BANGLADESH

*Enhancing Urban Horticulture Production to Improve Food and Nutrition Security
(TCP/BGD/3503)*



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**Food and Agriculture Organization
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June, 2016



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BASELINE STUDY ON ROOF TOP GARDENING IN DHAKA AND CHITTAGONG CITY OF BANGLADESH

*Enhancing Urban Horticulture Production to Improve Food and Nutrition Security
(TCP/BGD/3503)*

Prepared For

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Citation: Uddin, M. Jamal, N.A. Khondaker, A.K. Das, M. E. Hossain, A.T.M. Delwar Hossain Masud, A. S. Chakma, N.A. Nabila, M. I. Saikat and A.A. Chowdhury.(2016). Baseline Study on Roof Top Gardening in Dhaka and Chittagong City of Bangladesh. A final technical report under the project of “Enhancing Urban Horticulture Production to Improve Food and Nutrition Security” (TCP/BGD/3503) funded by Food and Agriculture Organization of the United Nations. FAO Representation in Bangladesh. Road#8, House#37, Dhanmondi R/A, Dhaka 1205. Bangladesh



Executive Summary

Rooftop garden plays an important role in the mental well-being of the gardeners as well as in amelioration of the physical environment. The production of fresh fruits and vegetables of the rooftop garden can increase nutritional status of household members of the urban citizens and it will make a positive contribution to the environment. As part of the project activities, the baseline study was undertaken to assess the current situations and characterize the potential issues of rooftop gardening in Dhaka and Chittagong city. The baseline report will provide direction for the preparation of the roadmap for Green City development in line with the project objective. It also serves as a platform for further intensive discussions among stakeholders and related parties, which include local residents, public agencies and business communities towards the preparation of a comprehensive and practical roadmap for rooftop gardening in Dhaka and Chittagong. Baseline characterization is important to measure project performance before making any changes to project processes and it is essential for assessing the impact of the project activities.

The study was carried out in 9 (nine) selected metro areas of Dhaka and Chittagong city. Of them 6 (six) areas were in Dhaka city namely Mohammadpur, Mirpur, Gulshan, Uttara, Kamrangirchar and Tejgoan. In Chittagong, the area was Panchlaish, Doubelmooring and Patenga. The selecting criteria of the respondents were: (i) having potential space on rooftop or opportunities for improving existing RTG as showing project impact (i.e M&E aspect) (ii) willingness of the participants (iii) cooperative motive (iv) easily accessible (v) replicable (vi) centrally demonstrable and (vii) comparatively nutritionally poor household. The study used both primary and secondary data as well as quantitative and qualitative data and information. Purposive and proportionate random sampling technique was adopted for selecting the sample size. Out of 300 targeted beneficiaries (sampling frame), a total of 142 (47.3%) sample households (both Dhaka and Chittagong city) were selected for the study. The sample size of Dhaka and Chittagong city was 97 and 45 which represent by 64.6% and 30.0% of the total sampling frame, respectively. The required data/information was collected through household survey using pre-tested semi-structured questionnaire. The study period was during January to June 2016.

Key Findings

Household size: The average size of household (family) of the respondent was recorded as 5.4 and 5.3 in Dhaka and Chittagong city, respectively which was found to be higher than national average (urban) implies that the family members can contribute to the RTG for sustainable food production.

Education of the respondents: The average education level was recorded as the highest as graduate level in both Dhaka and Chittagong city and were found statistically significant indicated that an educated person can easily adopt the new technology for RTG.

Occupation of the respondents: The highest percentages of the respondents were found as business man followed by retired person and housewives in both Dhaka and Chittagong city areas implied that these types of occupational people can contribute to the RTG by expending time and money.

Potential spaces of rooftop: Average per household total rooftop space was recorded as 1916sq. feet, where potential space 1593sq. feet for gardening and open space 323sq. feet in Dhaka city areas but it was 2190 sq. feet, 1607 sq. feet and 583 sq. feet in Chittagong city areas, respectively. These figures indicated that there were huge potential for rooftop gardening in both city areas.

Current uses of residential rooftops: The highest percentages of areas expressed by the respondents being used for gardening was 87%, drying cloths 25.8% and others 11.5% in Dhaka city areas while it was



71%, 42%, and 33% in Chittagong city areas, respectively and that implied that there was scope for improving and re-designing the current RTG's.

Vegetables and fruits produced in current RTG's: About 25 vegetables and 20 fruits were found to be grown in the current RTG's both in Dhaka and Chittagong city areas. But the composition of fruits and vegetables varied significantly among the households. The highest 61.6% rooftop gardeners produced tomato followed by brinjal (61%), Indian spinach (47.8%), and Lady's finger (46.8%), Chilli (45.3%) and Gourds (25%) in Dhaka city areas. In Chittagong areas, the highest 57% respondents produced Chilli in the current RTG's followed by Brinjal (48%), Indian spinach (35.7%), Gourds (35.6%), Lady's finger (31%), Tomato (23.7%), Red amaranth (23%), Bean (18%), Cabbage and Cauliflower (7%). In the case of fruits, the highest 75% respondents grew mango followed by lemon (72.8%), Guava (72.8%), Pomegranate (38.5%), Hog-plum (26.5%), Jujube (24.5%), Papaya (24%), Wax apple (13%), Malta (12.8%) and Sapota (10.5%) in Dhaka city areas. In Chittagong city areas, the highest 69% respondents grew mango followed by Guava (74.5%), lemon (64%), Hog-plum (42.3%), Pomegranate (33.5%), Jujube (29%), Orange/Malta (22%), Wax apple (20%), Sapota (13%) and Papaya (11%).

Input used in current RTG's: About 71.8% of the respondents used compost 44%, urea 38.5%, TSP 26.8%, MoP 13.6% Zypsum and 23% netting in Dhaka city areas. In Chittagong areas, it was 62%, 49%, 49%, 33% and 10%, respectively. But they didn't know the recommended packages of fertilizers and compost for different container systems in rooftop gardening.

Knowledge of compost and fertilizer application of the respondents: More than 94% of the respondents in Dhaka city areas were having knowledge on the function of compost and fertilizer application in the current RTG's but more than 75% did not in Chittagong areas, this might be due to lack of training on this topic.

Water source used for current RTG's: About 90% and 82% respondents used owned source (owned supply water) for irrigation to the RTG's in Dhaka and Chittagong city areas, respectively.

Container used in the current RTG's: The highest 72% respondents used half plastic drum, 62.5% plastic pot, 59% earthen pot, 53% half-drum made by GI sheet, 51% plastic bucket, concrete made bed/drum and 41.6% plastic tray. In Chittagong areas, the highest 42% respondents used concrete made drum, 40% half-drum made by GI sheet, 31% plastic/earthen pot, 27% half plastic drum, 16% plastic bucket, 7% concrete made bed and 5% plastic tray.

Per household agricultural equipment owned: The highest 76% of the household owned water cane, 44% hand sprayer, 40% hand hoe and 27% secateurs in Dhaka city areas while it was 13%, 36%, 11% and 7% for Chittagong areas, respectively.

Average yield of vegetables and fruits per RTG's: The average yield of vegetables and fruits was obtained for 10 common vegetables and fruits in the study. The average yield was found to be higher from gourds (20.8 kg/year/RTG) followed by tomato (11.9 kg), cauliflower (8.5 kg), brinjal and lady's finger (4.9 kg), bean (4.5 kg), cabbage (4.1 kg), Indian spinach (3.5 kg) and red amaranth (3.1 kg) in Dhaka city areas. In Chittagong city areas, the highest yield was obtained from gourds (all types) as 9.25 kg per RTG per year followed by tomato (8.47 kg), lady's finger (6.03 kg), Indian spinach (5.27 kg) and bean (4.0 kg). In the case of fruits, the highest average yield was obtained from guava (6.5 kg/year/RTG), followed by mango (4.8 kg), papaya (3.6 kg), hog-plum (3.3 kg), lemon (3.3 kg), wax apple (2.9 kg), jujube (2.0 kg), pomegranate (1.4 kg) and sapota (1.0 kg) in Dhaka city areas. In Chittagong areas, the highest yield was obtained from papaya (7.1 kg) followed by lemon (5.4 kg), wax apple (4.1 kg), guava (3.2 kg) and mango (2.7 kg).

Income from current RTG's: The gross return was obtained from all vegetables and fruits produced in the current RTG's in Dhaka city areas as Tk. 2686 per year. The highest gross return came from fruits as



Tk. 1486 and vegetables as Tk. 1200 while it was Tk. 1395, Tk. 833.5 and Tk. 562.0 respectively in Chittagong areas. Differences of gross return were found statistically highly significant at 1% level of probability in Dhaka but it was statistically insignificant in Chittagong.

Willingness of the respondents for improving current RTG's: All respondents of the selected metro areas of households in Dhaka and Chittagong city have shown their willingness and interest to improve the current RTG's if they got the proper logistic and technical support from the respective departments or agencies.

Preferences of vegetables and fruits for RTG: In vegetables, brinjal, chilli, tomato, red amaranth, Indian spinach, gourds, lady's finger, bean, stem amaranth and teasle gourd are preferred for rooftop garden. In fruits, mango, malta, lemon, guava, hog-plum, sapota, jujube, papaya, wax apple, and karanda had been chosen by the respondents of Dhaka and Chittagong city areas.

Occurrences of pest and diseases in current RTG's: The highest 52% of the respondent reported that attack of insect was the major problem for RTG followed by attack of birds (50%) flower dropping (44%), fruit dropping (40.5%) and fruit rotting (39.6%) in Dhaka city areas. About 40% to 64% respondent of Chittagong areas claimed that their roof gardens were affected by the above mentioned incidences.

Measures for controlling pest and disease in current RTG's: About 46% respondent used pesticides for controlling pest and diseases, 18% used herbal and IPM method but 19% didn't use any kind of control measures in Dhaka city areas while 40% respondents used pesticide at their current RTG in Chittagong areas.

Per capita consumption of vegetables and fruits of the sample households: Per capita vegetables consumption was recorded as 56.7 gm and 83.2 gm per day for the sample household in Dhaka and Chittagong city areas, respectively which was lower than national average. This might be due to unawareness about the nutrition of vegetables. In fruits, consumption per capita per day was found to be 67.9 gm and 70.2 in Dhaka and Chittagong city areas, respectively which was higher than that of national average.

Training received on RTG by the respondents: About 56% of the respondents in Dhaka city areas received training on roof top gardening from non-government organizations. But in Chittagong areas, no respondents received training on RTG. This might be due to lack of initiatives to provide such kind of training to the urban dwellers by any organizations.

Training needs assessment for RTG improvement: Training needs were identified as (i) compost and fertilizer management in the container system, (ii) pest management, (iii) irrigation and water management, (iv) post-harvest management of garden product and (v) container preparation and planting of seedling and sapling in both the cities.

Responses to support needed for RTG improvement: The respondents claimed that they needed 5 (five) types of support for improving current RTG's in good manner such as (i) technical support (ii) input/logistic support (iii) training support and (iv) monitoring through regular visit. (v) cash/credit support. Interestingly, very few respondents have shown interest for credit/cash support and this might be due to their ability to invest to the RTG.

Finally, a technically feasible, socially acceptable, economically viable and environment friendly RTG model can be developed and up-scaled gradually in both Dhaka and Chittagong city areas. Government guidance, policy and encouragement are urgently needed. City dwellers of Bangladesh intend to continue its work for greener roofs. Helping to develop better understanding of the role they can play in the conservation of biodiversity in towns and cities is important. In order to realize the potential of benefits that RTG can offer, major shifts in thinking of the policy makers is required.



ACRONYM AND ABBREVIATION

BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
DAE	Department of Agriculture Extension
FAO	Food and Agriculture Organization
GO	Government Organization
GR	Gross Return
gm	Gram
ha	Hectare
hh	Household
HEIS	Household Income and Expenditure Survey
IPM	Integrated Pest Management
Kg	Kilogram
ml	Milliliters
NGO	Non-Government Organization
RTG	Roof Top Garden
SSAO	Sub-Assistant Agriculture Officer
UA	Urban Agriculture



Acknowledgement

The report on '*Baseline Study on Roof Top Gardening in Dhaka and Chittagong City 2016*' is the result of the initiative of Mr. Mike Robson, FAO Representative in Bangladesh under the project of "*Enhancing Urban Horticulture Production to Improve Food and Nutrition Security (TCP/BGD-3503)*". I am highly grateful to him for his initiatives, encouragements during the whole study period.

My heartiest thanks and gratitude to Dr. Nur Ahamed Khondaker, Assistant FAO Representative (Programme) for his scholastic guidance and sincere support for the study. Despite an enormous workload because of his many responsibilities, Dr. Khondaker has always been extremely generous in giving his time and guidance. As a supervisor of the study, he provided invaluable suggestions to accomplish the work timely and accurately. Without his intellectual advice, guidance, constructive comments and help, this work would never come to life.

I gratefully acknowledge the contribution of all team members specially Dr. Anil Kumar Das, National Consultant of FAO for his continuous communication, sincere support during questionnaire preparation, field visit and overall supervision of data collection, entry and report writing etc. Special thanks to Mr. Enayet Ali, National Project Coordinator and A.T.M. Delwar Hossain Masud, National Consultant, Programme Officer, Food and Agriculture Organization of the UN, FAO Representation in Bangladesh for his sincere support during questionnaire preparation, field visit and data collection from different stakeholders in both Dhaka and Chittagong city areas.

All the data providers of different offices/organizations/stakeholders, DAE personal including Deputy Director, District Training Officer, Metropolitan Agricultural Officers and Sub-assistant Agricultural Officers in both Dhaka and Chittagong city deserve special thanks for their sincere cooperation for providing necessary information, selecting the targeted beneficiaries, organizing meeting, help to field visit and assist to Programme Support Assistant during data collection in the selected metro areas in Dhaka and Chittagong city. We will be in need of such cooperation in future too and hope that the same hospitality will be received from them again.

I am highly acknowledged to Dr. Wais Kabir, Senior Advisor of FAO, Bangladesh for his scholastic and sincere review of the report alone with valuable comments and suggestions. Until that this report would not come into the light.

My special thanks to Mr. David Doolan, Deputy FAOR and Prof. Dr. A. Sattar Mandal, Senior Advisor of FAO, Dhaka for their encouragement and suggestions during the study.

I sincerely acknowledged the hard work of Mr. Amitabh Shuva Chakma, Ms. Nusrat Alam Nabila, Mr. Mofidul Islam Saikat and Mr. Abdul Awal Chowdhury, Programme Support Assistant of FAO, Dhaka for data collection and data entry in time.

Thanks and grateful to all FAO personal involved in the project for their sincere support and cooperation in all aspect.

Above all, we are extremely grateful to Almighty ALLAH for all the grace.

Chittagong
June, 2016

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**Snapshots of Current RTG's Situation in Dhaka and Chittagong City Areas of Bangladesh
(Enough opportunities for improvement)**





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Photograph: Mr. Mike Robson, FAOR exchanged his views regarding rooftop gardening in Chittagong city in presence of high officials of DAE and BARI, Chittagong.



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CHAPTER I

1. INTRODUCTION

1.1 Background

Bangladesh is recognized as one of the vulnerable countries as a victim of adverse impact of climate change. The leading development challenges of country today include poverty alleviation, sustainable development and environment management in the context of rapidly growing population. Being densely populated city, meanwhile Dhaka and Chittagong have exceeded their carrying capacity. Urban ecology is the direct victim of the diminishing greens contributing to some extent towards global warming. In Bangladesh, due to migration from rural area to urban area populations in the cities are increasing rapidly thus the numbers of low-income consumers are also increasing in cities. Urban agriculture can provide city-dwellers with a source of fresh produce, improved diet and important household budgetary savings. Vegetated surfaces provide important sound insulations properties and are often employed for their noise reduction potential in urban settings. Green roofs can provide important noise reduction opportunities for buildings. It may also generate employment and economic facilities through its backward and forward linkages. Koc et al.(1999); Mann (2001); Bellows and Hamm (2003); Hamm and Bellows (2003) stated that rooftop garden can supplement the diets of the community as it supplies with fresh produce and provide a tangible benefits tie to food production. With rapid and unplanned urbanization, incidence of urban poverty and food insecurity has been also increasing alarmingly in Dhaka (Choguill 1995).Islam (2004) viewed that Urban agriculture (UA) contributes to food security by increasing the supply of food and by enhancing the quality of perishable foods reaching urban consumers. He also suggested that strong political commitment and solid policy guidelines are the preconditions for creating supportive environment for RTG.

The present baseline study is an integral part of the activities of project entitled "*Enhancing Urban Horticulture Production to Improve Food and Nutrition Security*" initiated by FAO with the Government counterpart of the Department of Agricultural Extension (DAE), Ministry of Agriculture, Bangladesh in 2015. The project aimed to promote urban horticulture/rooftop garden for increasing the production of fresh-nutritious vegetables and fruits and also creating a positive impact on environment. Rooftop garden plays an important role in the mental well-being of the gardeners as well as in amelioration of the physical environment. Roof gardening has also a promising potential as a small scale business that can accelerate additional family income. According to the urban town planner and chief revenue officer of Dhaka city Corporation, within last eight years (2006-2015), the number of buildings in Dhaka city has increased from 326,000 to 400,000. It is to be notified that bringing the building roofs of Dhaka and Chittagong metropolitan areas under urban horticulture/rooftop gardening would increase the production and consumption of fresh fruits and vegetables and thus both





food safety and security can be achieved for urban dwellers. Before implementation of the project activities, the present baseline study report would help to understand the exact situation of rooftop gardening in Dhaka and Chittagong cities. The present baseline study would be treated as a reference point or base for assessing the impact of project activities.

The previous study on rooftop gardening in Bangladesh was described only aesthetic and ecological values but the present study shows that rooftop gardening is not only an aesthetic culture to the gardeners moreover it has also a promising potential to improving the food security and meet nutritional deficiency to the urban dwellers. This study is mainly focused on current situations and potentialities of rooftop gardening in Dhaka and Chittagong cities.

Dhaka, the capital of Bangladesh is the ninth (9th) largest city in the world by area and also the 28th among the mostly densely populated cities of the world. Here 13 million people live only in an area of 150 km². According to the eastern economic review, Dhaka will become a home of 25 million people by the year of 2025. A larger portion of population is also living in Chittagong metropolitan area, respectively (Quoted from project document of TCP/3503). The other basic contextual information of both city corporations is stated below (Table 1.1).

Table 1.1 Contextual information of the Dhaka and Chittagong City Corporation

Sl. No.	Particulars	City Corporation	
		Dhaka	Chittagong
1.	Area (In sq.km.)	126.34	155.40
2.	Number of household	1576746	556451
3.	Population (no.)		
	Total	6970105	2582401
	Male	3876586	1360695
	Female	3093519	1221706
4.	Literacy rate (%)	74.6	68.7
5.	Average size of household (person/family)	4.6	5.1
6.	Density per sq. km. (In metro areas)	30551	20190
7.	Number of Hat/bazaar (In metro areas)	188	81
8.	Number of nursery (In metro area)	102	83
9.	Number of horticulture center (In metro areas)	2	01
10.	Number of NGO's (In metro areas)	11	77
11.	Daily average wage rate (In Tk.) of garden labour:		
	Male	250	400
	Female	200	350
12.	Average annual rainfall (millimeter)	1854	2794
13.	Average annual temperature (centigrade)		
	Maximum	33.7	33.8
	Minimum	12.7	14.5

Source: BBS, 2014, Pp: 41 and District Statistics, Dhaka and Chittagong, 2013



1.2 Rationale of the study

This baseline study is an integral part of the project activities. Baseline characterization is an important to measure project performance before making any changes to project processes. It is essential for assessing the impact of the project activities. A baseline is a line that is a base for comparisons or calculation or point of reference. It is an analysis of current situation to identify the starting points for a programme or project (Wikipedia, 2014). The baseline data helps to identify the level of resources and current livelihood status that would help answer the critical questions that were part of an evaluation (Uddin et al. 2014). Baseline situation is need for development planning and initiatives (UNDP, 2009).



If the evaluation is to be useful, the evaluator must interpret the information so that the stakeholders will understand the results and know how to use them for further action. For example, study the characterization of potentialities of RTG is an important indicator for assessing the impact of the project. Therefore, a household survey was undertaken to detail out baseline indicators for each of the target's set. The study is expected to establish benchmarks for the outcome indicators mentioned in the project results framework, which would serve as the baseline for assessment of the net contribution of the project at mid-term and end-of-project. Obtaining extensive information in this report would be useful to policy maker, researcher and development worker for effective planning along with improving or establishing rooftop gardening in the city dwellers of Bangladesh.

Rooftop gardens support the social life, as a space to be comfortable outdoor environment with family and friends. It also develops a sense of self identity and independence, where one can primarily achieve self and emotion regulation viewing different flower in different seasons (Rashid and Ahmed 2009) and affords restorative experience from demanding everyday activities in urban high rise residential building. Hence, the baseline study has been undertaken to know the present status of rooftop gardening along with its management aspects, and explore the potentialities in Dhaka and Chittagong city.

A baseline on green city is a document to communicate at local city level where policy makers can integrate climate change actions in the preparation of a new master plan or amendment of existing development plan (Siong Ho Chin et al. 2012). So, this preliminary baseline report will provide direction for the preparation of the roadmap for Green City development. It should also serve as a platform for further intensive discussions among stakeholders and related parties, which include local residents, public agencies and business communities towards the preparation of a comprehensive and practical roadmap for rooftop gardening in Dhaka and Chittagong.



1.3 Benefits of RTG

Rooftop garden plays an important role in the mental well-being of the gardeners as well as in amelioration of the physical environment. Roof gardening has also a promising potential as small scale business that can accelerate additional family income. Nevertheless, it may generate some employment facilities through its backward and forward linkages. The production of fresh fruits and vegetables of the rooftop garden can be increased nutritional status of household members of the urban citizens and it will make a positive contribution to the environment.

Sajjaduzzaman (2005) reported that the major purpose of roof gardening are passing leisure time (100%), creating aesthetic values (100%), contributing in environmental amelioration (45%) and financial gain being a very minor concern (4% only) in Dhaka Metropolitan city of Bangladesh. On the other hand, Rumana Rashid et. al., (2010) described the economic and social benefit of roof top gardening including fresh food supply for urban residents, converts the hard surface into soft green surface, energy saving, etc.). Many researches that demonstrate that there are many aspects of outdoor environments and green spaces that are attractive to people, regardless of age (Ward Thompsoil, 2007).



RTGs could provide more than 12,000 t year⁻¹ vegetables to Bologna (Itali), satisfying 77 % of the urban inhabitants' requirements (Orsini et. al., 2014). Beyond the benefits associated with food production and the natural environment, community gardening is claimed to improve human well-being (Okvat and Zautra 2011). Together with the urbanization process, there has been a trend in the quest for the green experience: throughout history, both gardening and more passive forms of contact with nature (e.g. taking a walk in a garden) have been recognized as having mental health benefits (Davis 1998). Although limited scientific reports are available to date on the therapeutic role of community gardening, the gardening-related benefits in reducing psychological disorders e.g. against dementia (Simons et al. 2006), enabling stress recovery (Kingsley et al. 2009), or fostering cardiac rehabilitation (Wichrowski et al. 2005) are well known.

According to website [oflivingroofs.org](http://www.oflivingroofs.org), the environmental benefits of roof top gardening are described below:

1. Increase Air Quality: Extensive planting within cities is now widely recognized as a means of improving air quality. Therefore, green roofs contribute to the reduction of a number of polluting air particles and compounds not only through the plants themselves, but also by deposition in the growing medium itself.

2. Increase Biodiversity and Wildlife: Green roofs are intrinsically of greater benefit to biodiversity than more traditional roofing methods. Many green roof manufacturers promote green roofs as benefiting wildlife, but with little evidence to demonstrate this. Of course 'off the shelf' green roof systems do



provide benefits for wildlife compared to non-green roofs, but research in Switzerland and in London shows that green roofs need to be designed to meet specific local biodiversity conservation objectives.

3. Energy Conservation improved thermal performance: Green roof systems are recognized as providing greater thermal performance and roof insulation for the buildings they are laid on. This can vary depending on the time of the year, and the amount of water held within the system.

4. Green space: The value of green spaces to people living and working in towns and cities has increasingly been recognized by Government. Government has subsequently launched a raft of new policies, initiatives and funding to promote the good design and management of green spaces.



5. Health: There is a growing body of evidence that the visual and physical contact with natural greenery provides a range of benefits to people. These include both mental benefits (such as reduction of stress) and physical benefits (including the provision of cleaner air). Access to green space can bring about direct reductions in a person's heart rate and blood-pressure, and can aid general well-being.

6. Urban Heat Island Effect [albedo effect]: The urban heat island effect is the difference in temperature between urban areas and the surrounding countryside. In large cities this can be as much as a 5oC difference between the city centre and the rural environs. Urban areas have large areas of hard reflective surfaces. This is referred to as the albedo effect. These surfaces absorb solar radiation and reflect this heat back into the atmosphere. Any reduction in this effect can have a positive effect on smog and airborne particles in the atmosphere. Roof areas are a significant part of urban hard surfaces. Plants on green surfaces absorb heat and then use it through evapotranspiration. Green roofs therefore would play an important role in reducing urban temperatures, and subsequent improvements in air pollution/smog, as associated with the albedo effect.

7. Noise and sound Insulation: The combination of soil, plants and trapped layers of air within green roof systems can act as a sound insulation barrier. Sound waves are absorbed, reflected or deflected. The growing medium tends to block lower sound frequencies whilst the plants block higher frequencies. The amount of sound insulation is dependent on the system used and the substrate depth. A green roof with a 12 cm substrate layer can reduce sound by 40dB and one of 20 cm by 46-50dB.

8. Recycled Materials: A number of materials used in green roofs are from recycled sources, such as the membranes and growing mediums, such as crushed porous brick, which is used by some suppliers.

9. Storm Water Amelioration: Green roofs store rainwater in the plants and growing mediums and evaporate water into the atmosphere. The amount of water that is stored on a green roof and evaporated back is dependent on the growing medium, its depth and the type of plants used. In summer green roofs can retain 70-80% of rainfall and in winter they retain between 25-40%.



1.4 Goal and objectives of the study

The goal of the baseline study is to develop a database on rooftop garden for Dhaka and Chittagong city dwellers regarding current status of existing rooftop garden, potentialities, and willingness of the building owner/residents, available facilities and limitations for urban garden and to select the measurable indicators for assessing the impact of the project.

The specific objectives are stated below:

- i. to document socio-demographic characteristics the respondents
- ii. to characterize the potential roof spaces, and current use by the building owner/residents
- iii. to identify the crops/plants composition, input used, yield, income, fruit and vegetables consumption, occurrence of pests and diseases and use of bio-pesticides.
- iv. to assess the training and other support needs for improving/extending rooftops garden in Dhaka and Chittagong city dwellers;
- v. to derive policy recommendations and strategies for rooftop gardening in Dhaka and Chittagong city dwellers.





CHAPTER II

2.0 APPROACH AND METHODOLOGY

2.1 Selection of the study area

For ensuring proper representation of location, higher numbers (nine) of metropolitan areas were selected from Dhaka and Chittagong cities. Of them, 6 metropolitan areas were selected from Dhaka and 3 from Chittagong city purposively. The name of metropolitan areas is: Mohammadpur, Mirpur, Gulshan, Uttara, Kamrangirchar and Tejgoan in Dhaka. In Chittagong, the area was Panchlaish, Doubelmooring and Patenga. Before selecting the areas in both cities, two consultation meetings (one for Dhaka and another for Chittagong) were organized with active participation of DAE personnel. A day long discussion was made and finalized the area for data collection in the two cities.



2.2 Selection criteria of the respondents

Selection procedure of the respondent is very important for collecting authentic information. After long discussion with the team members and based on outcomes of the two stakeholder meetings, the following criteria were fixed for selecting the respondent. These are: (i) having potential space on rooftop or opportunities for improving existing RTG as showing project impact (i.e M&E aspect) (ii) Willingness of the participants (iii) Cooperative motive (iv) Easily accessible (v) Replicable (vi) Centrally demonstrable (if possible) and (vii) Comparatively nutritionally poor household. Based on this criterion, the data collection procedure was started in Dhaka and Chittagong simultaneously.

2.3 Sample size and sampling techniques

Sampling, there are no strict rules to follow, and the researcher must rely on logic and judgment. The population is defined in keeping with the objectives of the study (David S. Walonick, 2010). In the study, a sampling frame was constructed in consultation with Metro Agricultural Officers, Councilors of the city corporation, Mayor, local elite persons and other relevant persons before final sample selection. Stratified random sampling was used for selecting the sample. It has already been mentioned that there are 6 metro agricultural areas in Dhaka and 3 for in Chittagong city. Each metro area was treated as a stratum and sample was drawn from each stratum randomly. There is no safe general rule as to how large sample size must be for use of the normal approximation in computing confidence limit (Cochran, 1999). When the population size is known or roughly so and the researchers are careful of the heterogeneity problem, any number (equal to or) greater than the statistically large sample (of 30 sample units) may be appropriate (Freund and Williams (1983). But he didn't mention the exact number and percentage. In the study, in order to normalize the data the following Fisher's measure of skewness was used and by applying this technique an optimum number of samples were chosen for each location of this study (Fisher, 1958; Karim, 1996).

Sample size, $n \geq 25 G_1^2$ (which says 95% confidence probability)



$$\text{Where, Fisher's measure of skewness, } G_1 = \frac{E(y_i - \bar{Y})^3}{\sigma^3} = \frac{1}{N\sigma^3} \sum_{i=1}^N (y_i - \bar{Y})^3$$

N = Population size; y_i = i^{th} member of the population; \bar{Y} = Population mean and σ = Standard deviation.

Proportionate random sampling technique was used for selecting sample size in each location. In this process, after obtaining the sample size at Dhaka (97) and Chittagong (45) from the above equation, sample size of each location was determined by proportionate sampling. For Dhaka 48.80% and for Chittagong 30% households of the sampling frame was taken as sample. The proportionate sampling was done considering the minimum percentage of 30 in each location. By applying this technique, out of 300 targeted beneficiaries, a total of 142 (47.3%) sample households (both Dhaka and Chittagong) were selected for the study. The distribution of samples according to city and locations are presented in Table 2.4

Table 2.1 Distribution of samples according to selected location in Dhaka and Chittagong

Study area (Metropolitan areas)	Distribution of samples according to selected location					
	Dhaka	%	Chittagong	%	All	%
Mohamm dpur	14 (25)	56	-	-	14 (25)	56
Mirpur	17 (25)	68	-	-	17 (25)	68
Gulshan	18 (25)	72	-	-	18 (25)	72
Uttara	20 (25)	80	-	-	20 (25)	80
Kamrangirchar	16 (25)	64	-	-	16 (25)	64
Tejgoan	12 (25)	48	-	-	12 (25)	48
Panchlaish	-	-	15 (50)	30	15 (50)	30
Doubelmooring	-	-	15 (50)	30	15 (50)	30
Patenga	-	-	15 (50)	30	15 (50)	30
All	97 (150)	64.67	45 (150)	30	142 (300)	47.3

Figures within parentheses are sampling frame (Targeted beneficiaries' household as stated in project document).

2.4 Data collection procedure

The primary and secondary data were used in the study. The extensive literature review, relevant documents/reports and secondary information were collected during the study. Primary data were collected from sample households using the semi-structured questionnaire. Four well educated enumerators (3 male and 1 female) were employed for data collection. During the data collection, the DAE personnel particularly Sub-Assistant Agricultural Officers (SAAO) of the respective metropolitan areas was accompanied with the data enumerators in both cities. Data were sought on rooftop gardening like roof top size, uses of open space, species composition, materials used, yield of fruits and vegetables, income from RTG, management issues, fruits and vegetables consumption, training and support need assessment for rooftop gardening in the study area. Demographic and socio economic data were also collected from the respondents. All qualitative and quantitative data were collected in local terms and units and then converted into standard unit. The quantities of fruits and vegetables consumed by sample households in the last three days were collected and were divided by household size to obtain the intake per capita per day. In the case of calculating yearly household income from existing RTG, all sorts of



income earned from RTG were taken into consideration with the perception of the interviewers. The primary data were collected from April to June 2016. Interviews were performed during daytime, with an average duration of about 30 minutes. Respondents were free to express their own view at each step of the interview. The whole study period was January-June, 2016.

2.5 Analytical techniques

For the current study, the primary and secondary data are analyzed. Descriptive statistics i.e. mean, standard deviation, percentage were used to analyze data. The mean comparison and significance test was done by One-Way ANOVA using SPSS. In ANOVA technique, the F-value is used to judge whether the difference among several sample means is significant or is just a matter of sampling fluctuations (C R Kothari, 1990). In the case of significance tests in comparing percentages to determine whether there is a significant difference between them. The one or two-sample t-test between figures in percent was used using statistical software. The measurable indicators for assessing the impact of the project have been developed. These were done keeping in view the parameters captured in the study leading to the primary data analysis. The baseline indicators matrix thus developed attempts to record and evaluate the project impact in future.





CHAPTER III

3.0 RESULTS AND DISCUSSION

3.1 Basic socioeconomic characteristics of the respondents

Age of the respondents: Age of the respondents is an important factor that influences production decision and provides authentic information. The younger respondents are more technically efficient than the older one and can easily adopt new technology and thereby increase efficiency (Ajibefun et al., 1996, Battese and Coelli, 1995). In the study, the average age of the respondent was recorded as 51.2 (ranged 47.3-53.3) years in all selected metro areas of Dhaka city and that of 48.18 (ranged 46-50) years in Chittagong areas which implied that they reached at mid-level age (Table 3.1). There is, however, little variation (mean comparison) in the age of respondent in all selected areas of both cities. Analytical results revealed that the mean differences of the age of respondents varied insignificantly among the locations in both Dhaka and Chittagong city areas Rahman et al (2013) found that the rooftop gardeners belonged to age group 31-40 years (41.56%) and 41-50 years (30.22%).

Household size: Results revealed that the average size of household (family) of the respondent was recorded as 5.4 in all selected metro areas of Dhaka city and that of 5.3 for Chittagong city areas. All the figures were found to be higher than national average (urban) of 4.41 (BBS, 2014). Among the location, the highest household size was found to be 6.5 at Tejgaon areas and the lowest was 4.1 at Uttara areas in Dhaka city while it was found to be as the highest 5.6 in Doubelmooring and the lowest in Panchlaish areas of Chittagong city (Table 3.1). The differences of household size varied significantly among the location in both cities. In one-way ANOVA results indicated that the mean difference of average household size were found to be highly significant in Dhaka areas but insignificant in Chittagong areas.

Education: Education of the respondent can play a vital role in efficient management and operations as well as in successful production. An educated person can have better access to the relevant technical and scientific information and can make judicious economic decisions. In the study, the education level of the respondents have been categorized into 4 (four) groups such as secondary, higher secondary, graduate and post-graduate. Results revealed that the average education level was recorded as the highest 54 per cent respondent was found as graduate and the lowest secondary level 14 per cent irrespective of all selected areas of Dhaka city and it was 31 per cent and 13 per cent for Chittagong city, respectively (Table 3.2). The differences of education level among the locations were found statistically significant. Rahman et al (2013) observed that the year of schooling of the gardeners was 10-12 years (Secondary to higher secondary level).

Occupation: A good number of diversified respondents were involved in various occupations such as services (Govt. and private), business, student, housewife and retired. The highest 38.8 per cent respondents were found as business man followed by retired person and housewives (21%) irrespective of all selected areas of Dhaka city. On the other hand, the highest 26.7 per cent respondents were found as housewife followed by business man (22.3 per cent) and retired person (19.7 percent) irrespective of all areas of Chittagong (Table 3.3). Rahman et al (2013) reported that the major income activities of rooftop gardeners were centered on government job (25.56%), while involvement in rooftop gardening by the retired employee was 17.3%.



Table 3.1 Average age and household size of the respondent in the selected areas of Dhaka and Chittagong city

City/Metropolitan areas	Average age (years)	Average size of household (person/family)		
		Total	Male	Female
A. Dhaka city (n=97)				
Mohammdpur	51.43	5.07	2.29	2.79
Mirpur	50.53	5.94	2.65	3.29
Gulshan	53.11	4.61	2.17	2.56
Uttara	53.50	4.10	2.15	1.95
Kamrangirchar	47.31	6.38	3.38	3.00
Tejgoan	51.08	6.50	3.50	3.00
All	51.16	5.43	2.69	2.77
F-value	0.569 ^{ns}	4.614 ^{**}	5.649 ^{***}	2.889 ^{**}
B. Chittagong city (n=45)				
Panchlaish	50.27	5.13	2.40	2.73
Doubelmooring	48.20	5.67	2.67	3.00
Patenga	46.07	5.20	2.87	2.33
All	48.18	5.33	2.65	2.69
F-value	0.952 ^{ns}	3.71 ^{**}	4.73 ^{**}	3.03 [*]

Note: *** significance at 1% level of probability, ** significance at 5% level of probability, * significance at 10% level of probability and ^{ns} = not significant

Table 3.2 Percentage distribution of education level of the respondents

City/Metropolitan areas	Education level as % of each respondents				Total
	Post-graduate	Graduate	Higher Secondary	Secondary	
A. Dhaka city (n=97)					
Mohammdpur	28.6	57.1	14.3	-	100.0
Mirpur	5.9	64.7	29.4	-	100.0
Gulshan	11.1	77.8	11.1	-	100.0
Uttara	25.0	50.0	15.0	10.0	100.0
Kamrangirchar	12.5	25.0	43.8	18.7	100.0
Tejgoan	-	50.0	50.0	-	100.0
All	16.62	54.10	27.27	14.35	100.0
B. Chittagong city (n=45)					
Panchlaish	40.3	13.2	27.0	20.4	100.0
Doubelmooring	27.1	53.0	20.1	-	100.0
Patenga	13.6	27.4	40.3	20.7	100.0
All	27.00	31.20	29.13	20.55	100.00



Table 3.3 Percentage distribution of occupation of the selected respondents

City/Metropolitan areas	Occupation as % of each respondents						Total
	Govt. service	Private service	Business	Student	Housewife	Others (Retired)	
A. Dhaka city (n=97)							
Mohammadpur	14.0	17.0	29.0	-	14.0	26.0	100.0
Mirpur	12.0	-	41.0	-	29.0	18.0	100.0
Gulshan	11.0	11.0	22.0	-	28.0	28.0	100.0
Uttara	5.0	15.0	30.0	-	20.0	30.0	100.0
Kamrangirchar	13.0	6.0	56.0	-	19.0	6.0	100.0
Tejgoan	8.0	-	55.0	-	17.0	20.0	100.0
All	10.5	12.3	38.8		21.2	21.3	100.0
B. Chittagong city (n=45)							
Panchlaish	26.0	7.0	7.0	7.0	33.0	20.0	100.0
Doubelmooring	27.0	-	13.0	7.0	33.0	20.0	100.0
Patenga	-	13.0	47.0	7.0	14.0	19.0	100.0
All	17.67	6.67	22.33	7.00	26.67	19.67	100.0

Source: Household Survey 2016

3.2 Potential spaces of rooftop in the selected household

Potential space on rooftops is an utmost important for improving or establishing the garden in the cities. In the study, results revealed that per household total rooftops space was recorded as 1916 sq. feet in Dhaka city areas. Of them average 1593 sq. feet was considered as potential space for gardening and 323 sq. feet was remained as open but presently the open space are being used in different purposes by the owner of the building. On the other hand, per household total rooftops space was recorded as 2190 sq. feet in Chittagong. Of them 1607 sq. feet was considered as potential space for gardening and 583 sq. feet was remained as open but presently the open space are being used in different purposes by the owner of the building (Table 3.4). Analysis results implied that the differences in the potential rooftop space per household was found to be significant at 10% level of probability ($F= 2.002^*$ and $p < .086$) among the location in Dhaka areas). But in the case of other areas in Dhaka and Chittagong it was found to be insignificant (Table 3.4).

3.3 Current uses of residential rooftops in Dhaka and Chittagong city

Presently the rooftops of the residential buildings are being used for various purposes such as gardening, drying and washing clothes, playground for children, entertaining guest, passing pleasure time etc. In the study, results revealed that the highest percentages of the respondents are being used for gardening (87%), drying cloths (25.8%) and others (11.5%) irrespective of all areas in Dhaka city while it was 71% for gardening, 42% for drying cloths and others (33%) in Chittagong city areas (Table 3.4). Islam (2004) reported that the rooftops of the residential buildings was used for drying (88%) and washing (45%) clothes, as playground for children (97%), for entertaining guests (20%), for cool air during the summer (64%), to sunbathe in the winter (33%). On most of the roofs, some form of pleasure garden exists (78%), sometimes there are fruit gardens (12%), and, less often, vegetable garden as well (8%).



Table 3.4 Estimation of potential space on rooftop and use of open space in the selected household

City/Metropolitan areas	Size of space on rooftop per household (In sq. feet)			Used of open space as % of each respondents		
	Total space	Open space	Potential space for RTG	For gardening	For drying cloths	Others
A. Dhaka city (n=97)						
Mohammdpur	1500	325	1175	79	36	7
Mirpur	1950	338	1612	76	6	24
Gulshan	1806	256	1550	94	11	11
Uttara	2035	460	1575	90	35	10
Kamrangirchar	2131	356	1775	100	25	-
Tejgoan	2075	200	1875	83	42	17
All	1916	323	1593	87.0	25.8	11.5
F-value	1.863 ^{ns}	1.111 ^{ns}	1.210 ^{ns}			
B. Chittagong city (n=45)						
Panchlaish	2007	440	1567	87.0	53.0	-
Doubelmooring	2320	453	1867	53.0	13.0	33.0
Patenga	2243	856	1387	73.0	60.0	-
All	2190	583	1607	71.0	42.0	33.0
F-value	0.324 ^{ns}	0.921 ^{ns}	1.415 ^{ns}	-	-	-

3. 4 Vegetables and fruits produced in current RTG's in Dhaka and Chittagong city

Different fruits and vegetables were found to be grown by the respondents. The green plants and flora in the house influence the feeling of harmony, simplicity and authenticity. Natural green has significant effect on overall life satisfaction and improve the occupant's wellbeing (Rashid et al. 2010). Bangladesh is blessed with many horticultural crops. More than 90 vegetables, 60 fruits and 25 spices are being grown in the country. The average annual growth rates of yield for all fruits were found to be positive in the Chittagong region (Uddin et al. (2016). But, not all types of fruits can be produced on the rooftop. So, species selection for roof gardening is an important task for every gardeners. The types and mix are chosen in the city depending upon individual household food preferences, availability of seeds/sapling types that can be grown on the rooftop, climate and availability of soils. In the study, the following vegetables and fruits were produced in the existing rooftop garden in Dhaka and Chittagong city areas. But the composition of fruits and vegetables are differed in each household significantly. However, the commonly produced fruits and vegetables in the current RTG both in Dhaka and Chittagong cities are shown below:

Fruits produced in current RTG		Vegetables produced in current RTG	
- Mango	- Sapota	- Brinjal	- Bitter gourd
- Guava	- Karanda	- Tomato	- Sweet gourd
- Hog-plum	- Custard apple	- Cabbage	- Snake gourd
- Jujubee	- Litchi	- Cauliflower	- Pointed gourd
- Lemon	- Pummelo	- Chilli	- Cucumber
- Pomegranate	- Karambola	- Indian Spinach	- Red amaranth
- Orange	- Dragon fruit	- Lady's finger	- Stem amaranth
- Malta	- Grape	- Country bean	- Lettuce
- Papaya	- Strawberry	- Yard long bean	- Capsicum
- Wax apple	- Bilombi	- Bottle gourd	- Coriander
		- Teasle gourd	- Arum
		- Ash gourd	- Drum stick
			- Sugarcane



It was observed in the study that both in Chittagong and Dhaka areas, about 25 vegetables and 20 fruits were found to be grown in the current RTG's. But the composition of fruits and vegetables varied significantly among the household. The highest 61.6% rooftop gardeners produced tomato followed by brinjal (61%), Indian spinach (47.8%), Lady's finger (46.8%), Chilli (45.3%) and Gourds' (25%) irrespective of all selected metro areas of Dhaka city (Table 3.5).

On the other hand, the highest (57%) respondent was found to be grown Chilli in the current RTG's followed by Brinjal (48%), Indian spinach (35.7%), Gourds (35.6%), Lady's finger (31%), Tomato (23.7%), Red amaranth (23%), Bean (18%), Cabbage and Cauliflower (7%) irrespective of all selected areas in Chittagong city (Table 3.5).

Table 3.5 Vegetable crops planted in the current RTG in the selected areas of Dhaka and Chittagong city

City/ Metropolitan areas	Vegetables									
	Chilli	Brinjal	Indian Spinach	Gourds (all)	Lady's finger	Tomato	Red amaranth	Bean	Cabbage	Cauliflower
In % of respondents who produced the vegetables in RTG										
A. Dhaka city (n=97)										
Mohammdpur	50	57	43	21	29	36	-	29	-	-
Mirpur	53	65	59	12	35	63	-	19	12	-
Gulshan	44	56	39	22	56	67	17	17	6	6
Uttara	60	60	50	25	50	68	25	20	15	-
Kamrangirchar	50	63	63	38	69	69	50	19	-	-
Tejgoan	15	67	33	33	42	67	17	18	-	-
All	45.3	61.3	47.8	25.1	46.8	61.6	18.1	20.3	5.5	6.0
B. Chittagong city (n=45)										
Panchlaish	53	40	27	7	40	7	7	7	7	7
Doubelmooring	51	53	33	73	20	13	-	20	-	-
Patenga	67	51	47	27	33	51	40	27	-	-
All	57.0	48.0	35.6	35.6	31.0	23.6	23.3	18.0	7.0	7.0

In the case of fruits, the highest 75% respondents have grown mango followed by lemon (72.8%), Guava (72.8%), Pomegranate (38.5%), Hog-plum (26.5%), Jujubee (24.5%), Papaya (24%), Wax apple (13%), Malta (12.8%) and Sapota (10.5%) irrespective of all selected metro areas in Dhaka city (Table 3.6).

On the other hand, in Chittagong city areas, the highest 69% respondents have grown mango followed by Guava (74.5%), lemon (64%), Hog-plum (42.3%), Pomegranate (33.5%), Jujubee (29%), Orange/malta (22%), Wax apple (20%), Sapota (13%) and Papaya (11.3) irrespective of all selected areas in Chittagong city (Table 3.6). [Islam \(2004\)](#) observed that in the rooftop garden the following fruits and vegetables are commonly grown; Guava, Lemon, Papaya, Grapes, Green Chili, Pumpkin, Squash, Onion, Garlic, Coriander leaves, Tomato, Mushroom, Leafy vegetables (e.g., Callaloo, Jute Leaf and Red Amaranthus), and other (e.g., Cucumber, Flat bean, Bitter ground, Ribbed ground, Ladies finger, Amaranthus, Dhudi, Cowpea and Brinjal). Some families also cultivate spices and plants used for medicinal purposes.



Table 3.6 Fruit crops planted in the current RTG in the selected areas of Dhaka and Chittagong city

City/ Metropolitan areas	Fruit plants									
	Mango	Lemon	Guava	Hog- plum	Pomegr- anate	Jujubee	Malta	Papaya	Wax apple	Sapota
In % of respondents who have grown the respective fruits in RTG										
A. Dhaka city (n=97)										
Mohammdpur	57	64	57	7	29	-	7	29	-	7
Mirpur	76	59	71	24	29	41	12	29	-	6
Gulshan	83	78	78	44	33	33	11	22	44	22
Uttara	85	84	85	29	65	40	20	20	15	15
Kamrangirchar	75	69	81	38	50	25	19	19	13	13
Tejgoan	75	83	75	17	25	8	8	25	8	-
All	75.2	72.8	74.5	26.5	38.5	24.5	12.8	24.0	13.3	10.5
B. Chittagong city (n=45)										
Panchlaish	67	60	57	27	47	33	26	20	27	33
Doubelmooring	40	33	36	33	20	27	13	7	13	7.
Patenga	100	100	93	67	-	27	27	7	-	-
All	69.0	64.3	62.0	42.3	33.5	29.0	22.0	11.3	20.0	13.3

3.5 Input used in current RTG's in Dhaka and Chittagong city

Two types of input were commonly used in rooftop gardening: 1. Fixed input such as planting base materials i.e. earthen pot, plastic containers, cemented drum and its preparation; various planting tools (e.g. hoes, spades, sprinkles), seeds, vegetative parts and seedlings, etc. Fixed input i.e. irrigation equipment varied according to roof size, species composition and permanent structure needed for maintenance, and (ii) variable input includes fertilizers and insecticides, sapling/seed/seedling for replanting, soil change, weeding, hoeing, human labour etc. The amount of fertilizer and pesticide to be applied depend on the nature of species and soil mixture. When gardeners spend the gardening time for another job and get some wages then this wage is the opportunity cost of roof gardening.

Uses of fertilizer/compost and netting in the existing RTG was recorded as ‘yes’ or ‘no’ basis of the respondents in the selected areas. Results revealed that almost all respondents used fertilizer and compost in the rooftop garden. But they didn’t know the recommended packages of fertilizers and compost for different container systems in rooftop gardening. Results revealed that about 71.8% of the respondents used compost, urea (44%), TSP (38.5%), MoP (26.8%), Zypsum (13.6%) and netting (23%) irrespective of all selected metro areas in Dhaka city. On the other hand, about 62 per cent respondent used compost, urea (49%), TSP (49%) and MoP(33%) in the rooftop garden but only 10 percent respondents used netting for controlling birds and insect irrespective of all areas in Chittagong city (Table 3.7). Generally the urban dwellers work in garden either in morning or evening depending on their leisure time. Moreover, they enjoy while gardening. Therefore, for roof gardening, the opportunity cost seems to be zero. Roof gardening is not an easy going activities like conventional gardening as its success largely depend on suitable species selection, appropriate containers, proper cultural methods and sufficient supervision and control (Rahman et al, 2013).

Table 3.7 Input used in current RTG's in the selected areas of Dhaka and Chittagong city

City/Metropolitan areas	In % of respondents who used the inputs in the RTG					
	Compost	Urea	TSP	MoP	Zypsum	Netting
A. Dhaka city (n=97)						
Mohammdpur	50	36	36	21	7	29
Mirpur	80	47	53	35	12	29
Gulshan	78	56	44	28	28	28
Uttara	75	55	25	35	5	20
Kamrangirchar	56	38	31	25	13	25
Tejgoan	92	33	42	17	17	8
All	71.83	44.17	38.50	26.83	13.67	23.17
B. Chittagong city (n=45)						
Panchlaish	80.0	47.0	40.0	27.0	-	-
Doubelmooring	53.0	33.0	47.0	33.0	-	13.0
Patenga	53.0	67.0	60.0	40.0	-	7.0
All	62.0	49.0	49.0	33.3	-	10.0

3.6 Knowledge of compost and fertilizer application of the respondents

In the study, more than 94% of the respondents in Dhaka city areas were having knowledge on the function of compost and fertilizer application in the current RTG's but more than 75 percent respondents in Chittagong areas opined that they had no idea about the function of compost and fertilizer application for rooftop garden. This might be due to lack of training on this topic (Figure 3.1 and Figure 3.2).

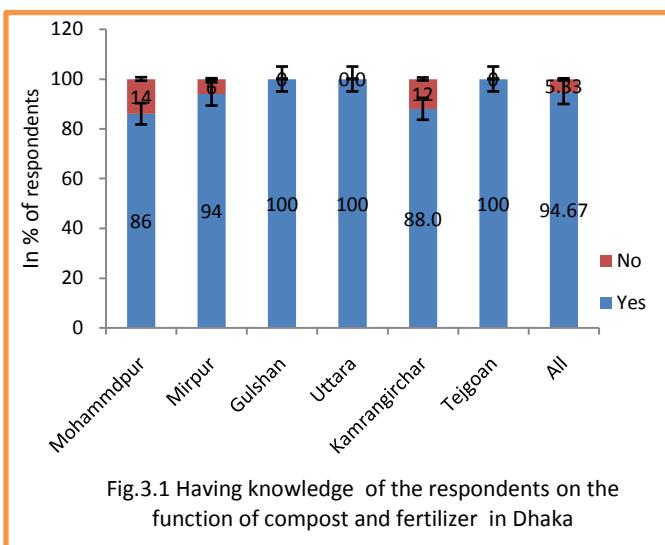


Fig.3.1 Having knowledge of the respondents on the function of compost and fertilizer in Dhaka

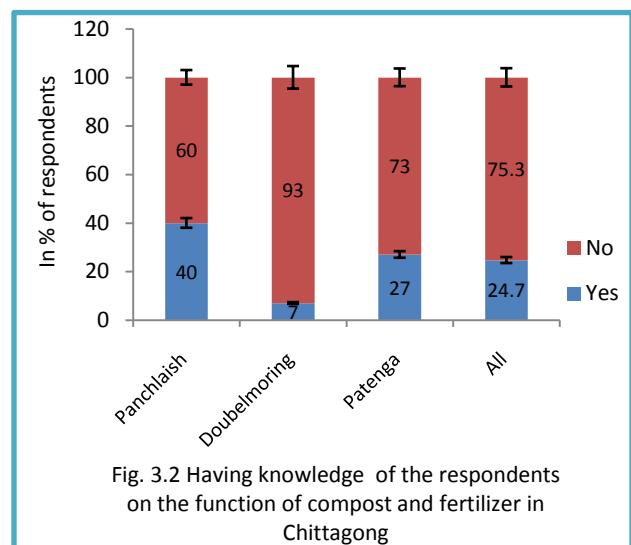
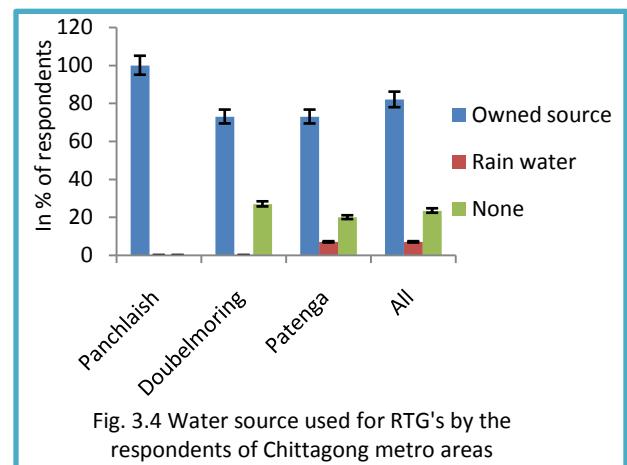
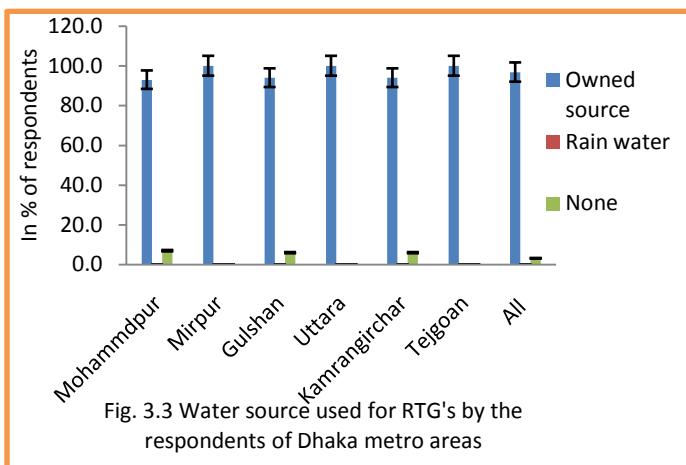


Fig. 3.2 Having knowledge of the respondents on the function of compost and fertilizer in Chittagong

3.7 Water source used for current RTG's in Dhaka and Chittagong city

Water source is essential for providing irrigation to the RTG's plant. Irrigation can contribute to produce higher yield of plant. In the study, two main water sources (owned and rain water harvest) were observed. In the selected areas of Dhaka city, more than 90% respondents used owned source (owned supply water)

for irrigation to the RTG's plants. Irrespective of all selected areas of Chittagong, about 82 per cent respondents used owned source (owned supply water) for irrigation in the RTG. About 23 percent respondent didn't provide irrigation but only 7 per cent used the conserved rain water for irrigation purpose (Figure 3.3 and Figure 3.4).



3.8 Container used in the current RTG's in Dhaka and Chittagong city

Container is one of the important input materials for growing plant in the rooftop. Selection of suitable containers is important factor for raising the plants well. Bienz (1980) reported that suitable growing medium must be prepared ensuring sufficient water and mineral elements. The various types of containers were used by the rooftop gardeners. The choice of containers was dependent on availability, preferences and nature of the growing plants. It was observed that in the selected areas of Dhaka city, the highest 72% respondents used half plastic drum, 62.5% plastic pot, 59% earthen pot, 53% half-drum made by GI sheet, 51% plastic bucket, concrete made bed/drum and 41.6% plastic tray (Table 3.8).On the other hand, in the selected areas of Chittagong, the highest 42% respondents used concrete made drum, 40% half-drum made by GI sheet, 31% plastic/earthen pot, 27% half plastic drum, 16% plastic bucket, 7% concrete made bed and 5% plastic tray (Table 3.8). Differences of container used were found to be significant among the locations in both cities. Rahman et al (2013) found that for rooftop gardening 77% used earthen containers, 8% cemented bed, 7% drums, 5% brass made pots and 3% others are in use.



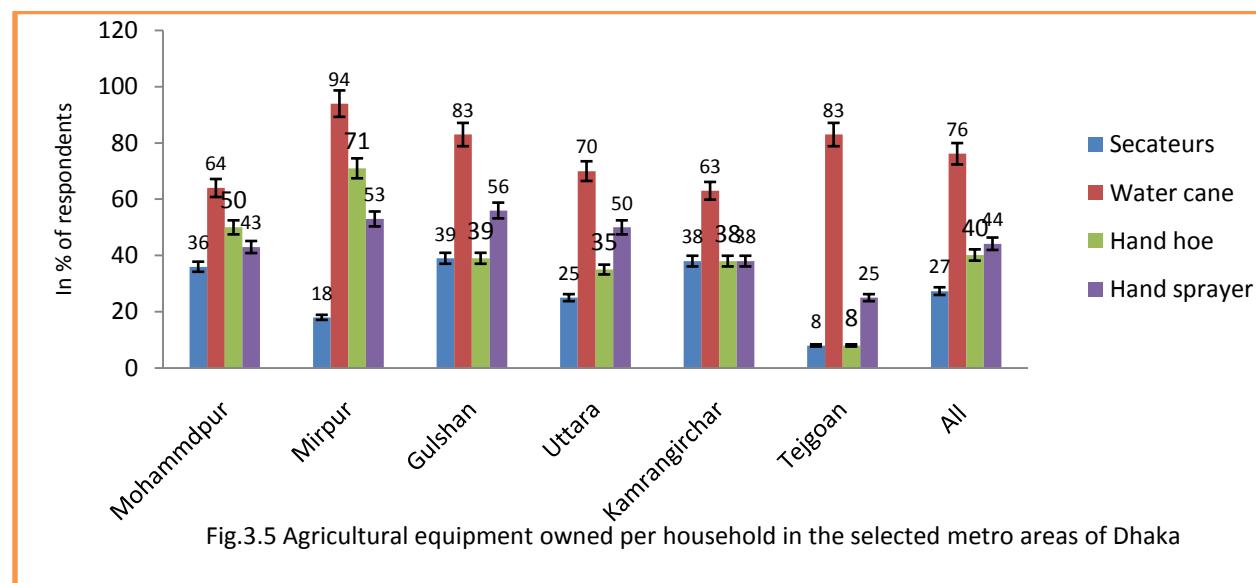


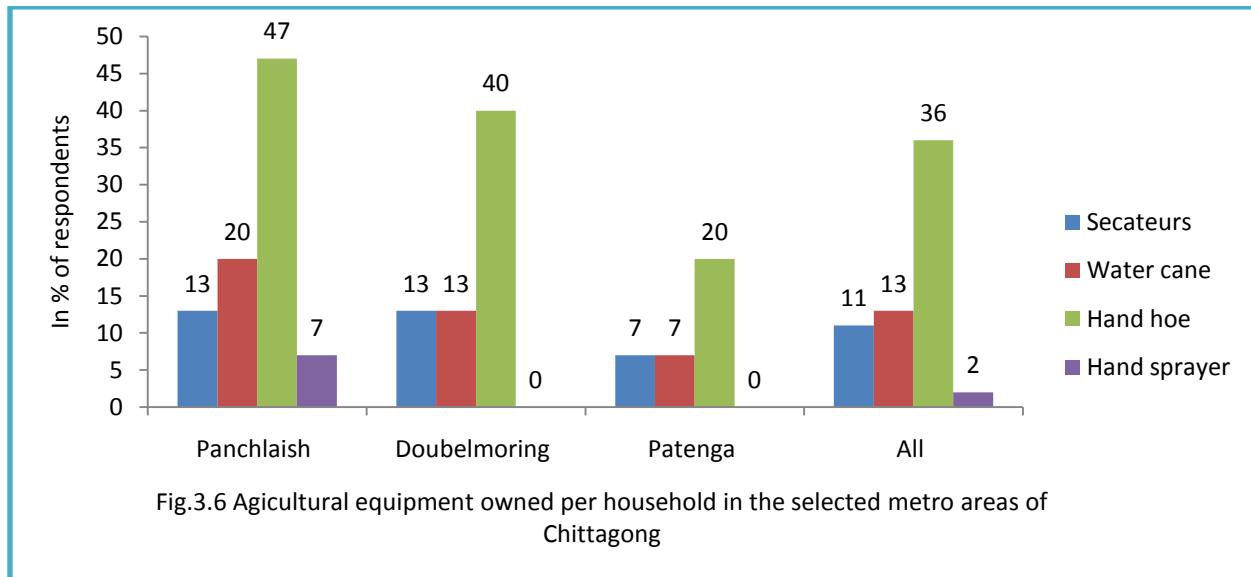
Table 3.8 Container used in the current RTG's in Dhaka and Chittagong city

City/Metropolitan areas	In % of respondents who used the following types of container in the RTG's							
	Half plastic drum	Half drum made by GI sheet	Plastic pot	Earthen pot	Concrete made drum	Plastic tray	Plastic bucket	Concrete made bed
A. Dhaka city (n=97)								
Mohammdpur	86.0	64.0	79.0	57.0	71.0	71.0	71.0	50.0
Mirpur	76.0	47.0	76.0	59.0	53.0	53.0	47.0	41.0
Gulshan	72.0	44.0	56.0	67.0	56.0	39.0	44.0	56.0
Uttara	65.0	40.0	50.0	55.0	40.0	45.0	45.0	45.0
Kamrangirchar	50.0	50.0	56.0	50.0	44.0	25.0	50.0	44.0
Tejgoan	83.0	75.0	58.0	67.0	42.0	17.0	50.0	75.0
All	72.00	53.33	62.50	59.17	51.00	41.67	51.17	51.83
B. Chittagong city (n=45)								
Panchlaish	40.0	53.0	40.0	27.0	40.0	7.0	27.0	13.0
Doubelmoring	20.0	20.0	27.0	33.0	33.0	-	13.0	-
Patenga	20.0	47.0	27.0	33.0	53.0	7.0	7.0	7.0
All	27.0	40.0	31.0	31.0	42.0	5.0	16.0	7.0

3.9 Per household agricultural equipment owned

Agricultural equipment is one kind of household assets, generally used for growing agricultural produces that might ensure food security at household level. It can be seen from Figure 3.5 that the highest (76%) of the respondents owned water cane followed by hand sprayer (44%), hand hoe (40%) and secateurs (27%) irrespective of all locations in Dhaka city. It was reported that about 36% household owned hand hoe, 13% water cane, 11% secateurs and only 7% hand sprayer irrespective of all locations in Chittagong (Figure 3.6). Agriculture equipment owned by the households varied significantly across the respondents and locations





3.10 Average yield of vegetables and fruits per RTG's in Dhaka and Chittagong city

The average yield of vegetables and fruits was obtained for 10 common vegetables and fruits in the study. The yield data was converted into kilogram per household per year basis. Results revealed that the average yield was found to be higher from gourds (20.8 kg/year/RTG) followed by tomato (11.9 kg), cauliflower (8.5 kg), brinjal and lady's finger (4.9 kg), bean (4.5 kg), cabbage (4.1kg), Indian spinach (3.5 kg) and red amaranth (3.1 kg) irrespective of all locations in the selected metro areas of Dhaka city (Table 3.9). Differences of yield of all vegetables were found statistically insignificant except red amaranth in Dhaka areas.

On the other hand, in the Chittagong areas the highest yield was obtained from gourds (all types) as 9.25 kg per RTG per year followed by tomato (8.47 kg), lady's finger (6.03 kg), Indian spinach (5.27kg) and bean (4.0 kg) irrespective of all locations (Table 3.9). The yield data varied among the respondents and locations. Differences of yield for all vegetables were found statistically insignificant except brinjal for Chittagong areas.

In the case of fruits, Table 3.13 revealed that the highest average yield was obtained from guava (6.5 kg/year/RTG), followed by mango (4.8 kg), papaya (3.6 kg), hog-plum (3.3 kg), lemon (3.3 kg), wax apple (2.9 kg), jujube (2.0kg), pomegranate (1.4 kg) and sapota(1.0 kg) irrespective of all selected locations in Dhaka city. Differences of yield of all fruits were found statistically insignificant except red mango and jujubee in Dhaka areas.

On the other hand, the highest yield was obtained from papaya (7.1 kg) followed by lemon (5.4kg), wax apple (4.1kg), guava (3.2kg) and mango (2.7 kg)irrespective of all locations (Table 3.10). The mean differences of yield of guava was found statistically highly significant but insignificant in all others fruits in Chittagong areas.



In Dar us Salaam (Tanzania), urban agriculture provides the city with about 100,000 t year⁻¹ of fresh food (Ratta and Nasr 1996) and in Shanghai, a municipal programme promoting urban agriculture enabled cereal supplies of about 2,000,000 t year⁻¹ (Yi-Zhang and Zhangen, 2000). In Toronto (Canada), Peck (2003) found that from 650,000 m² of “greened” rooftops growing vegetable crops, a production of 4.7 million kg was produced per year. Kaethler (2006) stated that in Vancouver (Canada), it is easy to find RTGs producing food above supermarkets, restaurants and social housing. Also in Cleveland (Ohio, USA) showed that hydroponic RTGs produced an average of 19.5kg m⁻² year⁻¹ against 1.3 kg m⁻² year⁻¹ in conventional urban gardens (Grewal and Grewal 2012).

Table 3.9 Average yields of vegetable crops produced in per RTG's in Dhaka and Chittagong city

City/Metropolitan areas	Vegetables									
	Brinjal	Tomato	Cabbage	Cauliflower	Chilli	Indian Spinach	Lady's finger	Bean	Gourds (all types)	Red amaranth
Yield (kg/RTG/year))										
A. Dhaka city (n=97)										
Mohammdpur	5.31	12.80	-	15.00	5.07	2.33	3.75	8.00	25.67	-
Mirpur	4.68	6.67	5.67	-	2.00	4.00	3.75	4.00	12.5	-
Gulshan	3.90	13.75	3.00	2.00	2.75	3.43	4.70	4.00	14.83	4.00
Uttara	4.17	7.00	3.67	-	2.21	5.40	4.60	4.75	21.54	5.60
Kamrangirchar	3.90	7.32	-	-	3.13	3.90	6.09	1.67	24.51	2.00
Tejgoan	7.75	24.00	-	-	1.58	2.50	6.80	5.00	26.25	1.00
All	4.95	11.92	4.11	8.50	2.79	3.59	4.95	4.57	20.88	3.15
F-value	0.98 ^{ns}	1.44 ^{ns}	1.85 ^{ns}	1.14 ^{ns}	0.73 ^{ns}	1.00 ^{ns}	1.75 ^{ns}	1.54 ^{ns}	0.89 ^{ns}	3.08 ^{**}
B. Chittagong city (n=45)										
Panchlaish	6.0	15.0	2.0	2.0	2.8	4.3	3.0	4.2	10.0	3.0
Doublelmoring	7.9	6.0	-	-	6.2	9.4	11.7	5.7	14.5	-
Patenga	3.1	4.4	-	-	6.2	2.1	3.4	2.1	3.25	3.0
All	5.67	8.47	0.67	0.67	5.07	5.27	6.03	4.00	9.25	2.00
F-value	2.60*	0.176 ^{ns}	1.00 ^{ns}	1.00 ^{ns}	1.94 ^{ns}	1.20 ^{ns}	0.511 ^{ns}	0.293 ^{ns}	0.530 ^{ns}	0.500 ^{ns}

Table 3.10 Average yields of fruits per RTG's in the selected metro areas of Dhaka and Chittagong city

City/Metropolitan areas	Fruit plants									
	Mango	Guava	Hog-plum	Jujubee	Lemon	Pomegranate	Sweet Orange	Papaya	Wax apple	Sapota
Yield (Kg/RTG/year)										
A. Dhaka city (n=97)										
Mohammdpur	4.0	8.3	3.0	-	5.7	1.3	1.0	3.5	-	1.1
Mirpur	2.8	5.5	6.0	3.0	4.1	1.6	1.3	6.0	-	1.0
Gulshan	6.6	5.9	3.5	2.7	2.1	1.3	0.6	2.8	2.1	1.2
Uttara	5.9	6.2	3.0	1.2	2.8	0.9	0.6	2.8	0.3	1.0
Kamrangirchar	5.7	7.9	2.2	2.1	2.3	2.1	0.8	3.3	3.5	0.8
Tejgoan	4.3	5.2	2.5	1.0	3.2	1.7	1.0	3.7	6.0	-
All	4.88	6.50	3.37	2.00	3.37	1.48	0.88	3.68	2.98	1.02
F-value	1.91*	0.78 ^{ns}	1.26 ^{ns}	2.45 ^{**}	0.607 ^{ns}	1.17 ^{ns}	0.466 ^{ns}	0.97 ^{ns}	1.06 ^{ns}	1.22 ^{ns}
B. Chittagong city (n=45)										
Panchlaish	1.9	2.3	1.8	2.1	5.1	0.59	1.0	10.3	1.9	1.3
Doublelmoring	2.1	3.0	0.5	2.0	8.1	1.2	3.6	7.5	6.3	5.0
Patenga	4.1	4.3	1.0	1.8	3.1	0.66	0.44	3.5	-	0.69
All	2.70	3.20	1.10	1.97	5.43	0.82	1.68	7.10	4.1	2.33
F-value	1.67 ^{ns}	5.50 ^{***}	1.645 ^{ns}	2.19 ^{ns}	0.036 ^{ns}	1.55 ^{ns}	1.29 ^{ns}	0.666 ^{ns}	1.27 ^{ns}	0.261 ^{ns}



3.11 Income from current RTG's in Dhaka and Chittagong city areas

Employment and income from small-scale non-farm activities, is of growing importance in the economy of developing countries (Hecht et al. 1988; Gunatilake et al. 1993; Arnold 1995). It was observed from the survey that generally very few people consider rooftop gardening commercially to get profit. The return varies due to size and number of species. This analysis was done on the basis of average production and current market prices. The gross return was calculated by adding all income derived from vegetables and fruits in each sampled RTG. Results revealed that the gross return was obtained from all vegetables and fruits produced in the current RTG's in Dhaka city areas which were at Tk. 2686 per year. The highest gross return came from fruits at Tk. 1486 than vegetables at Tk. 1200 in Dhaka areas. Differences of gross return were found statistically highly significant at 1% level of probability (Table 3.11).

On the other hand, the gross return in the Chittagong areas was estimated by Tk. 1395.5 per year while the highest gross return was found from all fruits (Tk. 833.5 per year) than all vegetables at Tk. 562.0 (Table 3.9). Differences in the incomes among the locations were found statistically insignificant in the selected areas of Chittagong (Table 3.11). Results indicate that, the current rooftop gardening was not found to be financially viable. So, there is a scope for raising income at current RTG's through scientific interventions in both cities. [Rahman et al \(2013\)](#) reported that on an average economic return per year was Tk.13966 from vegetables and Tk. 10,500 from fruits in rooftop gardening in Sylhet City Corporation area but they claimed that very few people consider rooftop gardening commercially to get profit and from the cost-return analysis this gardening system can be economically viable if proper and scientifically managed. They also concluded that active government and NGOs could play vital role to increasing this activities by providing training and motivate people with technical aspects of rooftop gardening.

Table 3.11 Gross return from vegetables and fruits of current RTG in the selected areas, 2016

City/Metropolitan areas	Gross return (Tk./RTG/year) by locations		
	From vegetables	From fruits	Total
A. Dhaka city (n=97)			
Mohammdpur	1111	1085	2196
Mirpur	712	1172	1884
Gulshan	1158	1437	2596
Uttara	871	1445	2316
Kamrangirchar	1396	2408	3804
Tejgoan	1951	1368	3319
All	1200	1486	2686
F-value	-	-	5.56***
B. Chittagong city (n=45)			
Panchlaish	350	766	1116
Double mooring	761	775	1536
Patenga	575	960	1535
All	562	834	1396
F-value	-	-	0.136 ^{ns}

3.12 Willingness of the respondents for improving current RTG's

Cent per cent respondents of the selected metro areas of household in Dhaka and Chittagong city have shown their positive willingness and interest to improve the current RTG's if they get the proper logistic and technical support from the respective departments/agencies.



3.13 Preferences of vegetables and fruits for RTG

Out of available vegetables, the respondent preferred brinjal, chilli, tomato, red amaranth, Indian spinach, gourds, lady's finger, bean, stem amaranth and teasle gourd for rooftop garden. The highest 93% of the respondent preferred red amaranth followed by chilli 91.8%, tomato 91.6%, gourds 88%, stem amaranth 87.3%, gourds, brinjal, Indian spinach 88% and lady's finger and bean 85.8% irrespective of all selected metro areas of Dhaka city (Table 3.12). In the case of fruits, more than 92% respondent preferred mango and malta followed by lemon 90%, guava 89%, hog-plum, sapota 87%, jujube 87%, papaya 85%, wax apple 82% and karanda 80% irrespective of all selected areas of Dhaka city (Table 3.13). On the other hand, in Chittagong areas, cent percent respondent preferred brinjal for RTG followed by 97.7% chilli, 91% tomato, 60% red amaranths, 51% Indian spinach, 46% gourds (all types), 40% lady's finger, 31% bean, 17% teasle gourd particularly (Table 3.12). In the case of fruits, cent percent preferred mango and lemon, 93% guava, 82% hog-plum, 33% jujube, 27% wax apple, 26.7% sweet orange, 24% sapota, 20% Karanda and 16% pappy (Table 3.13).

Table 3.12 Percentage distribution of the respondents who preferred the vegetables for RTG

City/Metropolitan areas	In % of respondents who preferred the vegetable for RTG									
	Brinjal	Chilli	Tomato	Red amaranth	Indian Spinach	Gourds	Lady's finger	Bean	Stem amaranth	Teasle gourd
A. Dhaka city (n=97)										
Mohammdpur	93	93	93	93	79	79	93	79	86	93
Mirpur	100	100	100	100	100	100	100	100	100	100
Gulshan	94	100	94	100	100	83	89	83	89	78
Uttara	70	75	75	90	95	95	50	95	55	60
Kamrangirchar	88	100	88	94	81	88	100	75	94	88
Tejgoan	83	83	100	83	75	83	83	83	100	83
All	88.0	91.8	91.6	93.3	88.3	88.0	85.8	85.8	87.3	83.6
B. Chittagong city (n=45)										
Panchlaish	100	100	87	53	53	50	73	47	27	13
Doubelmoring	100	100	93	87	67	67	20	27	33	33
Patenga	100	93	93	40	33	20	27	20	13	7
All	100.0	97.7	91.0	60.0	51.0	45.7	40.0	31.3	24.3	17.7

Table 3.13 Percentage distribution of the respondents who preferred the fruits for RTG

City/Metropolitan areas	In % of respondents who preferred the fruit for RTG									
	Mango	Lemon	Guava	Hog-plum	Jujube	Wax apple	Malta	Sapota	Karanda	Papaya
A. Dhaka city (n=97)										
Mohammdpur	93	79	93	86	93	86	86	93	86	93
Mirpur	100	100	100	100	100	100	100	100	100	100
Gulshan	83	89	67	94	67	67	89	78	69	76
Uttara	90	90	85	70	100	65	95	75	50	70
Kamrangirchar	94	94	100	94	94	94	94	88	100	88
Tejgoan	92	92	92	83	67	83	92	92	75	83
All	92.0	90.6	89.5	87.8	86.8	82.5	92.6	87.6	80.0	85.0
B. Chittagong city (n=45)										
Panchlaish	100	100	93	87	20	7	13.0	7.0	7.0	20.0
Doubelmooring	100	100	93	93	53	47	40.0	40.0	33.0	20.0
Patenga	100	100	93	67	27	-	27.0	-	-	7.0
All	100.0	100.0	93.0	82.3	33.3	27.0	26.6	23.5	20.0	15.6



3.14 Occurrences of pest and diseases in current RTG's

Attack of pest and diseases was the common phenomenon for all plants. Attack of birds, attack of insect, flower dropping, fruit dropping and fruit rotten was the common occurrence for current rooftop garden reported by the respondents. The highest 52% of the respondent reported that attack of insect was the major problem for RTG plants followed by attack of birds 50%, flower dropping 44%, fruit dropping 40.5% and fruit rotten 39.6% irrespective of all selected areas of Dhaka city. About 40% to 64% respondent of Chittagong areas claimed that their roof gardens were affected by the above mentioned incidence (Table 3.14).

Table 3.14 Occurrences of pest and disease in fruits and vegetables at the existing RTG

City/Metropolitan areas	In % of respondents who faced the following occurrences in RTG				
	Attack of birds	Attack of insect	Flower dropping	Fruit dropping	Fruit rotten
A. Dhaka city (n=97)					
Mohammdpur	43	43	43	36	36
Mirpur	41	65	59	59	53
Gulshan	56	61	56	56	39
Uttara	55	50	45	25	37
Kamrangirchar	38	44	38	25	31
Tejgoan	67	50	25	42	42
All	50.00	52.17	44.33	40.50	39.67
B. Chittagong city (n=45)					
Panchlaish	40.0	73.0	53.0	47.0	67.0
Doubelmooring	33.0	53.0	40.0	44.0	40.0
Patenga	47.0	67.0	67.0	60.0	53.0
All	40.0	64.3	53.3	50.3	53.3





3.15 Measures for controlling pest and disease in current RTG's

Controlling pest and disease of the species is important for increasing the productivity and higher income. Integrated pest and diseases management is an important issue for RTG. Most of the respondents didn't follow the appropriate measures for controlling the pest and diseases in the RTG. This might be happened due to lack of training in this regard. In the study, more than 46% respondent used pesticides for controlling pest and diseases followed by herbal and IPM method (18%) but 19% respondents didn't found to take any kind of control measures against the pest and disease in current RTG's irrespective of all selected areas of Dhaka city. About 40% respondents of all selected areas of Chittagong used pesticide for controlling pest and diseases at their current RTG (Table 3.15)

Table 3.15 Measures for controlling pest and disease in current RTG's of Dhaka and Chittagong city

City/Metropolitan areas	Measures taken for controlling pest and disease			
	Used pesticide	Used herbal method	Used IPM technology	None
In % of respondents				
A. Dhaka city (n=97)				
Mohammdpur	36.3	7.2	7.3	29.2
Mirpur	59.6	12.5	-	6.4
Gulshan	61.1	28.2	39.4	17.2
Uttara	65.7	20.1	5.2	-
Kamrangirchar	31.4	19.5	25.1	-
Tejgoan	25.3	25.7	17.3	25.0
All	46.6	18.9	18.8	19.5
B. Chittagong city (n=45)				
Panchlaish	47.3	-	-	33.1
Doubelmooring	27.0	-	7.0	20.5
Patenga	47.5	7.2	-	13.0
All	46.6	7.2	7.0	22.2

3.16 Per capita consumption of vegetables and fruits of the sample households

Per capita vegetables consumption was recorded at 56.7 and 83.2 gm per capita per day for the sample household in Dhaka and Chittagong, respectively which was lower than national average of 155 gm/capita/day might be due to unaware about the nutritional value of vegetables but the consumption of potato was found much higher than that of national average in both cities (Table 3.16). Comparing the districts, the highest amount of vegetables was consumed by the household in Potenga, Chittagong (93.4gm/capita/day) and the lowest amount of vegetables consumption was recorded (51.7gm/capita/day)by the household in Mirpur, Dhaka. Results revealed that vegetables (chilli, bean, brinjal, teasle gourd, indian spinach and lady's finger) consumption among the surveyed household varied significantly but the consumption of other vegetables were found to be insignificant among the surveyed household in Dhaka city areas. On the other hand, differences of consumption of potato, chilli and cucumber were found to be statistically significant in the selected areas of Chittagong city (Table 3.16).

In the case of fruits consumption per capita per day was found to be 67.9 gm and 70.2 gm irrespective of all selected household in Dhaka and Chittagong city, respectively. Both the figure was found to be higher



than that of national average (50.5 gm). This might be due to all respondents were richer and they were much more capable to purchase fruits from the market. But they opined that they were not happy to purchase fruits from market due to food safety reasons. Results revealed that fruit consumption particularly mango, sweet orange and apple among the surveyed household varied significantly but the consumption of other fruits varied insignificantly among the respondents and locations in both cities (Table 3.17).

Table 3.16 Per capita consumption of vegetables in the surveyed household

City/Metropolit an areas	Quantity (gm) of vegetables consumed per capita per day										All
	Potato	Brinjal	Teasle gourd	Tomato	Chilli	Indian Spinach	Lady's finger	Bean	Cucumb er	Red amaranth	
A. Dhaka city (n=97)											
Mohammdpur	47	72	82	85	27	78	85	98	86	139	79.9
Mirpur	83	46	51	40	32	64	52	32	64	53	51.7
Gulshan	65	48	29	73	31	61	48	22	32	60	46.9
Uttara	56	68	20	59	23	81	25	47	64	53	49.6
Kamrangirchar	91	53	33	52	45	78	56	52	74	65	59.9
Tejgoan	71	60	25	112	43	45	47	24	33	64	52.4
All	68.8	57.8	40.0	70.2	33.5	67.8	52.2	45.8	58.8	72.3	56.7
F-value	1.25 ^{ns}	1.88*	2.09*	1.37 ^{ns}	4.11***	2.44**	2.19*	3.00**	1.53 ^{ns}	1.16 ^{ns}	-
B. Chittagong city (n=45)											
Panchlaish	95	66	56	46	78	122	97	97	71	97	82.5
Doubelmoring	84	51	110	10	66	157	32	76	76	76	73.8
Patenga	92	108	44	92	77	139	102	96	92	92	93.4
All	90.3	75.0	70.0	49.3	73.7	139.3	77.0	89.7	79.7	88.3	83.2
F-value	6.57***	1.44 ^{ns}	0.911 ^{ns}	0.485 ^{ns}	6.38***	0.700 ^{ns}	1.89 ^{ns}	0.146 ^{ns}	2.52*	0.111 ^{ns}	-
National average (urban), HIES, 2013	66.7	-	-	-	-	-	-	-	-	-	155.0

Note: *** indicate significant at 1% level of probability, ** Significant at 5% level of significant and * Significant at 10% level of probability.

Table 3.17 Per capita consumption of fruits in the surveyed household

City/ Metropolitan areas	Quantity (gm) of fruits consumed per capita per day										All
	Mango	Guava	Grape	Apple	Lemon	Jackfruit	Sweet orange	Papaya	Wax apple	Sapota	
A. Dhaka city (n=97)											
Mohammdpur	202	75	23	21	14	33	23	37	-	-	54
Mirpur	143	83	22	35	31	40	32	50	20	17	47
Gulshan	274	145	41	76	27	-	56	68	4	10	78
Uttara	264	169	69	85	35	41	56	41	-	-	95
Kamrangirchar	260	55	25	42	78	20	-	37	-	-	74
Tejgoan	133	90	49	60	74	32	34	60	-	4	60
All	212.7	102.8	38.2	53.2	43.2	33.2	40.2	48.8	12.0	10.3	67.9
F-value	3.23**	9.21***	2.86**	1.97*	1.88*	1.47 ^{ns}	1.41 ^{ns}	2.87**	39.3***	8.19***	-
B. Chittagong city (n=45)											
Panchlaish	105	34	92	32	42	-	60	97	-	39	74.1
Doubelmooring	121	47	72	19	40	76	35	64	64	-	68.8
Patenga	283	79	-	77	42	44	-	96	32	-	67.6
All	169.7	53.3	82.0	42.7	41.3	60.0	47.5	85.7	48.0	39.0	70.2
F-value	10.26***	0.460 ^{ns}	0.825 ^{ns}	2.728*	0.756 ^{ns}	1.06 ^{ns}	3.77**	0.55 ^{ns}	0.642 ^{ns}	1.00 ^{ns}	-
National average (urban), HIES, 2013	-	-	-	-	-	-	-	-	-	-	50.4

Note: *** indicate significant at 1% level of probability, ** Significant at 5% level of significant and * Significant at 10% level of probability.

3.17 Knowledge of the respondents on nutritional value of fruits and vegetables

Irrespective of all locations in Dhaka, more than 97% respondents had the knowledge on nutritional value of fruits and vegetables while it was 82% for Chittagong city areas (Figure 3.7 and Figure 3.8). This might be due to well-educated respondents. But they claimed that training on that issue would help to improve their existing knowledge.

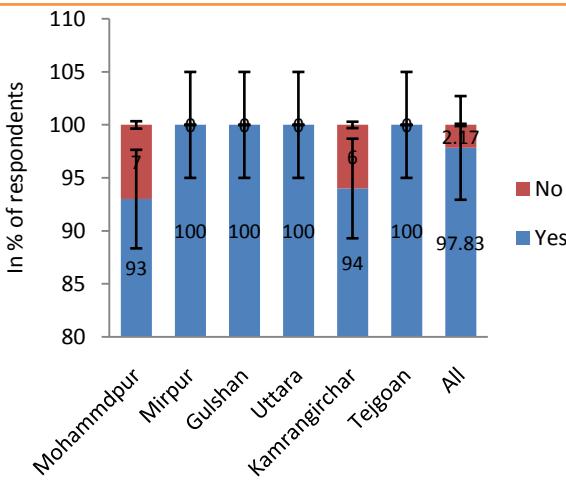


Fig. 3.7 Having knowledge of the respondents on nutritional value of fruits and vegetables in Dhaka city

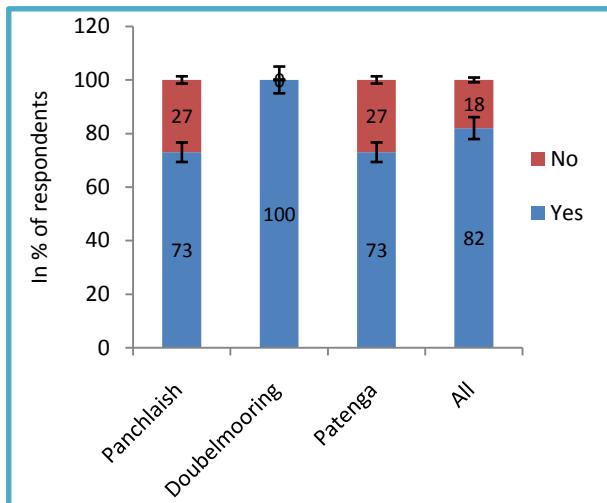


Fig. 3.8 Having knowledge of the respondents on nutritional value of fruits and vegetables in Chittagong

3.18 Training received on RTG by the respondents

Skilled manpower is essential for ensuring success of RTG at household level. Skills can be improved by training and it could have a role to play in the food production process (Uddin et al, 2010). In the study, more than 56% of the respondents in Dhaka city areas received training on roof top gardening from non-government organizations. But in Chittagong areas, it was reported that no respondents received training on RTG. This might be happened due to lack of initiatives to provide such kind of training to the urban dwellers (Figure 3.9 and Figure 3.10). Differences of the training received were found to be significant at the .05 critical alpha level, $t= 3.345$, $p=.001$ among the locations in Dhaka areas.

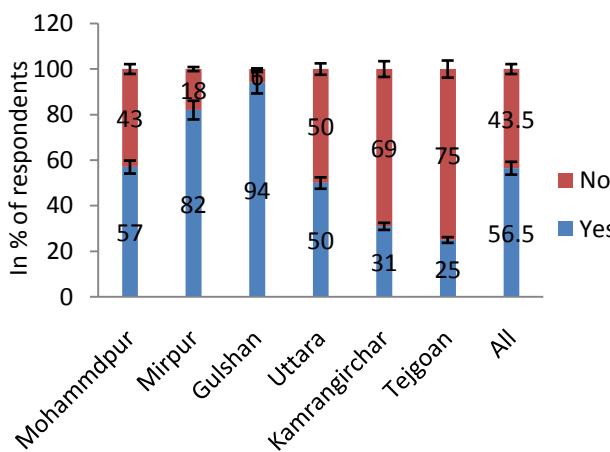


Fig. 3.9 Training received by the respondents on RTG in Dhaka city areas

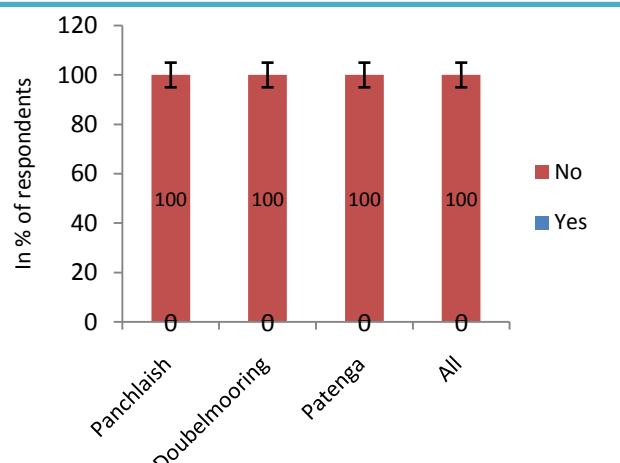


Fig. 3.10 Training received on RTG in Chittagong city areas

3.19 Training needs assessment for RTG improvement

Training needs assessment on RTG is essential for developing skill of the urban dwellers which can lead to food and nutritional security at household level. In the study, based on respondents opinions 5 (five) training topics on rooftop gardening were identified during the study such as (i) compost and fertilizer management in the container system, (ii) pest management, (iii) irrigation and water management, (iv) post-harvest management of garden product and (v) container preparation and planting of seedling and sapling which was reported by 92%, 85%, 80%, 82% and 81% respondents of all areas of Dhaka city, respectively. On the other hand, that of reported by 84%, 80%, 78%, 64% and 49% respondents in the selected areas of Chittagong (Table 3.18).

Table 3.18 Training needs assessment for rooftop gardening in Dhaka and Chittagong city areas

City/Metropolitan areas	Training needs (topics)				
	Compost & fertilizer management	Pest management	Irrigation management	Container preparation & planting	Post-harvest techniques
In % of respondents					
A. Dhaka city (n=97)					
Mohammadpur	79.2	79.1	79.3	79.2	79.2
Mirpur	100.0	76.3	65.2	82.5	76.3
Gulshan	78.5	89.6	67.1	78.3	78.5
Uttara	95.2	80.2	90.3	90.2	90.2
Kamrangirchar	100.0	94.3	88.5	81.7	88.5
Tejgoan	100.0	92.5	92.2	83.4	75.4
All	92.2	85.3	80.4	82.6	81.4
B. Chittagong city (n=45)					
Panchlaish	93.0	67.2	80.3	67.7	53.5
Doublemoring	67.5	73.6	67.0	53.4	27.3
Patenga	93.7	100.0	87.6	73.0	67.1
All	84.7	80.3	78.3	64.7	49.3

3.20 Having idea of the respondents on hydroponic system for RTG

Hydroponics is a subset of hydro culture and is a method of growing plants using mineral nutrient solutions in water, without soil. Terrestrial plants may be grown with their roots in the mineral solution only, or in an inert medium, such as perlite or gravel. This is just one type of hydroponic gardening known as N.F.T (nutrient film technique). In the study, it was reported that about 42% of the respondents in Dhaka areas had no idea on hydroponic system for rooftop gardening while it was 89% in the Chittagong areas. But 58% respondents in Dhaka areas and 11% of Chittagong areas had the idea conceived from TV news and DAE personnel (Figure 3.11 and 3.12). Differences the idea on hydroponic system was not found significant at the .05 critical alpha level, $t= 1.803$, $p=.071$ among the all locations.

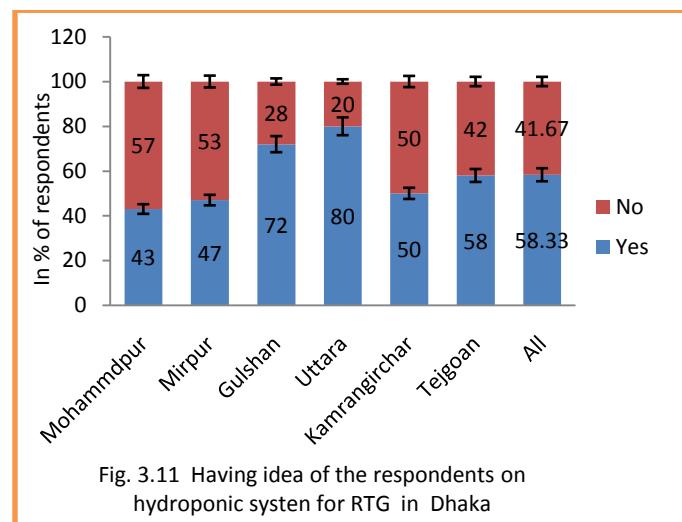


Fig. 3.11 Having idea of the respondents on hydroponic system for RTG in Dhaka

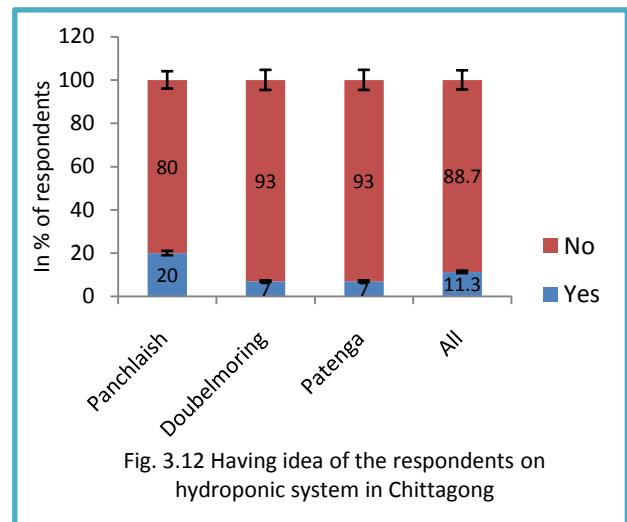


Fig. 3.12 Having idea of the respondents on hydroponic system in Chittagong

3.21 Responses to the benefits of RTG

While some benefits are directly measurable and have ‘hard’ values such as the energy savings due the insulation provided by the soil and vegetation of a green roof, many benefits are not readily measurable and their values are difficult to estimate such as the health benefits of a rooftop garden. In the study, six types of common benefits were derived by the respondent opinions and these are shown in the (Table 3.19).





Table 3.19 Responses to the benefits of RTG by the selected respondents in Dhaka and Chittagong city

City/Metropolitan areas	In % of respondents reported to the benefits of RTG					
	Increase social status	Economic support	Ensure safety vegetables & fruits	Increase nutritional value	Added cultural value	Environmental benefits
A. Dhaka city (n=97)						
Mohammedpur	100.0	100.0	100.0	100.0	100.0	100.0
Mirpur	100.0	100.0	100.0	100.0	100.0	100.0
Gulshan	83.3	83.3	78.3	83.3	83.3	78.4
Uttara	80.5	70.6	70.5	80.4	85.6	80.3
Kamrangirchar	88.0	25.9	81.1	81.2	94.5	69.3
Tejgoan	75.2	92.1	83.8	75.6	92.1	92.5
All	87.8	78.7	85.6	86.8	92.6	86.8
B. Chittagong city (n=45)						
Panchlaish	7.3	73.2	100.0	53.2	13.1	73.0
Doubelmoring	40.5	53.5	87.6	20.4	27.3	47.5
Patenga	27.0	53.1	73.3	67.7	-	47.3
All	24.9	59.9	87.0	47.1	20.2	55.9

3.22 Responses to carry the inputs on the rooftop

Carry the input (soil, compost, fertilizer, container, seedling, sapling etc.) on the rooftop is important for successfully gardening. In the study, in Dhaka city areas about 90% of the respondents reported that they had no problem for carrying the input on their rooftop and other 10% respondents opined that it would be a problem if not carefully carry the input to the rooftop. On the other hand, more than 52% respondents of Chittagong areas reported that they had no problem for carrying input to the rooftop (Figure 3.13 & 3.14).

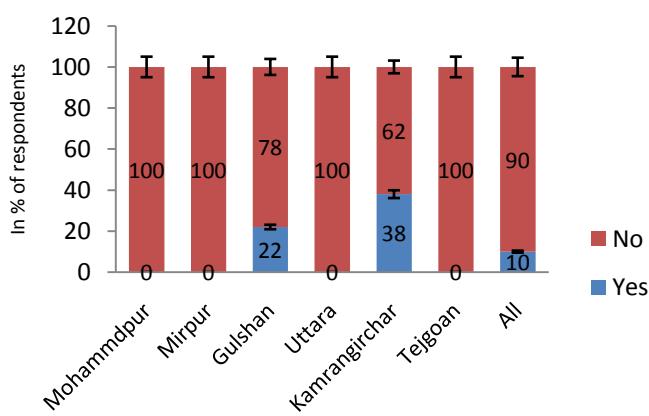


Fig. 3.13 Responses to carry the inputs on the rooftop in Dhaka city areas

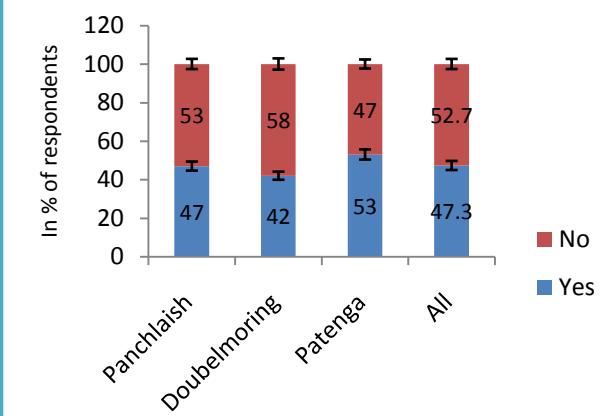
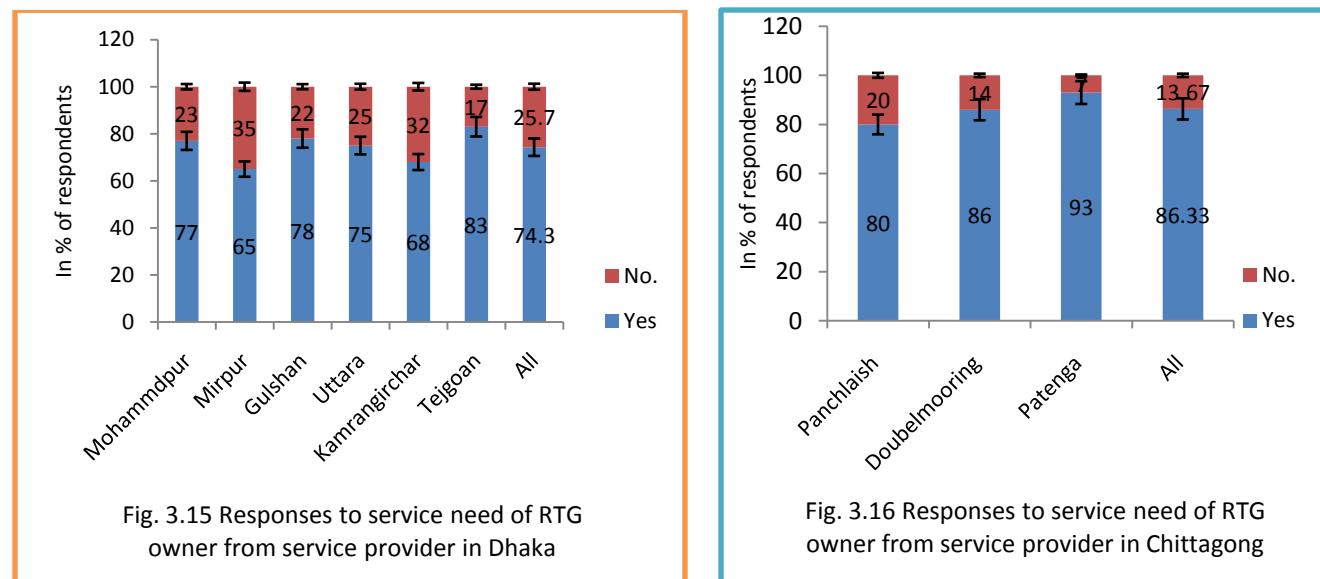


Fig. 3.14 Responses to carry the inputs on the rooftop in Chittagong city areas



3.23 Responses to service need from service provider (SP) and its payment systems

Service provider (include DAE/research/NGO's personal, nursery man, fertilizer/seed dealer, container seller etc.) can play an important role for supplying necessary materials and technical support to the gardeners in time. A trustworthy and sincere service provider can lead to successful implementation of the rooftop garden in the respective areas. Most of the respondents in both city areas opined that they needed sufficient service like input supply, weakly visit for management and technical support to the rooftop garden. In all Dhaka areas, more than 74% of the respondent claim that they needed service from service provider while it was 86% in all Chittagong areas (Figure 3.15 and Figure 3.16). All the respondents reported that they are agree for cash payment system to the service provider.



3.24 Responses to need support from research and extension personnel for RTG

A particular question was throwing to the respondents for getting their responses on the support needed from the Department of Extension (DAE) and Research Institute for RTG. The types of support derived from interview were classified into 5 (five) categories such as (i) technical support (ii) input/logistic support (iii) cash/credit support, (iv) training support and (v) monitoring through regular visit. The highest 94% of the respondents claim that they needed technical support followed by input support (92%), training (88%) and monitoring through regular visit (72%) in all selected areas of Dhaka city (Table 3.20). On the other hand, all most all respondents opined that they needed technical and input support for RTG followed by training (84.6%) and monitoring through regular visit (80%) in all selected areas of Chittagong city (Table 3.20 and Figure 3.59). Interestingly, very limited respondents demanded for the credit/cash support, might be due to higher income level among the respondents in both city areas.



Table 3.20 Responses to need support from extension personnel for RTG

City/Metropolitan areas	Types of support needed for RTG				
	Technical	Input support	Cash support	Training	Regular visit
A. Dhaka city (n=97)	In % of respondents				
Mohammdpur	93.4	93.2	36.0	93.3	86.3
Mirpur	100.0	100.0	-	88.7	82.2
Gulshan	100.0	83.3	6.4	83.3	83.1
Uttara	85.3	85.7	20.3	90.1	60.4
Kamrangirchar	88.5	100.0	-	94.0	44.7
Tejgoan	100.0	92.5	-	83.6	75.4
All	94.5	92.5	10.5	88.8	72.0
B. Chittagong city (n=45)					
Panchlaish	100.0	100.0	13.4	73.2	60.3
Doubelmooring	100.0	100.0	20.2	87.0	87.6
Patenga	100.0	100.0	7.7	93.5	93.1
All	100.0	100.0	13.8	84.6	80.3

3.25 Marketing of rooftop gardening products

There was no organized marketing system of rooftop gardens products in the study area. This might be due to limited production of the rooftop garden and that of consumed by the members of household. From this study it was found that rooftop garden production, income and self-use increases with the increasing size, investment and what purposes owner managed his garden. After ensuring available production of the gardens, the marketing system can be developed for sale their product.

3. 26 Conclusions and recommendations

Urban agriculture (UA) particularly rooftop gardening contributes to creation of healthy environment and food security. It increases supply of fresh food and by enhancing the quality of perishable foods reaching urban consumers. The Government of Bangladesh does not have any specific policy provision or legislation that promotes urban agriculture in general or rooftop garden in particular. There is no specific city policy that promotes urban agriculture in Dhaka and Chittagong. This is important as has been shown in many countries like Switzerland and Germany and there is huge potential for roof gardening. Government guidance and encouragement is urgently needed to expand the RTG. *Bangali Nature* intends to continue its work in greening roofs, helping to refine our understanding of the role they can play in the conservation of biodiversity in towns and cities. In order to realize the potential that RTG can offer, major shifts in thinking of the policy makers is required. The most radical one would be on part of the city officials to integrate Urban Agriculture (UA) in general and RTG in particular with urban planning. In order to do this, some fundamental research and experimentation/demonstration is required. This project could be successful with required political commitment and concerted action, underpinned by scientific research, technical expertise and good design.

Based on the findings the following recommendation is made:

- Utilization of the unused or potential space on rooftop for fresh food production would be an ideal option;



- Plant composition at the current RTG's can be justified as an economic point of view and capacity of the roof.
- Crop diversity can be enhanced by introducing high yielding variety of vegetables and fruits developed by BARI and other relevant organizations;
- Yield of vegetables and fruits in the current RTG's could be increased through proper management and ensuring regular visit by the respective service provider or DAE or NGO's personal.
- Selection of crop and container should be taken carefully for improving RTG in the respective areas;
- Training on container preparation for planting, fertilizer application and irrigation method is essential for the rooftop gardeners;
- Hands on training on pest and disease management for RTG could help to produce quality and safety production;
- Strengthening linkage between RTG owner and service provider (SP) in the respective location;
- Functional and technical capacity should be strengthened in rooftop garden association in both Dhaka and Chittagong city. Wherever it was absent, the new association could be formed with the help of DAE/NGO personal;
- Regular monitoring can be established in collaboration with DAE, NGO and BARI etc.;
- Need to change mindset of the RTG owner for adopting improved technologies through motivation or awareness program;
- Ensure free access to the RTG for input carrying to the rooftop and monitoring;
- All inputs should available with the help of service provider in the locations;
- Finally, a technically feasible, socially acceptable, economically viable and environment friendly RTG model should be developed and up-scaling gradually in both Dhaka and Chittagong city areas.

3. 26. 1 Potential area for RTG in Dhaka and Chittagong city

According to the project document entitled' Enhancing Urban Horticulture Production to Improve Food and Nutrition Security (TCP/BGD/3503)' and respondents opinion the following potentialities was expressed for RTG in Dhaka and Chittagong. These are stated below:

- Most of the rooftops of Dhaka and Chittagong cities are flat and suitable for gardening;
- Most of the buildings in these two cities are suitable for RTG as rooftops are easily accessible;
- Large number of government and commercial office buildings rooftop are not currently under use and can be used for gardening;





- Climate is suitable for urban agriculture particularly rooftop gardening in the city areas;
- Available fruits and vegetables variety developed by BARI, many of them are suitable for rooftop gardening. According to respondents opinion the BARI mango-4, BARI mango-11, BARI malta-1 and BARI brinjal (Pls. see picture) would be suitable for RTG;
- In the city, requirement of irrigation for growing plant is less than requirement in the field;
- There already exists network of pipelines for water supply to the rooftop for almost every building in the Dhaka and Chittagong city. Centrally Dhaka's Water Supply & Sewerage Authority (WASA) does not yet provided restriction on supply of water for the roof or garden;
- The gardeners can easily buy their materials from the nearby nurseries. The existence of huge number of nurseries in the city will ensure the supply of plants and inputs in time.
- Most of the owners of the residential buildings are willing to initiate RTG. This indicates that a possibility of economic return will make them interested in renting out or leasing out rooftops for gardening purposes.
- Large number of government and commercial office building roofs that are not currently under any use which can be used for gardening.
- Declaration of Dhaka Mayor (South) for the reduction of holding tax of rooftop garden owner can be seen as an opportunity for RTG initiatives for the urban dwellers. The declaration can be easily tuned in line with the practice (*Daily Prothom Alo*, dated on 2/6/2016).
- There already exists network of pipelines for water supply to the rooftop for almost every buildings surveyed. Dhaka WASA has an advertisement on the national television that shows how to use water properly for gardening purposes.
- There is an extensive NGO networking within the country from where a range of assistance is available for initiating new projects for RTG.
- The gardeners can easily buy their materials from the nearby adjacent markets of the city.



Photo courtesy: BARI mango-4, RARS, BARI,
Hathazari, Chittagong 2016



Photo courtesy: DG, BARI, Shared
in Face book on 23 October 2016



- The existence of huge number of nurseries in the city will ensure the supply of plants in time.
- Most of the owners of the residential buildings are willing to initiate RTG. This indicates that a possibility of economic return will make them interested in renting out or leasing out rooftops for gardening purposes.

3. 27 Constraints of RTG in Dhaka and Chittagong

Some major constraints that have been found from the interview, survey and relevant literature search include:

- Many of the city residents do not have training on rooftop gardening. Starting gardening without proper training may lead to frustration, which might result in reluctance of the people in initiating new projects.
- There are several constraints due to the present conditions of buildings. For example, some buildings are old, especially in the old part of the city.
- Dhaka and Chittagong is situated in an active seismic zone. Many experts express their concerns about possibility of building collapse as a large number of 3-5 storied brick buildings are built with very little seismic resistance. Moreover, many of these are founded on recent loose fills, with a possibility of ground failures during earthquake.
- Even some new buildings are not suitable for RTG. There have been several cases of buildings collapsing the city in recent years. These happened due to the noncompliance with the building construction regulation. In the city some buildings exceeded the limit of number of stories allowed to build on specified building foundation and structures.
- Although supply of water is not an issue for those who can afford it, there is a shortage of water particularly during the dry season from November to March.
- The main insight resulting from the survey and discussion is that the people are not fully aware of the benefits that can be tapped from RTG. This is mainly due to the fact that there are no organized efforts on it from government, community and NGO side.
- There is a pool of agricultural skills among the recent migrants, which has not been utilized for UA. Through the use of RTG their potential can be tapped.

3. 27.1 Strategies to improve rooftop gardening in Dhaka and Chittagong city areas

Based on respondents opinion the following strategies have been made for improving current RTG's in Dhaka and Chittagong metro areas:

- Strong political commitment and solid policy guidelines are the preconditions for creating supportive environment for RTG
- A committee consisting of both the government representatives and the related organizations should be formed in order to identify the possible strategies
- Building regulations and laws have to be amended that take into consideration the weight of RTG in the construction. New buildings and structures should have sound foundations to stand against the muddy loose earth. Pillars of the proposed buildings should be strong enough to bear the load of the building.
- Donor agencies and NGOs effort in promoting RTG will create an environment that will help the Government and the public in this regard.
- Availability of external support for expansion of RTG may be explored.
- A suitable rooftop gardening model can be developed and implemented through maintaining linkage among BARI, DAE and NGO's.



- Strengthening functional and technical capacity of rooftop gardening association (RGA) in Dhaka and Chittagong city areas;
- Maintaining linkage among the rooftop gardeners and service provider.

3.28 Measurable indicators/variables for assessing the impact of the project activities

Sl. No.	Name of Indicators	Method of estimation	Remarks
1	Beneficiary household	# no. of beneficiary household increase or decrease	
2	Uses of potential rooftop space	# Potential space use for rooftop garden before and after project	
3	Crop composition	# Crop composition index increase or decrease or # % change of respondents who produce crops	
4	Yield of vegetables	# % of yield increase or decrease	
5	Yield of fruits	# % of yield increase or decrease	
6	Types of vegetables and fruits	# no. of vegetables/fruits increase or decrease at RTG	
7	Income from RTG	# % of income increase or decrease	
8	Garden equipment	# number and types of equipment in the household before and after project;	
9	Type of container use	# number and type of sustainable container use in the garden before and after project	
10	Nutritional status	# Change of vegetable consumption per capita per day # Change of fruit consumption per capita per day	
11.	Training receive	# no. of training provide # % of beneficiaries who receive training on RTG	

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Annexure:

Annex1. Matrix of rooftop spaces per sample households in the selected metro areas of Dhaka city

Sample No.	Locations/ respondents	Total space of roof top (In sq. feet)	Potential space for RTG (In sq. feet)
Mohammadpur			
1	Md.Humayun Kabir	1800	1500
2	Roji Sultana	1200	1000
3	Habibur Rahman	1000	800
4	Taslima Azad	2000	1900
5	Kamruzzaman	3000	3000
6	Islam Uddin Mandal	800	600
7	AbulKashem	1300	700
8	FazlulHaque	1000	700
9	Mosharraf Hossain	1800	1400
10	Hossain Md.Emran	1400	1200
11	HasmataraYasmin	2250	1250
12	Samsuddin Alam	750	200
13	Md. Moslem Uddin	1200	1000
14	Md. AkterHossen	1500	1200
Mirpur			
15	Hosneara Begum	2200	1500
16	TahminaHossen	1950	1200
17	Hosneara Lily	2400	2400
18	Sahjalaluddin	1500	1500
19	AnowaraMohsin	1000	800
20	Md. RazzabAli	2000	1800
21	Mominuddin Ahmed	1500	1200
22	HaziTofazzalHossen	4400	3800
23	M. NazmulHaque	1400	1000
24	SorowariMehediMobarak	1600	1600
25	Bappi	2500	2000
26	Kadiza Akhter	3500	3000
27	NurunnaharParul	1200	700
28	Hazi Mohammad Nurul Islam	1300	1200
29	SyadAzizur Rahman	1200	1000
30	Md.Abu Noman	2000	1700
31	Shipton	1500	1000



Gulsan

32	Md. Shahid Hossain	1600	1600
33	Jahidul Islam Chowdhury	1600	1600
34	Anowarul Kabir	1800	1200
35	HabibaSorowar	1800	1500
36	Kamrul Ahsan	2000	1200
37	Ataur Rahman	2200	1800
38	Md. Jahirul Islam	2000	2000
39	UmmeKulsumUrmī	2400	2400
40	Afsana Begum	1700	1600
41	MahbubaAfroz	2000	1600
42	ShahjadAlamgir	1200	1000
43	Md. Saidur Rahman	2200	2000
44	Mrs. Salma	1000	1000
45	Md.ShirajulHaque	2500	2200
46	Md.Nuruzzaman	2000	1800
47	Dr. Giasuddin Ahmed	1000	900
48	Md.Mohsin Mia	1700	900
49	Mrs.Ratna	1800	1600

Uttara

50	Abdul Malek	1600	1500
51	Abul Hashem	1800	1600
52	Jalil	2000	1800
53	Fajlul Rahman Ashrafi	2000	1900
54	Faruque(Dina)	3000	2900
55	Shahana Akhter	1400	1200
56	AlhazMosharraf Hossain	1200	1000
57	M.Saiful Islam(Turjo)	1000	800
58	Saidur Rahman Dipu	2600	2500
59	FatemaBarkotullaā	400	400
60	Kismataraislam	1800	1800
61	ShirinAkhter	2000	1200
62	Md. Masum Billah	2800	1800
63	FirozaKhanom	2000	1800
64	Shahana Akhter	2400	1800
65	Nazmul Hasan	2500	1400
66	AnowarHossen	3500	2200
67	Abul Bashar	2200	1600
68	Colonel KLenin Kamal	3000	1200
69	Major Kamal	1500	1100



Kamrangirchar

70	Haji Md.Ali Hossain	2400	2200
71	Nurul Islam Majumder	2500	2000
72	Mahbub Hasan Shourov	1400	1200
73	Marium Bibi	1600	1300
74	Abdul Wadud	2600	2400
75	Kulsum	1800	1400
76	Nadim Hossain	2300	1700
77	Md. Akash	1600	1400
78	Abdul Mannan	1500	1200
79	Md. Sahibran	1200	1200
80	Md. Monsur Ali	3800	2400
81	Sahnaz Begum	2200	1800
82	Kamrul Hasan	3200	2800
83	Evana Akhter	2500	2200
84	Md. Abdul Karim	2000	2000
85	Captain Aziz Ahmed	1500	1200

Tejgaon

86	Md. Abdur Rob	1600	1500
87	Ferdaus Ara Begum	2400	2100
88	Shima Akhter	1500	1400
89	Farida Yasmin	1600	1400
90	Md. Kamal Hossain	2400	2000
91	Mamun	1400	1200
92	Md. Rezaul Karim	3000	2800
93	Rafiqul Islam	2000	1200
94	Abu Taher Munna	1600	1500
95	Hazi Md. Selimuddin Khan	1500	1500
96	Rezaul Haque Chowdhury	3500	3500
97	Md. Moniruzzaman	2400	2400

Mean	1916	1593
Minimum	400	200
Maximum	4400	3800
Standard Deviation	704.78	646.31
N	97	97



Annex 2. Matrix of rooftop spaces per sample households in the selected metro areas of Chittagong city

Sample No.	Locations/Respondents	Total space of roof top (In sq. feet)	Potential space for RTG (In sq. feet)
Panchlaish			
1	Nurul Amin Chowdhury	2500	2000
2	Tahmina Begum	2000	1800
3	Jahid Sharif	2200	2000
4	Siddiqul Islam	2500	2500
5	Tahera Begum	2200	1500
6	Jahedul Islam	4000	2000
7	Saleha Begum	2000	1000
8	Mrs. RawshanAra	700	700
9	Sumi Akter	1500	1200
10	NasrinAkter	1900	1900
11	Maleka Begum	1900	1900
12	Md.Saiduzzaman	1800	1600
13	Shirazul Islam	200	1200
14	C.S. Mahmud	2500	1000
15	Mrs. Rabeya Chowdhury	2200	1200
Doublemooring			
16	Nure Jannat	1600	1200
17	Jannat Jaman Chowdhury	1500	1200
18	SanowaraRajjak	7000	5000
19	Jamila AkterNeli	2600	1200
20	H.M. Jahidul Islam	1100	1100
21	PurabiChakrabarti	800	800
22	BelalHossen	1500	1000
23	Md. ArifulHaque	2000	2000
24	Md. Shafiqul Islam	1200	1200
25	Md. Jahangir Alam	3000	3000
26	MorshedAkter	2400	2400
27	NasrinAkter (Halishahar)	3500	3500
28	Shiraz Mia Khondaker	3000	2000
29	Nazli sultana	1600	900
30	Mrs .Julekha Chowdhury	2000	1500
Patenga			
31	ShafiqulMawla	1900	1500
32	A. N. M Mohsin	1400	1200
33	Mst. LutfulneshaFaruqi	1500	1200
34	Khokan Das	850	800
35	JavedIkbal	2100	1700
36	Md.Saiful Alam	2900	1200



37	Md.Delowar Hossain	1200	800
38	Md.Easin Murad	1800	700
39	Hazi Md. Ishak	1700	1500
40	Mubtasimfuad	3500	1200
41	Mustafa Kamal Kiron	3000	2500
42	Md. Nurul Islam	3000	1800
43	Mrs. Sayida Sultana	3000	1200
44	Md. AbulHassain	3300	1500
45	Md. Abu Azad	2500	2000
Mean		2190	1606.7
Minimum		200	700
Maximum		7000	5000
Standard Deviation		1094.3	797.0
N		45	45





Annex 3. Questionnaire of the baseline study, 2016

Baseline Study on Roof Top Gardening in Dhaka and Chittagong Cities of Bangladesh

*Under the Project of Enhancing Urban Horticulture Production to Improve Food and Nutrition Security
(TCP/BGD/3503)*

Sample No:

Questionnaire

[Note: Use √ mark in multiple choice questions and write in the blank space when necessary]

1. Types of respondent: (a) Existing RTG (b) No existing RTG

2. Name of the respondent:-----Mobile number:-----

Address : House no#-----Road no.# -----Flat No (if any).:-----, Ward no.:-----

Location:-----City: Dhaka /

Chittagong [Use √ mark]

2.1 Age:-----years 2.2 Education: (a) Illiterate (b) Primary (c) Secondary (d) Higher Secondary
(e) Graduate (f) Post-graduate (g) PhD 2.3 Family size (number of person/family): Male-----Female-----

2.4 Main Occupation: (a) Govt. service (b) Private service (c) Business (d) Agriculture (e) Others:-----

3. Technical Information:

3.1 Total space of roof top (In sq. feet):-----3.2 Open space in roof top-----sq.feet

3.3 Potential space for rooftop garden-----sq.feet 3.4 What purposes the open space is
being used: (a) for gardening (b) for drying cloths (c) None (d) Others (please specify):-----

3.5 If your answer is 3.4 (a) then answer the following question (3.5.1):

3.5. 1 Mention the name of existing plants and their respective yield and income in the last year one year

Sl. No.	Vegetables and others plants	Yield (Kg/year)	Income (Tk/year)	Sl.No	Fruits	Yield (Number of fruits)	Income (Tk./year)
1	Brinjal(<i>Begun</i>)			1	Mango (<i>Aam</i>)		
2	Tomato			2	Guava (<i>Payera</i>)		
3	Cabbage			3	Hog-plum		
4	Cauliflower(<i>Fulcopy</i>)			4	Jujubee (<i>Kul</i>)		
5	Chilli(<i>Marich</i>)			5	Banana (<i>Kola</i>)		
6				6	Lemon (<i>Lebo</i>)		



Table 3.5.1cont'd

Sl. No.	Vegetables and others plants	Yield (Kg/year)	Income (Tk/year)	Sl.No	Fruits	Yield (Number of fruits)	Income (Tk./year)
7				7			
8				8			
9				9			
10				10			

Note: Income of existing RTG will be derived by respective yield multiplied by its market price

3.6 If your answer is Q 3.3 (c), then 3.6.1 Do you agree to establish rooftop garden? Y/N; if answer is 'yes' mention the name of your choice of plants for rooftop garden:

Vegetables: (a) Brinjal (b) Tomato (c) Cabbage (d) Cauliflower (e) Chilli (f) Others (specify):-----

Fruits: (a) Mango (b) Guava (c) Lemon (d) Hog-Plum (Amra) (e) Others (specify):-----

3.7 Vegetables and fruits usually consumed by your family in last 3 days average

Sl. No.	Name of vegetables usually your family consumed per day	Total quantity (kg) consumed in last 3days average	Sl. No.	Name of fruits usually your family consumed per day	Total quantity (no.) consumed in last 3 days average
1			1		
2			2		
3			3		
4			4		
5			5		

3.8 Occurrence of pest and diseases of fruits and vegetables in the existing rooftop garden

(a) Attack of birds (b) Attack of insect (c) Flower dropping (d) fruit dropping (d) fruit rotten (e) None
(f) Others (Specify):-----

3.9 Used of bio-pesticides for controlling pest and diseases of fruits and vegetables in the existing roof top garden

(a) Used pesticide (b) Used herbal method (c) None (d) If others measures taken (Please specify):-----



3.10. Did you use the following inputs in your existing rooftop garden? [Y/ N; if ‘yes’ use ✓ mark in below]

Compost	Urea	TSP	MoP	Gypsum	Pesticide	IPM technology	Netting	Others:
---------	------	-----	-----	--------	-----------	----------------	---------	---------

3.11 Have you any knowledge of application and function of compost and fertilizer? Y/N; [Use ✓ mark];

3.12. What is your present irrigation system in your RTG? (a) Owned source (b) None (c) Others:-----

3.13 What types of container usually you used or choose for different types of plants in your rooftop garden?

(a) Half plastic drum (b) Half GI sheet drum (c) Plastic pot (d) Earthen pot (e) Concrete made drum (f) Plastic tray

(g) Plastic bucket (h) Others (specify):-----

3.14. Do you have any agricultural equipment for using in the existing RTG? Y/N [Use ✓ mark]; if yes, use ✓ mark in the following (a) Secateurs (b) water cane (c) Hand hoe (d) Others (specify): -----

3.15 Do you know the nutritional value of vegetables and fruits? Y/N [use ✓ mark]

3.16. Have you received any training on RTG? Y/N [use ✓ mark]

3.17 What kind of training do you need (a) for improving or (b) establishing your RTG?

3.18. If your RTG in the flat system, what will be the RTG management system particularly in the flat system (such as input purchase, product distribution & take care of RTG etc.):

3.19. Do you know the hydroponic system? Y/N; if yes from whom did you hear it?

(a) Scientist (b) DAE personnel (c) NGO personnel (d) Others (specify):-----

3.20 What are the benefits of RTG? (a) Increase social status (b) economic support (c) ensure safety fruits and vegetables (d) Increase nutritional value (e) Added cultural value (f) environmental benefits

(g) Others (specify): -----

3.21 Do you think that carrying of inputs (soil, sapling, fertilizer, container, net etc.) to roof is a problem particularly in the flat system? Y/N [Use ✓ mark]; if ‘yes’ ; how the inputs can be carried to the roof?

3.22. Do you think any service provider (SP) (such as company/ volunteer organizations, social organization etc.) is needed to establish a garden and to get necessary support? Y/N; if ‘Yes’ what type of support do you need from SP?



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3.22.1 Do you like to pay them for their service (inputs supply, technical knowledge etc.)? Y/N; if 'Yes' what would be the payment system particularly in the flat owner?

(a) Cash payment by RTG owner (b) Cash payment by flat community (c) Others (specify)-----

3.23. What sorts of support you expect from extension personnel (i.e DAE, NGO's etc.) (a) for improving RTG or (b) for establishing RTG??

(a) Technical support (b) Input support (c) Cash support (d) Others (Specify):-----

Thank You So Much for Your Nice Cooperation

Verified by the

Supervisor/NC:

Signature and date:

Name:

Designation and Address:

Signature of data

collectors:

Name:

Designation and Address:

A Seminar Paper on
Roof top gardening in Bangladesh- An approach of fruits and vegetable production for family consumption

Course Title: Seminar
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ABSTRACT

Rooftop garden plays an important role in the mental well-being of the gardeners as well as in amelioration of the physical environment. The production of fresh fruits and vegetables of the rooftop garden can increase nutritional status of household members of the urban citizens and it will make a positive contribution to the environment. As part of the project activities, the baseline study was undertaken to assess the current situations and characterize the potential issues of rooftop gardening in Dhaka city. Urban population in the cities of developing countries are growing rapidly which also means the number of low-income consumers is increasing. Because of this, food insecurity in these cities is increasing. Urban agriculture (UA) contributes to food security by increasing the supply of food and by enhancing the quality of perishable foods reaching urban consumers. The exploration of local socio-economic and institutional conditions that might promote and hinder urban agriculture is needed to implement policies that effectively integrate agriculture into the urban environment. This study aims to identify the potential for and barriers to UA with reference to rooftop gardening (RTG) and to explore strategies to promote food security in Dhaka. The study was carried out in 6 (nine) selected metro areas of Dhaka city namely Mohammadpur, Mirpur, Gulshan, Uttara, Kamrangirchar and Tejgoan and 2 areas of Khulna city namely Nirala and Sonadanga. The study used both primary and secondary data as well as quantitative and qualitative data and information. Purposive and proportionate random sampling technique was adopted for selecting the sample size. Out of 300 targeted beneficiaries (sampling frame), a total of 142 (47.3%) sample households were selected for the study. The sample size was 97 which represent by 64.6% of the total sampling frame. The required data/information was collected through household survey using pre-tested semi-structured questionnaire.

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CHAPTER I

INTRODUCTION

Bangladesh is identified as one of the susceptible international locations as a sufferer of detrimental have an impact on of local weather change. The main improvement challenges of us these days consist of poverty alleviation, sustainable improvement and surroundings administration in the context of swiftly developing population. Urban ecology is the direct sufferer of the diminishing veggies contributing to some extent toward world warming. In Bangladesh, due to migration from rural place to city place populations in the cities are growing swiftly therefore the numbers of low-income customers are additionally growing in cities. Urban agriculture can supply city-dwellers with a supply of sparkling produce, accelerated food plan and essential family budgetary savings. Vegetated surfaces furnish essential sound insulations homes and are frequently employed for their noise discount doable in city settings. Green roofs can supply vital noise discount possibilities for buildings. It may additionally additionally generate employment and financial services thru its backward and ahead linkages. Koc et al.(1999); Mann (2001); Bellows and Hamm (2003); Hamm and Bellows (2003) noted that rooftop backyard can complement the diets of the neighborhood as it components with clean produce and furnish a tangible advantages tie to meals production. With speedy and unplanned urbanization, incidence of city poverty and meals insecurity has been additionally growing alarmingly in Dhaka (Choguill 1995).Islam (2004) seen that Urban agriculture (UA) contributes to meals protection by means of growing the furnish of meals and by means of improving the fantastic of perishable meals attaining city consumers. He additionally counseled that robust political dedication and strong coverage hints are the preconditions for developing supportive surroundings for RTG.

Rooftop gardens guide the social life, as a area to be satisfied outside surroundings with household and friends. It additionally develops a experience of self identification and independence, the place one can in particular acquire self and emotion legislation viewing special flower detached seasons (Rashid and Ahmed 2009) and affords restorative ride from stressful daily things to do in city excessive upward shove residential building.

Rooftop backyard performs an necessary function in the intellectual well-being of the gardeners as nicely as in amelioration of the bodily environment. Roof gardening has additionally a promising plausible as small scale enterprise that can speed up extra household income. Nevertheless, it may additionally generate some employment services via its backward and ahead linkages. The manufacturing of clean fruits and greens of the rooftop backyard can be multiplied dietary fame of family contributors of the city residents and it will make a high quality contribution to the environment. Sajjaduzzaman (2005) said that the important reason of roof gardening are passing amusement time (100%), growing aesthetic values (100%), contributing in environmental amelioration (45%) and economic reap being a very minor subject (4% only) in Dhaka Metropolitan metropolis of Bangladesh. On the different hand, Rumana Rashid et. al., (2010) described the financial and social gain of roof pinnacle gardening along with clean meals furnish for city residents, converts the tough floor into smooth green surface, power saving, etc.). Many researches that display that there are many components of out of doors environments and inexperienced areas that are desirable to people, regardless of age (Ward Thompsoil, 2007).

RTGs ought to grant greater than 12,000 t year⁻¹ veggies to Bologna (Itali), fulfilling seventy seven p.c of the city inhabitants“ necessities (Orsini et. al., 2014). Beyond the advantages related with meals manufacturing and the herbal environment, neighborhood gardening is claimed to enhance human well-being (Okvat and Zautra2011). Together with the urbanization process, there has been a style in the quest for the inexperienced experience: at some point of history, each gardening and extra passive types of contact with nature (e.g. taking a stroll in a garden) have been identified as having intellectual fitness advantages (Davis 1998). Although restricted scientific reviews are reachable to date on the therapeutic position of neighborhood gardening, the gardening-related advantages in decreasing psychological problems e.g. in opposition to dementia (Simons et al. 2006), enabling stress restoration (Kingsley et al. 2009), or fostering cardiac rehabilitation (Wichrowski et al. 2005) are nicely known.

Dhaka is the biggest and quickest developing metropolis of Bangladesh. Rapid populace increase in Dhaka has created extreme stress on the land of the already overcrowded country. Agricultural lands have given way to housing tendencies and roads in an agriculturally based totally financial system like Bangladesh. With fast and unplanned urbanization, incidence of city poverty and meals insecurity has been additionally growing alarmingly in Dhaka (Choguill 1995).

Rooftop gardening can be a positive approach in ensuring meals furnish and enjoyable dietary desires of the inhabitants (Helen Keller International and Institute of Public Health Nutrition 1985). Rooftop gardening, though is being practiced in the town in many structure for years in the past, there have been infrequently any concerted effort on section of the Government, neighborhood groups and as properly the ordinary residents to combine it to city agriculture. Proper appreciation of the troubles and potentialities related with the adoption of insurance policies will contribute, to a fantastic extent, to elevated meals furnish in the city.

The key goal of the paper is to become aware of and discover the fundamental techniques to stimulate city agricultural increase in the town of Dhaka via analyzing the areas for improvement and re-development of rooftop gardening (RTG). Therefore the precise precedence goals are to inspect the present city agricultural insurance policies and exercise in the town with a precise reference to rooftop gardening; to discover the attainable areas the place coverage interventions are required for advertising rooftop gardening to meet the wants of Dhaka and to propose measures which leads to the components and profitable implementation of the insurance policies with regard to rooftop gardening.

The unique goals are cited below:

1. To study different techniques and other related aspects of roof top gardening.
2. To way out of producing fruits and vegetables for family consumption through roof gardening.

CHAPTER II

MATERIALS AND METHODS

This paper is absolutely a review paper. With a view to preparing this paper, all informations were collected from secondary sources. The topic related findings have been reviewed by internet browsing, studying extensively various articles and research papers published in varied journals, books, proceedings, dissertation available in online. Valuable suggestion and information were received from honorable major professor and course instructors. After collecting information, these were compiled and organized chronologically for preparing this seminar manuscript.

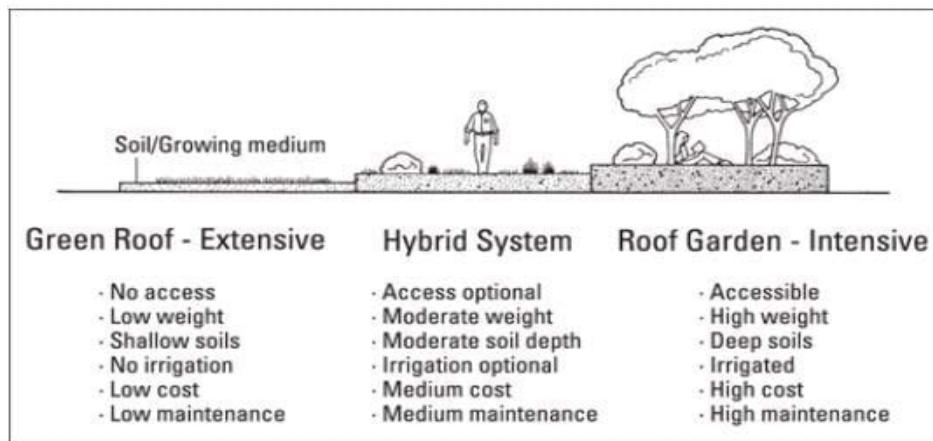
CHAPTER III

REVIEW OF FINDINGS

3.1 Rooftop Gardening

Rooftop gardens are man-made green spaces on the topmost levels of industrial, commercial, and residential structures. They may additionally be designed to develop produce, supply play space, provide color and shelter, or honestly be there as a living, green area.

Two most important divisions of garden types exist: extensive and intensive. Extensive gardens require minimal upkeep and behave as another form of roofing material. They are no longer intended for heavy foot site visitors nor do they want to meet any extra safety standards. The different extreme consists of intensive gardens created with the intent of lively human use. These gardens require landscaping and ordinary upkeep. In some cases, the roof shape should be bolstered via the addition of decking or extra bracing to accommodate the combined weight of soil, plants, and precipitation. Furthermore, intensive gardens may additionally need to comply with protection rules related to decks and public areas on raised structures. These regulations may additionally require some variety of fencing or barrier to be set up with the intent of preventing humans from slipping over the area of the roofline.



(Source : Bermudez, 2019)

Figure 1 Cross section of different rooftop garden

3.2 Potential areas of rooftop in the chosen family

Potential area on rooftops is an utmost essential for enhancing or organising the backyard in the cities.

In the study, consequences published that per family whole rooftops house used to be recorded as 1916 sq. ft in Dhaka metropolis areas. Of them common 1593 sq. ft used to be regarded as viable area for gardening and 323 sq. ft used to be remained as open however at present the open house are being used in extraordinary functions through the proprietor of the building. Analysis outcomes implied that the variations in the doable rooftop area per family was once determined to be tremendous at 10% stage of chance ($F= 2.002^*$ and $p < .086$) amongst the region in Dhaka areas). But in the case of different areas in Dhaka it used to be determined to be insignificant (Table 1).

3.3 Current uses of residential rooftops in Dhaka metropolis

Presently the rooftops of the residential constructions are being used for a variety of functions such as gardening, drying and washing clothes, playground for children, wonderful guest, passing pleasure time etc. In the study, consequences printed that the easiest percentages of the respondents are being used for gardening (87%), drying cloths (25.8%) and others (11.5%) irrespective of all areas in Dhaka city. Islam (2004) suggested that the rooftops of the residential constructions was once used for drying (88%) and washing (45%) clothes, as playground for youngsters (97%), for enjoyable friends (20%), for cool air in the course of the summer time (64%), to sunbathe in the wintry weather (33%). On most of the roofs, some shape of pleasure backyard exists (78%), every so often there are fruit gardens (12%), and, much less often, vegetable backyard as nicely (8%).

Table 1 Estimation of potential space on rooftop and use of open space in the selected household

Dhaka city areas (n=97)	Size of space on rooftop per household (In sq. feet)			Used of open space as % of each respondents		
	Total space	Open space	Potential space for RTG	For gardening	For drying cloths	Others
Mohammdpur	1500	325	1175	79	36	7
Mirpur	1950	338	1612	76	6	24
Gulshan	1806	256	1550	94	11	11
Uttara	2035	460	1575	90	35	10
Kamrangirchar	2131	356	1775	100	25	
Tejgoan	2075	200	1875	83	42	17
All	1916	323	1593	87	25.8	11.5

(Source: Uddin *et al.*, 2016)

3.4 Vegetables and fruits produced in cutting-edge RTG's in Dhaka metropolis

Different fruits and greens had been determined to be grown by using the respondents. The inexperienced flowers and flowers in the residence have an effect on the feeling of harmony, simplicity and authenticity.

Natural inexperienced has substantial impact on usual lifestyles delight and enhance the occupant's health (Rashid *et al.* 2010). Bangladesh is blessed with many horticultural crops. More than ninety vegetables, 60 fruits and 25 spices are being grown in the country. But, now not all sorts of fruits can be produced on the rooftop. So, species resolution for roof gardening is an vital challenge for each gardeners. The kinds and combine are chosen in the town relying upon character family meals preferences, availability of seeds/sapling kinds that can be grown on the rooftop, local weather and availability of soils. In the study, the following veggies and fruits had been produced in the present rooftop backyard in Dhaka town areas. But the composition of fruits and greens are differed in every family significantly. However, the often produced fruits and vegetables in the cutting-edge RTG in Dhaka cities are proven below:

Fruits produced in current RTG		Vegetables produced in current RTG	
Mango	Sapota	Brinjal	Bitter gourd
Guava	Karanda	Tomato	Sweet gourd
Hog-plum	Custard apple	Cabbage	Snake gourd
Jujube	Litchi	Cauliflower	Pointed gourd
Lemon	Pummelo	Chilli	Cucumber
Pomegranate	Karambola	Indian Spinach	Red amaranth
Orange	Dragon fruit	Lady's finger	Stem amaranth
Malta	Grape	Country bean	Lettuce
Papaya	Strawberry	Yard long bean	Capsicum
Wax apple	<i>Bilombi</i>	Bottle gourd	Coriander
		Teasle gourd	Arum
		Ash gourd	Drum stick
			Sugarcane

It used to be found in the learn about that in Dhaka areas, about 25 veggies and 20 fruits have been observed to be grown in the contemporary RTG's. But the composition of fruits and greens variousextensively amongst the household. The best 61.6% rooftop gardeners produced tomato accompanied by means of brinjal (61%), Indian spinach (47.8%), Lady's finger (46.8%), Chilli (45.3%) and Gourds" (25%) irrespective of all chosen metro areas of Dhaka metropolis (Table 2).

Table 2 Vegetable crops planted in the current RTG in the selected areas of Dhaka

Dhaka city areas (n=97)	Vegetables									
	Chilli	Brinjal	Indian spinach	Gourds(All)	Okra	Tomato	Red amaranth	Bean	Cabbag e	Cauliflow er
	In % of respondents who produced the vegetables in RTG									
Mohammedpur	50	57	43	21	29	36		29		
Mirpur	53	65	59	12	35	63		19	12	
Gulshan	44	56	39	22	56	67	17	17	6	6
Uttara	60	60	50	25	50	68	25	20	15	
Kamrangirchar	50	63	63	38	69	69	50	19		
Tejgoan	15	67	33	33	42	67	17	18		
All	45.3	61.3	47.8	25.1	46.8	61.6	18.1	20.3	5.5	6

(Source: Uddin *et al.*, 2016)

In the case of fruits, the best possible 75% respondents have grown mango observed via lemon (72.8%), Guava (72.8%), Pomegranate (38.5%), Hog-plum (26.5%), Jujubee (24.5%), Papaya (24%), Wax apple (13%), Malta (12.8%) and Sapota (10.5%) irrespective of all chosen metro areas in Dhaka town (Table 3).

Islam (2004) determined that in the rooftop backyard the following fruits and greens are many times grown; Guava, Lemon, Papaya, Grapes, Green Chili, Pumpkin, Squash, Onion, Garlic, Coriander leaves, Tomato, Mushroom, Leafy veggies (e.g., Callaloo, Jute Leaf and Red Amaranthus), and different (e.g., Cucumber, Flat bean, Bitter ground, Ribbed ground, Ladies finger, Amaranthus, Dhudi, Cowpea and Brinjal).

Some households additionally domesticate spices and flora used for medicinal purposes.

Table 3 Fruit crops planted in the current RTG in the selected areas of Dhaka

Dhaka city areas (n=97)	Fruit plants									
	Mango	Lemon	Guava	Hogplum	Pomegranate	Jujubee	Malta	Papaya	Wax apple	Sapota

	In % of respondents who produced the fruits in RTG									
Mohammdpur	57	64	57	7	29		7	29		7
Mirpur	76	59	71	24	29	41	12	29		6
Gulshan	83	78	78	44	33	33	11	22	44	22
Uttara	85	84	85	29	65	40	20	20	15	15
Kamrangirchar	75	69	81	34	50	25	19	19	13	13
Tejgoan	75	83	75	17	25	8	8	25	8	
All	75.2	72.8	74.5	26.5	38.5	24.5	12.8	24.5	13.5	10.5

(Source: Uddin *et al.*, 2016)

3.5 Intercultural Operation

Results on Table 5 point out that 100% of the rooftop gardeners used to exercise the intercultural operations of irrigation and weeding alongside with training/pruning (81.7%), control of insects-pests (75%), decoration (70%) and thinning (51.7%). But, most of the intercultural operations had been conducted as per demand and in that case the respondents did now not observe any normal frequency.

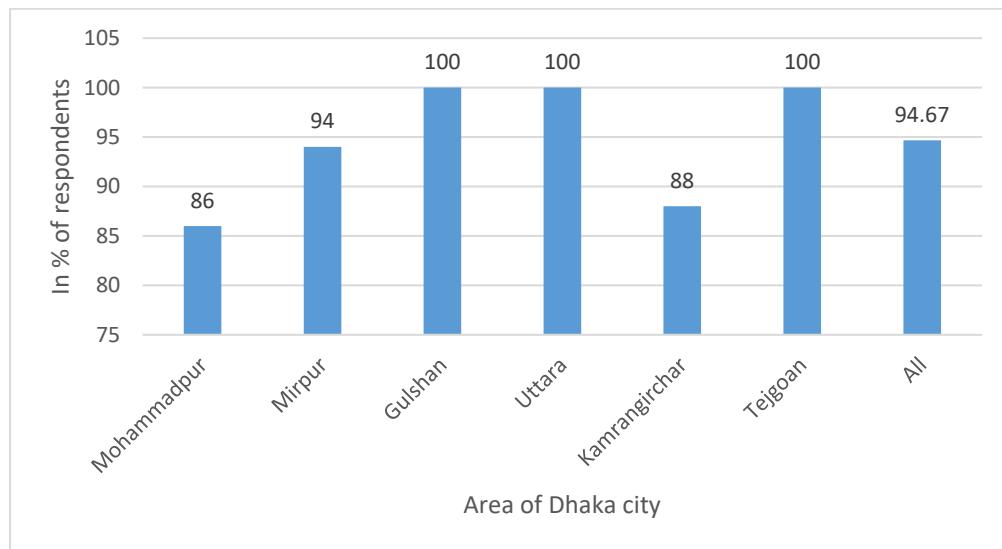
Table 4. Distribution of the respondents based on the practiced intercultural operations

Intercultural operations	Respondents (N = 60)		Rank
	Frequency	Percent	
Irrigation pattern	60	100	1
Weeding	60	100	1
Training/Pruning	49	81.7	2
Insect & disease control	45	75.0	3
Decoration	42	70.0	4
Thinning	31	51.7	5
Shading	6	10.0	6
Others	5	8.3	7
Drainage system	3	5.0	8

(Source: Sheel *et al.*, 2019)

3.6 Knowledge of compost and fertilizer software of the respondents

In the study, greater than 94% of the respondents in Dhaka metropolis areas had been having know-how on the feature of compost and fertilizer utility in the contemporary RTG's. (Fig. 2).

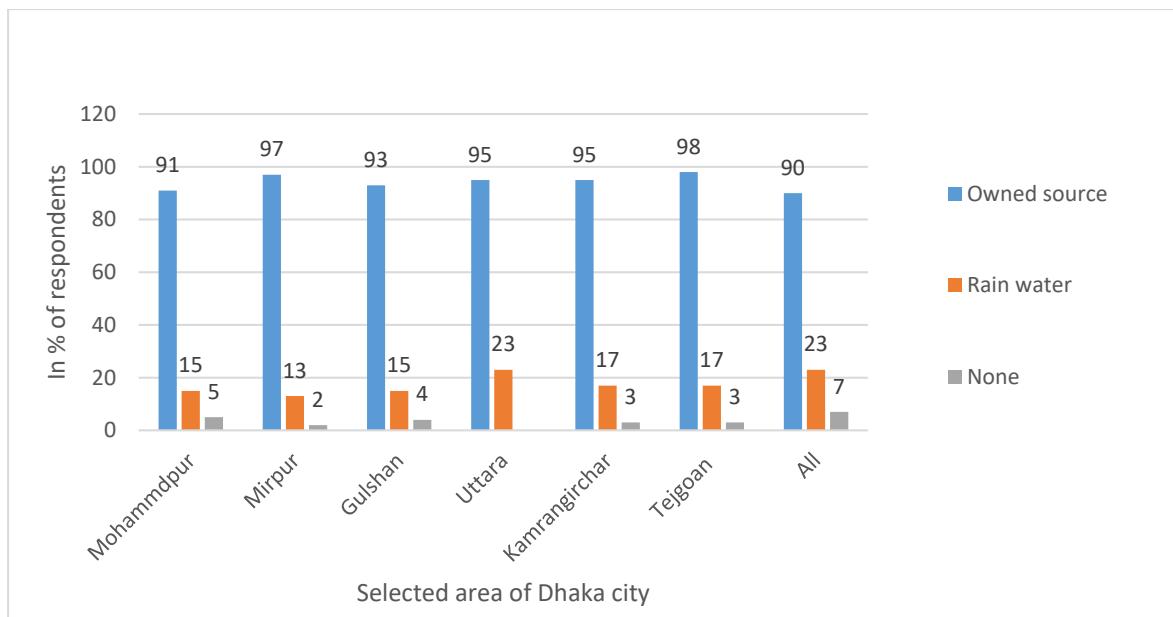


(Source: Uddin *et al.*, 2016)

Figure 2 Knowledge of the respondents on the function of compost and fertilizer in Dhaka.

3.7 Water supply used for contemporary RTG's in Dhaka

Water supply is indispensable for imparting irrigation to the RTG's plant. Irrigation can make a contribution to produce greater yield of plant. In the study, two fundamental water sources (owned and rain water harvest) have been observed. In the chosen areas of Dhaka city, greater than 90% respondents used owned supply (owned furnish water) for irrigation to the RTG's plants. About 23 percent respondent didn't supply irrigation however solely 7 per cent used the conserved rain water for irrigation motive (Fig. 3).



(Source: Uddin *et al.*, 2016)

Figure 3 Water source used for RTGs by the respondents of Dhaka city.

3.8 Container used in the contemporary RTG's in Dhaka metropolis

Container is one of the necessary enter substances for developing plant in the rooftop. Selection of appropriate containers is vital thing for elevating the flora well. Bienz (1980) said that appropriate developing medium should be organized making sure ample water and mineral elements. The a number sorts of containers had been used by way of the rooftop gardeners. The desire of containers was once established on availability, preferences and nature of the developing plants. It used to be discovered that in the chosen areas of Dhaka city, the easiest 72% respondents used half of plastic drum, 62.5% plastic pot, 59% earthen pot, 53% half-drum made through GI sheet, 51% plastic bucket, concrete made bed/drum and 41.6% plastic tray (Table 3.8).Rahman et al (2013) discovered that for rooftop gardening 77% used earthen containers, 8% cemented bed, 7% drums, 5% brass made pots and 3% others are in use.

Table 5 Container used in the current RTG's in Dhaka

Dhaka city areas (n=97)	In % of respondents who used the following types of container in the RTG							
	Half plastic drum	Half drum made by GI sheet	Plastic pot	Earthen pot	Concrete made drum	Plastic tray	Plastic bucket	Concrete made bed
Mohammadpur	86	64	79	57	71	71	71	50
Mirpur	76	47	76	59	53	53	47	41
Gulshan	72	44	56	67	56	39	44	56
Uttara	65	40	50	55	40	45	45	45
Kamrangirchar	50	50	56	50	44	25	50	44
Tejgoan	83	75	58	67	43	17	50	75
All	72	53.33	62.50	59.17	51	41.47	51.17	51.83

(Source: Uddin *et al.*, 2016)

3.9 Average yield of vegetables and fruits per RTG's in Dhaka town

Around 60 fruit and vegetable varieties are manufactured in Bangladesh. It is not possible to produce all styles on the rooftop. Depending on man or woman family food preferences, availability of seed sorts that can be grown on the rooftop, weather, and soil quality, the types and mixes are chosen in the region. Guava, Lemon, Papaya, Grapes, Green Chili, Pumpkin, Squash, Onion, Garlic, Coriander leaves, Tomato, Mushroom, Leafy greens(e.g., Callaloo, Jute Leaf and Red Amaranthus) and others (e.g., Cucumber, Flat Bean, Bitter ground, Ribbed ground, Ladies foot, Amaranthus, Dhudi, Cowpea, and Brinjal) are usually grown in the food garden. Some households also domesticate spices and flora used for medicinal purposes, Islam, S (2002). A baseline survey used to be performed from January to June 2016 with a sample of about ninety seven the usage of a pre-tested semi-structured questionnaire for required data/information on rooftop gardening in Dhaka determined that the common yield was once higher for quite a few unique veggies and fruits (Fig.4).

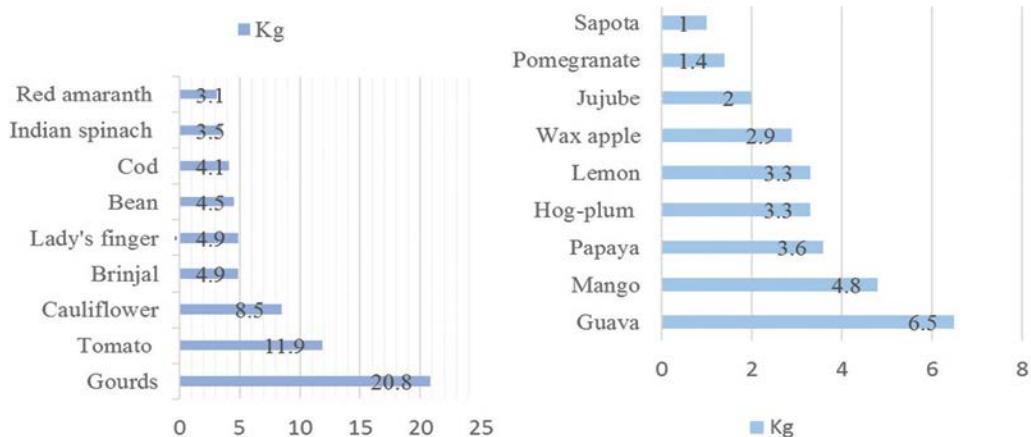


Figure 4 Average yield of vegetables fruits on rooftops in Dhaka

(Source: Chowdhury *et al.*, 2020)

3.10 Occurrences of pest and diseases in present day RTG's

Ant (65%), mealy worm (36.7%) and green leaf hopper (13.3%) were suggested as the primary bugs by means of the rooftop gardeners (Table 6). There had been also some minor insects named with the aid of whitefly, lemon butterfly, crimson pumpkin beetle, aphid, termite, fruit borer etc. On the other hand, majority (23.3%) of the rooftop gardeners cited about die back; whereas viral diseases, leaf curling, leaf hot and fungal diseases constituted 21.7%, 18.3%, 15% and 13.3%, respectively (Table 6).

As Table 6 indicated, there had been 21.7% respondents who did no longer face any insect problem; whilst 35% respondents stated that there is no disorder infestation in their rooftop garden. To defend plant life from different insects-pests and diseases, rooftop farmers carried out a wide variety of control measures. Most often times used practices in opposition to insects-pests had been finish, elimination of infested part, hand killing of insects, washing with water, wheel powder + water, Ripcord, neem + mehagani juice, tobacco + water, kerosene, Nitro, Green tonic, Sevin etc. On the different hand, the most common protection strategies towards diseases was once removal of the contaminated part compared to Tilt, Malathion, Vertimex, Noin powder, Aora, Mancozeb, Flora, Uromil etc. There were a variety of respondents who did not take any motion in opposition to insects-pests and illnesses infestation rather facing the issues in exclusive extent. Insect hassle used to be determined as a 12 months round problem; whereas iciness season was

once revealed as the most important disease infestation time. Table 6 evident the important fertilizers viz. cow dung (51.7%), compost (43.3%), urea (36.7%), MoP (25%), sesame cake (23.3%) and TSP (21.7%) used via the rooftop gardeners. Besides, there have been some minor fertilizers such as DAP, vermi-compost, birds litter, bio-salary, egg shell etc. Almost all of the rooftop gardener did now not comply with any regular sample in case of insects-pests control, diseases manage and in fertilizer application dose and stage.

Table 6. Distribution of respondents based on insect infestation, disease infestation and fertilizer use

Items	Major findings	Respondents (N=60)		Rank
		Frequency	Percent	
Insects name	Ant	39	65.0	1
	Mealy bug	22	36.7	2
	Not at al	13	21.7	3
	Green Leaf Hopper (GLH)	8	13.3	4
	Whitefly	5	8.3	5
Diseases name	Not at al	21	35.0	1
	Die back	14	23.3	2
	Viral disease	13	21.7	3
	Leaf curling	11	18.3	4
	Leaf scorching	9	15.0	5
	Fungal disease	8	13.3	6
Fertilizer name	Cow dung	31	51.7	1
	Compost	26	43.3	2
	Urea	22	36.7	3
	Muriate of potash (MoP)	15	25.0	4
	Sesame cake	14	23.3	5
	Triple super phosphate (TSP)	13	21.7	6

(Source: Sheel *et al.*, 2019)

3.12 Per capita consumption of vegetables and fruits of the sample households

Per capita vegetables consumption used to be recorded at 56.7 gm per capita per day for the pattern family in Dhaka, respectively, which was once decrease than countrywide common of one hundred fifty fivegm/capita/day would possibly be due to unaware about the dietary cost of veggies however the consumption of potato used to be determined tonsgreater than that of countrywide common in each cities. (Table 7).

In the case of fruits consumption per capita per day used to be observed to be 67.9 gm an irrespective of all chosen family in Dhaka city. This would possibly be due to all respondents had been richer and they have been a whole lot extra sucessful to buy fruits from the market. But they opined that they had been no longer blissful to buy fruits from market due to meals security reasons. Results printed that fruit consumption specificallymango, candy orange and apple amongst the surveyed family differentextensively however the consumption of different fruits variousinsignificantly among the respondents and locations. (Table 8)

Table 7 Per capita consumption of vegetables in the surveyed household

Dhaka city areas (n=97)	Quantity (gm) of vegetables consumed per capita per day										
	Potato	Brinjal	Teasle gourd	Toma to	Chilli	Indian spinach	Ladys finger	Bean	Cucumber	Red amarenth	All
Mohammdpur	47	72	82	85	27	78	85	98	86	139	79.9
Mirpur	83	46	51	40	32	64	52	32	34	53	51.7
Gulshan	65	48	29	73	31	61	48	22	32	60	46.9

Uttara	56	68	20	59	23	81	25	47	64	53	49. 6
Kamrangirc har	91	53	33	52	45	78	56	52	74	65	59. 9
Tejgoan	71	60	25	112	43	45	47	24	33	64	52. 4
All	68.8	57.8	40.0	70.2	33.5	67.8	52.2	45. 8	58.8	72.3	56. 7

(Source: Uddin *et al.*, 2016)

Table 8 Per capita consumption of fruits in the surveyed household

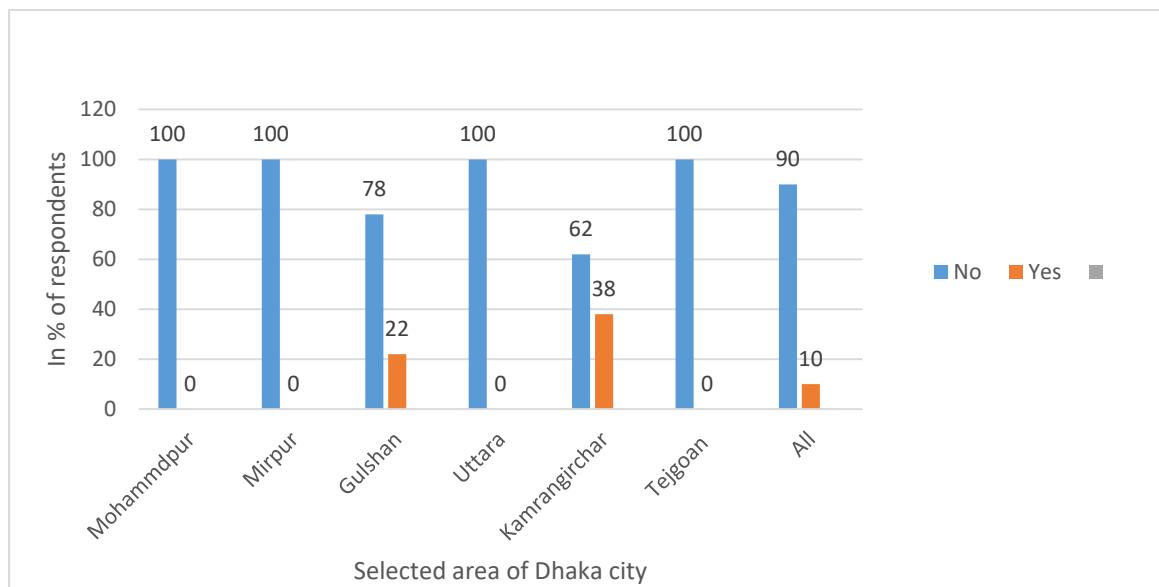
Dhaka city areas (n=97)	Quantity (gm) of fruits consumed per capita per day										
	Man go	Gua va	Gra pe	App le	Lem on	Juckfr uit	Swee toran ge	Papa ya	Wa x appl e	Sap ot	All
Mohammdp ur	202	75	23	21	14	33	23	37	—	—	54
Mirpur	143	83	22	35	31	40	32	50	20	17	47
Gulshan	274	145	41	76	27	—	56	68	4	10	78
Uttara	264	169	69	85	35	41	56	41	—	—	95
Kamrangirc har	260	55	25	42	78	20	—	37	—	—	74

Tejgoan	133	90	49	60	74	32	34	60	-	4	60
All	43.2	212.	33.2	102	80.2	38.2	67.9	53.2	48.8	12.0	10. 3

(Source: Uddin *et al.*, 2016)

3.13 Responses to raise the inputs on the rooftop

Carry the enter (soil, compost, fertilizer, container, seedling, sapling etc.) on the rooftop is essential for efficaciously gardening. In the study, in Dhaka town areas about 90% of the respondents said that they had no trouble for carrying the enter on their rooftop and different 10% respondents opined that it would be a trouble if no longer cautiously elevate the enter to the rooftop.



(Source: Uddin *et al.*, 2016)

Figure 5 Responses to carry the inputs on the rooftop in Dhaka city areas.

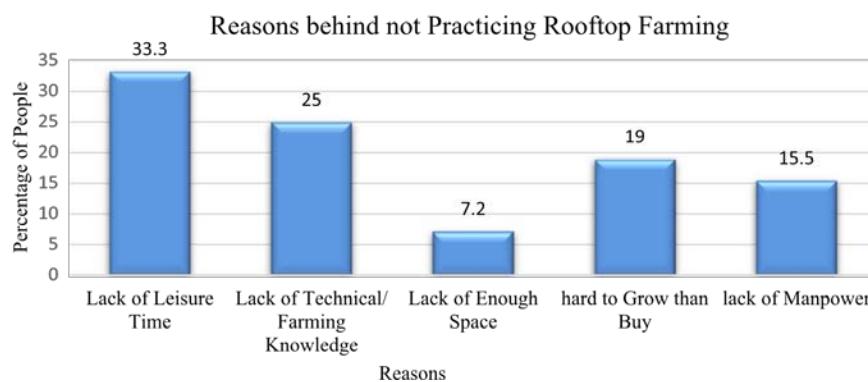
3.14 Marketing of rooftop gardening merchandise

There was once no geared up advertising gadget of rooftop gardens merchandise in the learn about area. This may be due to confined manufacturing of the rooftop backyard and that of ate up by using the contributors of household. From this find out about it was once determined that

rooftop backyard production, earnings and self-use will increase with the growing size, funding and what functions proprietor managed his garden. After making sure on hand manufacturing of the gardens, the advertising device can be developed for sale their product.

3.15 Threats to rooftop farming in Dhaka

During non-practitioners survey it had been explored why human beings were now not training rooftop farming. Most of them answered that they did now not have sufficient entertainment or free time to put in force and appear after the garden. 33.3% human beings told that they are busy with their private and reliable works and do now not have sufficient time to spend on gardening or farming. Lack of technological information is additionally a constraint for not practicing. There is very few opportunities for acquire technological and farming knowledge. There is no government or non-public initiative to train humans and serve desirable farming facilities. So 25% people stated that they are no longer inclined to exerciseas they do no longer have suitable farming knowledge.



(Source: Safayet *et al.*, 2017)

Figure 6 Reasons behind not willing to Practice Rooftop Farming.

There is additionally a tendency to buy meals objects from near market places as a substitute than developing them. 19% people assume that it

is easier to buy vital products from nearby market or kutcha bazar than developing on their rooftop as it requires time, labor and money. So they suppose they can have what they want by using spending some money. Lack of manpower is additionally a limitation.

If people desire to implement farming on their rooftop, they need some help but in present circumstance there is lack of experienced and competent labor for taking care of farming. 15.5% human beings suppose that it is a hassle to them of having no manpower. Only 7.2% humans answered that they do now not have enough area due to the fact their roof is used by way of other purposes(Safayet *et al.*, 2017).

CHAPTER IV

CONCLUSIONS

Urban agriculture (UA) specifically rooftop gardening contributes to introduction of wholesome surroundings and meals security. It will increase grant of clean meals and by means of bettering the fantastic of perishable meals attaining city consumers. The Government of Bangladesh does now not have any unique coverage provision or law that promotes city agriculture in accepted or rooftop backyard in particular. There is no precise metropolis coverage that promotes city agriculture in Dhaka. This is vital as has been proven in many nations like Switzerland and Germany and there is big conceivable for roof gardening. Government training and encouragement is urgently wanted to amplify the RTG. Bangali Nature intends to proceed its work in greening roofs, assisting to refine our perception of the position they can play in the conservation of biodiversity in cities and cities. In order to realise the workable that RTG can offer, primary shifts in wondering of the coverage makers is required. The most radical one would be on phase of the town officers to combine Urban Agriculture (UA) in frequent and RTG in precise with city planning. In order to do this, some necessary lookup and experimentation/demonstration is required. This mission should be profitable with required political dedication and concerted action, underpinned by using scientific research, technical information and appropriate design.

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Would you like to establish a cattle farm in Bangladesh? Let's consider the factors

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Ashit Kumar Paul:



Bangladesh is one of the cattle loving country. Most of the people who have least amount of land or scope to keep cattle they try to occupy that land or use that scope for cattle farming. However, Bangladesh is densely populated and agriculture based income status country, so that there is limited space for keeping their beloved cattle. Therefore, most of the cattle are raised for small scale farming system. Cattle population in Bangladesh is about 24.13 million and buffalo 1.21 million within the limited land area. At the rural area, the main interest of farmer to rear cattle for dual purpose i.e. draught and milk/meat. They also invest very few money because of their household food residues are used for cattle feeding. Bangladesh is the only place around the world where both, milk and meat is highly demandable that encourage the people for farming. Among the private dairy farm, about 73% farms contains <11 cows, 17% about 11-20 cows and left are large scale farms.

Previously, Department of Livestock Services (DLS) is the only government department whose responsibility is to motivate and provide extension to livestock-rearing farmers. However, considering the rapid return with good profit there is many donor organizations (DFID, UK-AID, UNDP etc.), different NGOs and companies (Multimode group, BRAC etc.) are now taking potential step to extend the technologies at the farmer's door step.

Development of cattle and buffalo is an important tool for making profit as a self-employment strategy. It also influences the stockholder to invest in this sector, obviously increasing rapidly as while. But most of the stockholders have little idea about livestock management; in fact they want to know the present scenario of livestock at filed level as well as the important reproductive parameters besides the disease prevalence in context of Bangladesh, evidently at a glance. Therefore, paying attention to them, I would like to highlight some important data which are already published in distinguish national and international journals although there is no gross data throughout the country, only the regional basis survey. We are concerned much about that the main constrains for profitable farming is low pregnancy rate. The overall pregnancy rate in cows varies from 57.3 to 61% whereas the first service (artificial insemination-AI) pregnancy rate (PR-FAI) is about 42.7% (34.5 to 47.1%). About 1.3 to 1.7 AI service is required per pregnancy on an average. Seasonal variations are markedly influences the PR-FAI. PR-FAI in summer (May-July), rainy (August-October), winter (November-February) and spring (March-April) is 43.1, 34.5, 47.1 and 45.5% respectively. According the concern of age of cows, 2 to 4 years old is shown the higher rate (41.8 to 43.5%) of pregnancy whereas heifer is shown 42.2 to 44.8%. Body condition score (BCS) 2.5 to 3 with body weight 150 to 250kg is suitable for first pregnancy about 47.5%. Above all, the different factors i.e. genetics, semen quality, AI technicians, management system, knowledge of animal biology, experience of farming etc. are strongly influencing and promising issues for profitable farming.

The local breed of cattle is highly resistance for disease. There is prevalence of some infectious diseases

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such as Foot and mouth disease (FMD), anthrax, black quarter (BQ), hemorrhagic septicemia (HS), tetanus and so on. The prevalence of production disease such as mastitis (46.7%), endometritis, and retention of placenta is totally depended on the management technique of that farm. The rate of abortion is about 13.3% but it good news for people that the prevalence of cattle farmer's rival disease, brucellosis is about 2.4-7.6%. The organism, *Brucella abortus* is a zoonotic and nasty organism which causes drastic early abortion (3 to 4 months of gestation) of pregnant cows in the whole herd.

Breeding efficiency is directly related to the prosperity of dairy industry. Infertility among dairy farm animals is one of the great economic problems which confront the vets. It is particularly wide spread in cattle and buffaloes. Through there are many traditional farms present and expanded still now; many intrinsic and cooperative modern farms in private sector develop in this country. Therefore the production of domestic livestock product such as eggs, milk and meat increases. It saves our foreign currency to reduce the import. Many youth people are able to be self-employed person by dint of this sector. GDP of this sector increases day by day. 19% product of the agricultural sector comes from this sector. Finally, i hope and believed that this article will give you some important message for your investment in this sector.

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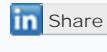


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Beef Cattle Production in Bangladesh - A Review

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Abstract: Cattle fattening for beef production have become an important business of the small farmers in Bangladesh. In few areas of Bangladesh a small scale commercial beef fattening program has already been started. Straw is the important crop residue; contribute the major portion of the fibrous part of the diet of the beef cattle. Rice straw is the basal feed for ruminants with low nutritive value and low digestibility. Farmers use rice straw of traditional varieties, green grass, sugarcane tops, wheat and rice bran, molasses, pulse bran and locally available resources such as pumpkin, carrot, banana, vegetable by products, rice gruel, boiled rice bran, oil cakes etc., for beef fattening. The chemical treatment of straw is the most effective and economic method to improving the quality. Straw is mainly treated with urea and molasses and in some cases chemical treatment also done by the farmers. Urea molasses straw treatment in beef cattle resulted higher body weight, dressing percentage and also in better carcass quality than untreated straw. The acute shortage of feeds and fodder has long been identified as a serious constraint to optimum livestock production in Bangladesh. The nutritional factor is considered a major constraint to livestock productivity. Traditional grazing field is scarce except in some pokets in Pabna and Sylhet districts. Farmers used three years old cattle for beef fattening and maximum growth rate between 1.1 years to 1.4 years of age. Cattle fattening period is 4.5 months in rural areas of Bangladesh.

Key words: Cattle fattening, beef, Bangladesh

Introduction

Livestock is recognized as an integral component of rice based agricultural production system in Bangladesh. The economy of the country largely depends on agriculture. Livestock being one of the four components of agriculture (such as crops, livestock, fisheries and forestry) plays a vital role in national economy, contributing about 6.5% of gross domestic products (GDP) and 13% of total foreign exchange earnings (GOB, 1991). Livestock plays an indispensable role in the traditional agriculture and largely subsistence economy of Bangladesh (Haq, 1992). The landless and marginal farmers largely depend on livestock for their survival (Ahmed, 1992). The total livestock population in Bangladesh is estimated as 24.34, 0.88, 11.55, 30.33, 123.00 and 16.00 million cattle, buffaloes, sheep, goats chicken and duck respectively (FAO, 1996). Cattle of Bangladesh is an inseparable and integrated part of the agricultural farming systems and it ranks 12th in the world and in the Asian countries, her position is third (Alam et al., 1994). Bangladesh has a higher cattle population than any other countries of European Economic Community (EEC) (Allen, 1990) and distributed with a greater density (2.6 cattle and buffalo heads per hectare) compared to other Southeast Asian countries (Assaduzzaman, 1996). Though livestock are huge in number in Bangladesh but in respect of per animal output, they are one of the poorest in the world.

It is reported that 75% of the world's cattle population is in the developing countries (Asia, Africa and Latin America), but it contribute only 34% of the beef production (Rahman, 1992) in the world. The annual meat production in Bangladesh is about 290000 metric ton, where as beef contributes 161000 metric ton (FAO, 1998) of the total meat production. Modern technologies, if properly generated through research and adopted in respect of breeding, feeding, management and disease control can raise the production to a much higher extent. For instance, a large number of farmers involved in bull fattening just before 3 or 4 months of Eid-ul-Azha, when they can sell the animals with profitable prices. Even, some landless people carry out fattening programmed year round as a way of their livelihoods. Cattle fattening for beef production have become an important business of the small farmers in Bangladesh (Sabur et al., 2000).

Straw is the important crop residue, contributes the major portion of the fibrous part of the diet of the ruminants in the tropical and subtropical countries. In Bangladesh, out of the total 29.1 million

tons roughages available for ruminants, rice straw contributes around 23.57 million tons (81%) and green grasses only 1.6 million tons (Tareque, 1985). Four metric ton fodder produced in Bangladesh every year which is very scant from required amount (Saadullah, 1991). Therefore, rice straw is the basal feed for ruminants with low nutritive value and low digestibility. Hossain et al. (1995) conducted an experiment to asses the rural beef fattening programme with traditional feeding practices (tethering, grazing and tree leaves with rice straw). They stated that farmers use rice straw of traditional varieties, green grass (road sides and weeds), sugarcane tops, wheat and rice bran, molasses, pulses bran and locally available resources such as pumpkin, carrot, banana, vegetable by products, rice gruel, boiled rice bran etc., for beef fattening. Hossain and Alam (1993) conducted a feeding trial with raising indigenous bull for beef purpose. The practice would be done by 4kg green grass/day/bull and 1-2 litre rice gruel per day in a modified technology.

Rice straw is the major crop residue being used as sole feed for cattle and buffaloes in Bangladesh. The animal productivity in Bangladesh largely depends upon the efficient utilization of this poor quality rice straw with low nitrogen content and low digestibility due to high lignin and silica content. The chemical treatment of straw is the most effective and economic method to improving the quality. Many experiment have been done on calves, heifers, bulls and dairy cows to know the effect of urea molasses treatment of straw on milk yield, body weight changes and reproductive performance but few research works on intake, nutrient digestibility, feeding behavior, fattening and carcass characteristics have so far been conducted.

Animal feed resources for beef fattening: The acute shortage of feeds and fodder has long been identified as a serious constraint to optimum livestock production in Bangladesh. The nutritional factor is considered a major constraint to livestock productivity. A sensible livestock development strategy needs to match the feed resources, type of animals and the animal products with the national requirement (Devendra, 1993). It is obvious from the experience over generation in Bangladesh, that an almost exclusive diet of rice straw, with little or no supplementation covers the nutritional needs of livestock, but that stunts growth, impairs reproduction, lactation and working ability. The main feed supplies for cattle, buffaloes, sheep and goats come from by-products of cash crops. The animals graze for grasses or any feeds that may

be available on the non-cultivated areas along with wayside. The bulk of the roughage for livestock feeding consists of rice straw, wheat straw and sugarcane tops and wayside grasses besides aquatic plants and tree fodder. Water hyacinth, banana leaves and stems, tree leaves and sugarcane tops also constitute a green supplement with straw based diet when available. Estimated total production of rice straw (based on grain production and a extraction rate of 100-150%) in respect of all varieties is about 16.9 million tons (Tareque and Saadullah, 1988). Doyle *et al.* (1986) suggested a formula for estimation of straw from grain that, grain: straw is 1:1 but in Bangladesh the ratio followed for grain to straw of local variety is 1:1.3 (Haque and Stem, 1993). The estimated rice straw production in Bangladesh is 36410.4 MT (FAO, 1996).

Total production of rice bran, wheat bran, mustard oil cake, sesame oil cake, and coconut oil cake were 2800800, 143750, 172200, 27440 and 29370MT (FAO, 1996; Haque and Stem, 1993) in Bangladesh, which is very much insufficient for the large cattle population. Saadullah (1991) conducted an experiment with straw (treated and untreated), water hyacinth and oil cake supplementation at different levels to observe calf growth and dressing percentage. Calves untreated straw group (with water hyacinth and 250 g oil cake) showed comparatively lower live weight gain (114g/day) than the calves supplied with 500 g oil cake and no water hyacinth (132g/day). In case of dressing percentage, 250 g oil cake and water hyacinth showed a greater dressing percentage (35) than 500 g oil cake supplementation (32). Very little grains are available for feeding animals in the country conventionally. The major feed of livestock is straw. About 2 kg of straw is available per head per day (Jackson, 1980) and supplementation is limited to about 1kg of green fodder plus marginal quantities of cereals and oilseed by-products. It has been estimated that 44% of the dry matter, 26% of the crude protein and 17% of the energy requirements are presently met from the available feed resources (Saadullah, 1995). Concentrates consist of rice bran, wheat bran, oil cakes, pulse bran, molasses and some cases fish meal and contribute 6.8% of the total dry matter. Traditional grazing field is scarce except in some pockets in Pabna and Sylhet districts (in winter only). These areas also become too deeply flooded for cropping in the monsoon and are used for production of fodder during the dry season.

Seasonal effects on the types and quantity of feed offered peaks in the availability of straw alternated with peaks of green feeds. More straw based rations are offered in January–March, July–August and again in November (Saadullah and Hossain, 2000). Most green materials are supplied from mid-March to July and during the month of September and October (FSRDP-BAU, 1986-87). These fluctuations follow more or less the succession in dry and wet season and the harvest with the straw peaks corresponding to the dry season and the green peaks to the wet season.

Beef cattle fattening: Indigenous cattle (*Bos indicus*) are reared by the farmers of Bangladesh mainly getting draught power, milk calves and meat. Cattle contribute about 98% of draught requirement, 99% of milk produced and 50% of meat sold in the market (BBS, 1991). Cattle fattening for beef production has become an important business of the small farmers in Bangladesh. The Directorate of Livestock Services (DLS) of the Government of Bangladesh has taken beef fattening as an action program to generate income for the rural poor farmer. Cattle are bought by the farmers usually 3-6 months before Eid-ul-Azha (Muslim festival) and then they are fattened and sold during the Eid festival. There is little information available on cattle fattening by the rural farmers. Hossain (1986) worked on management systems of cattle regarding feeding, housing, disease prevention and marketing in the Comilla district. Hossain *et al.* (1996a) conducted a study on beef fattening in the Manikganj district. Hud *et al.* (1997) reported that the farmers were benefited highly by selling fattened cattle before the Eid-ul-Azha in the Mymensingh

district. One of the advantages of the cattle by the rural farmer is that they use locally available cattle feed resources. Family members of the farmer are involved in feed processing and offering feed daily. No improved feeding technologies such as urea treated of straw and urea molasses block (Hossain *et al.*, 1996b) supplement were used by the farmers. Indigenous knowledge on cattle fattening (Rahman *et al.*, 1998) practiced by the rural livestock farmers of Mymensingh district of Bangladesh were found. Castration has a negative effect on growth rate and carcass characteristics of cattle (Plasses *et al.*, 1995), which may be the reason for using uncastrated cattle. Hossain *et al.* (1996a) reported that farmers used three years old cattle in Manikganj district of Bangladesh. Singh and Patel (1996) also reported that cattle in Gujarat, India showed maximum growth rate between 1.1 years to 1.4 years of age. Hossain (1986) and Hossain *et al.* (1996a) reported cattle fattening period of 4.5 months in rural areas of Bangladesh. Keeping cattle for fattening purposes in separate houses was cited by Hossain *et al.* (1996a). Hossain *et al.* (1996a) found buying cost Tk 5350/cattle. They also showed that net income per cattle was Tk 7745 in a period of 5.7 months. Ali and Anwar (1987) and Hossain *et al.* (1996b) reported that the shortage of animal feed was the greatest problem of the farmers for rearing cattle.

A study (Hashem *et al.*, 1999) investigated the cattle fattening programs of rural farmers in different districts of Bangladesh through field survey. In that study 51.2% farmers had primary level education and 28% had no education at all. About 60.4% farmers used cattle of 2-3 years of age and 32.2% farmers used cattle of 1-2 years age. About 70.4% farmers used bulls and only 5.2% used females. About 71.20% farmers had an average of 2 cattle for fattening and 28.80% farmers had an average of 3 cattle. 42 and 30% farmers reported fattening periods of 3-6 months and 7-12 months respectively. Separate houses for cattle were provided by 86% of the farmers. All the farmers washed and groomed their cattle in ponds and rivers. About 92% of the farmers did not have any training on cattle fattening, where as only 8% farmers has taken training on livestock rearing from the local Youth Training Centres. About 61.2% farmers dewormed their cattle before starting the fattening programs. About 72.8% farmers did not vaccinate against infectious diseases for their cattle. For treatment of cattle only 24% of farmers had taken help from a veterinary surgeon. About 46.4 of farmers bought their cattle at 2- < thousand Tk/cattle. Average buying and selling prices and net profits (Tk/cattle) were Tk 5043, 8360 and 3648 respectively.

In recent years, the women farmers of Bangladesh have involved and sustained beef fattening program in rural areas of the country. The women farmers borrow money from local bank or credit organizations. Hossain *et al.* (1996a) conducted a study upon nine selected women of Dhalla village under singair Thana of Manikganj district to evaluate the beef fattening as an income-generating source being practiced by the vulnerable group of women. The fattening programmed was financed by the local Grameen Bank, Dhalla branch. It was found that each woman borrowed an average loan money accounting to Tk 7,333.00 @ 20% interest per annum from the Grameen Bank. The study revealed that the average net income of each woman was Tk. 7,745.00/season (5.77 months) having 1.78 animals on an average. Individual record showed that two, out of these nine women earned an average net income of Tk 650.00 where as the other four women had an average income of Tk 4,800.00/season. On the other hand, the remaining three women earned a net income of Tk 11,700.00, 16,500.00 and 21,000.00/season respectively. The seasons behind these increased amounts of income by these three particular women were that their investment per animal was higher and the overall management of the fattening programme was very good.

Eating and rumination behavior of beef cattle: Feeding and rumination behavior was studied (Varlyakov *et al.*, 1994) in 4 male

Black and White calves and 4 male buffalo calves (Murrah x Bulgarian) at 10 months of age using a system of 24-h periods. During first period animals were fed on a diet containing concentrate mixture (CM, 3.0kg), Lucerne haylage (LH, 6.0kg) and meadow hay (MH, 1.2kg), with a concentrate to roughage ratio of 48:52. In the second period, proportions of diet components were changed to CM 1.3, LH 9.0 and MH 2.4kg. Animals were kept tied up in individual pens, feed was offered at 08.00 and 13.00h and feeding behavior was observed at the end of each experimental period by visual chronometry. Increasing the proportion of roughage in the diet resulted in a decrease in time spent from the start of eating to the first rumination, a decrease in the number of boluses per rumination period an increase in the time for rumination per bolus. Changing the proportion of concentrates and roughage in the diet had no influence on the number and duration of rumination periods, the rumination index and feeding activity (time for feeding + rumination). Higher rumination index and feeding activity were species specific feeding behavioral characteristics of buffalo calves compared with calves.

Grant *et al.* (1990) conducted an experiment in a 3 x 3 Latin square design, 3 rumen cannulated Holstein dairy cows housed in free stalls (with 0.7% slope) were fed on 3 total mixed rations, differing in silage particle size. They found that maximum rumination activity occurred during the night. On day 40 of a 138day feeding trial 93 crossbred yearling steers were observed (Hicks *et al.*, 1989) every 30 minutes for 24h. Steers spent 6.6%, 15.5% and 54.4% of their time eating, ruminating and lying respectively. Peak eating times occurred at 06.50 (47.3% of steers eating) and 17.00h (36.8% of eating) that corresponds to times of addition of fresh feed with another small peak at 21.00h (17.9% eating). Ruminating and lying peaks during the day occurred at times inverse to eating. Individual steers with highest eating times had highest rumination and lying times. Steers that spent more time for eating and ruminating gained weight slightly more rapidly. Daily gains increased by 0.02lb for each 1% increase in lying time. Results suggest that the frequencies of eating, ruminating and lying are correlated with animal performance.

Nutritive value and effects of UMS (urea molasses straw) on live weight gain: Many research work have already been done for the improvement of the quality of straw by treating with physical, chemical and micro-biological means. Saadullah *et al.* (1980) treated rice straw with one litre of animal urine per kg straw in a pit for 20 days. The nitrogen content increased from 0.53 to 0.90% of DM and the organic matter digestibility increased from 45 to 55% as the result of urine treatment.

The chemical treatments of straw with acids or alkali improving the quality of straw (Schiere and Ibrahim, 1989). Alkali supplies OH⁻ which breaks down the fibers by chemical action (saponification of ester bonds in the lignin-hemi cellulose molecules) as well as physical action (swelling which is due to the ions attracting water molecules which cause the fibers to rupture), which makes the straw easy digestive. They also stated that physical treatment like grinding, pelleting, chopping etc. decrease the particle size which results power the digestibility but increase intake. Higher intake occurs due to higher rate of passage.

Manurung and Zulbaridi (1996) conducted an experiment to evaluate the effect of urea molasses treatment on the quality of rice straw. Five levels of urea (0, 0.5, 1, 1.5 and 2%) and 4 levels of molasses (0, 1, 2 and 3%) were used with 5kg chopped rice straw and stored for 21 days in plastic bags. The results showed that urea and molasses treatment on rice straw decreased the dry matter and silica contents but increased in crude protein ($P < 0.01$). Dry matter and organic matter digestibility were not significantly affected by urea treatment but were increased highly significant by molasses treatment. In an experiment Huque and Chowdhury (1995) used urea, molasses and straw in the ratio 3:15:82 in urea molasses straw (UMS) and analysis the chemical composition. They found that DM is higher in dry straw (875g/kg) than UMS (734g kg⁻¹) and OM is slightly higher in dry straw (882g⁻¹) than

UMS (865g kg⁻¹). But crude protein is higher in UMS (100.0 g⁻¹) than dry straw (53.7g⁻¹) and acid detergent fibre is lower in UMS (406g kg⁻¹) than dry straw (430 g⁻¹).

Acorda *et al.* (1992) used rice straw with various combinations of 2% NaOH, 5% soybean meal (S), 5% urea (U), 10% molasses (M) and 30% cage layer manure (CLM) were packed in double layer polyethelene bags and allowed to ferment for 45 and 90 days. They also found that crude protein contents of rice straw plus S+U, S+U+M, CLM, M+CLM, S+U+CLM and S+U+CLM+M were higher than other mixtures. All mixtures had consistently higher digestible organic matter in dry matter than rice straw alone. Barnah *et al.* (1992) conducted an experiment to observe the effect of urea and molasses treatment of paddy straw on its chemical composition and nutritive value in crossbred calves. For these purpose 12 male crossbred calves 6-7 months old and average live weight 4.2kg, were fed on diets containing untreated or 2:5, 3:7.5 and 4:10 urea molasses treated rice straw ad-libitum (groups A and D respectively). They also observed that the dry matter intake was increased ($P < 0.05$) in group D. Digestibility of dry matter, organic matter, crude protein, ether extract, crude fibre and nitrogen free extract was higher ($P < 0.01$) in group D compared with group A. Digestible crude protein content of 4% urea and 10% molasses treated rice straw increased from 0 to 5.11% and total digestible nutrients increased from 40.16 to 54.43%. Sarker *et al.* (1990) described the effect of urea supplementation on the total intake of dry matter, crude protein, crude fibre, ether extract, nitrogen free extract and net metabolizable energy. Urea supplementation in the form of ammoniated straw and/or urea molasses block lick increased in voluntary intake of total dry matter.

The physical and chemical treatment of straw increases its available nutrient, the intake and digestibility of straw by the animals (Saadullah *et al.*, 1982 and Tareque, 1985). Dolberg *et al.* (1980) in their experiment treated the straw with 5% urea and preserved for 20 and 40 days. They also observed that *In vitro* analysis of digestibility was increased from 35. to 52.3% on dry matter basis in an earthen pit and increase in nitrogen was from 0.59 to 1.00 per cent in stack covered with banana leaves. Ahmed and Dolberg (1979) reported that animals could be fed treated straw for maintenance and consumed about 4 to 6kg straw per day. They also described that soaking of straw in water resulted small increase in digestibility and the addition of 10% molasses and 2% urea by weight with straw ration at feeding time is adequate to meet the animals maintenance requirements.

Chowdhury *et al.* (1995) stated that algae could be successfully used as animal feed. Heifers of indigenous breed consumed algae suspension at 10% of their live weight. In comparison to oil cake (0.5kg day⁻¹), algae suspension supplemented to a basal straw diet increased fibre digestibility (76 vs. 81%), growth rate (399g/d vs. 458g/d) and feed conversion efficiency [10.3g vs. 8.6g DOMI (digestible organic matter intake/g live weight gain)].

Rahman (2001) reported that higher feed intake and weight gain through feeding of urea molasses straw (UMS) for fattening indigenous bulls compared to feeding rice straw alone. Baset *et al.* (2002) observed that feed intake were more in case of UMS and UMS + concentrate than straw feeding. Average live weight gain/animal/day were 204.17, 400.0 and 418.75g incase of straw, UMS and UMS + concentrate treatment group respectively. Live weight changes in UMS and UMS + concentrate treatment groups were significantly differ from 2nd month to the end of the experiment at 1% level. Maximum live weight gain was observed at UMS + concentrate treatment group where extra wheat bran was added. Daily live weight gain and selling price were more in the steers of UMS + concentrate group but net return was observed maximum in the steers of UMS group.

Nutritive value of rice straw can be improved by proper chemical treatment and supplemented with nitrogen and energy. It was found that if urea and molasses mixture is supplied to the animals with straw than feed intake and digestibility of straw increases (Tareque, 1985). Urea is a non-protein nitrogenous compound that

can be used in the ruminant's ration as protein supplement. Rumen micro flora converts urea to protein. Molasses is a sugar mill by product, which can be obtained easily and can provide energy, minerals and vitamins very quickly. It adds sweet flavor and odor and has a special value increasing the palatability and efficiency of feed. The use of non-protein nitrogenous component incorporated with molasses is an economical means of providing suitable protein and energy for ruminant. Urea molasses straw (UMS) is the suitable feed to incorporate straw with urea and molasses.

Daniel et al. (1986) carried out an experiment with crossbred calves fed on urea molasses liquid diet, six Holstein Friesian x Haryana calves, 8-12 months of age were given a conventional ration (CR). A similar group was given to appetite for 150 days urea 2.5, molasses 9.2, minerals 3 and water 2.5% then CR to day 306 and final 1.5 times CR to day 336. The control group was given 2kg green sorghum and wheat straw to appetite whereas the second group got straw 0.8 kg/kg live weight. The animals were weighed initially and at 150, 306 and 336 days. Daily weight gains for the three periods were 458, 651 and 608, 102, 679 and 983g in control and second group respectively. It was concluded that younger calves fed on urea molasses had a much lower growth rate than older ones. An experiment was carried out by Lozand et al. (1987) for 70 days with Hereford x Aberdeen, Angus x Zebu steers weighing initially about 274kg in a 2 x 2 randomized block factorial experiment. Taking 3 replications each of two steers were given diet of molasses and urea with sunflower meal or cottonseed meal. Average daily gains were 1.015, 0.980, 0.0884 and 1.060kg with the four treatments respectively.

Su et al. (1984) observed body weight change with beef cattle using molasses and urea. A total of 30 Charolais x Chinese Yellow cattle of 17-19 months old were fed in 5 groups on a low energy, low protein diet without or with urea 0.06 and molasses 0.5, 1.0, 1.5 or 2.0 kg/head/day. The result showed that average total body weight gain was 32.3, 36.0, 37.2 and 37.5 kg. The 4th group which gain 39kg at 1.96kg concentrates daily, 1.5kg molasses and urea at 1.06-1.45 and 0.1-0.2% of body weight respectively was suitable. Manget and Gupta (1991) carried out an experiment on male crossbred calves. For these purpose they were divided into four equal groups fed wheat straw ad-libitum as basal roughage and concentrate mixture (group-I), UMMB lick II (group III) and UMMB lick III (group IV). They showed that wheat straw intake was significantly higher ($P < 0.01$) in groups II, III and IV as compared to group I.

Haque et al. (1984) in an experiment used three groups of local Bangladeshi male calves 4 in each group and were given diets based on rice straw untreated or treated with ammonia generated from urea or from urine. Daily supplement of rice bran (400g), oil cake (200g) and fresh rye side grass (1kg) were given during 105 days. Body weight gains from straw treated with ammonia using either urea or urine as a source, 162 and 171g/d were significantly higher than the gain untreated straw, 95 g/d. In a 60 day study by Chowdhury and Huque, (1998) 12 native growing bulls, 35 months old, 273kg live weight, were assigned to treatments consisting of chopped rice straw ad-libitum supplemented with 3% urea (US) 3% urea + 15% cane molasses (UMS) or 3% urea + 30% rice gruel (UGS) and observed daily live weight changes during the experimental period were 292, 125 and 19g respectively for UMS, UGS and US.

Intake and nutrient digestibility: On a urea molasses straw (3:15:82; UMS) based diet effect of graded leaves of cotton seed cake (CSC) supplementation on the performance of native (*Bos indicus*) bulls has been studied (Chowdhury, 2001) for 167 days. Eighteen growing bulls of 129 ± 13.4 kg weight and about 14 months old were randomly allocated to three dietary treatments designed in completely randomized design, having six animals in each treatment. Three dietary treatments were 0, 0.5 and 1.0kg CSC per head/d. In addition, each animal also received ad-libitum

UMS, 4kg Napier (*Pennisetum purpureum*) grass, 500g of each of rice and wheat bran and 60g mineral mixture daily. For unit increase in CSC, total DM intake was increased by 1g/kg $w^{0.75}/d$ the straw DM intake decreased by 0.54 g/kg $w^{0.75}/d$. Whole gut digestibility of DM and OM was not affected but N and ADF digestibility increased with incremental increase in dietary CSC. For unit (1kg) increase in dietary CSC intake N and ADF digestibility increased by 10 (± 1.155) and 3 (± 1.732) unit respectively.

In a 60 day study (Chowdhury and Huque, 1998), 12 native growing bulls, 35 months old, 273kg live weight, were assigned to treatments consisting of chopped rice straw ad-libitum supplemented (on a DM basis) with 3% urea (US), 3% urea + 15% cane molasses (UMS) or 3% urea + 30% rice gruel (UGS). Daily organic matter (OM) intake was higher ($P < 0.05$) in bulls fed on UMS (64g/kg $^{0.75}$) followed by UGS (53g/kg $^{0.75}$) and US (49g/kg $^{0.75}$). Estimated (from digestible OM intake) daily ME intake was 396, 348 and 301 kg/kg $^{0.75}$ for UMS, UGS and US respectively. Huque and Chowdhury (1997) conducted an experiment on supplementing effects of feeding systems of molasses and urea in indigenous bulls and found that UMS increases digestion and intake in association with reduced methane production in the rumen and that such a mixture (3:15:82; UMS) may be the best way of feeding molasses and urea to ruminants fed on straw.

Using a diet based on urea molasses straw (3:15:82; UMS) the effect of graded levels of mustard oil cake (MOC) supplementation on the performance of native bulls was studied (Chowdhury, 1999). Four cannulated adults bulls, 415kg live weight, 80 months of age, were given MOC 0, 200, 400 or 800g daily in four periods in a 4 x 4 Latin Square Design. Each bull also received 200g each of molasses and wheat bran and a mineral mixture. For a unit (1g) increases in MOC intake, total DM intake increased by 0.8g daily ($r^2=0.88$) with no change in the straw DM intake. With increasing levels of MOC, CP digestibility increased. However, MOC level had no effect on digestibility of DM, organic matter and ADF. On a UMS based diet supplementation of MOC up to 800g (10% of total intake) of the dietary intake had little or no effect on intake, digestibility, rumen parameters and microbial N yield but slightly increased N balance.

Carcass characteristics: Study of the carcass quality and quantity is important for economic marketing of beef. The amount of marbling fat or intramuscular fat in beef is recognized as an important carcass quality characteristic in North American and Asian markets, particularly when the meat is sold to food service institutions for consumption in an upscale dining environment (Huffman et al., 1996). Budmaska and Kalinka (1994) conducted a feeding trial, Black pied bulls over 6 months old in 4 groups were fed on a basal diet plus maize silage and concentrates. The diets are supplemented with 2.5% urea, the basal diet plus UMS or ACMS, or maize silage that was mixed with ammonia carbonate 10kg/t just before feeding. Average daily live weight gain was 713, 726, 748 and 807g respectively. The trial was repeated on young bulls of initial live weight 167 to 173kg. Average daily live weight was 728, 781 and 802g. Bulls took 7.5, 6.9, 6.8 and 6.7 feed units/kg gain. At controlled slaughter, killing-out percentage was 50.4, 51.6, 53.0 and 53.3, carcass yield was 49.9, 50.7, 52.0 and 52.2%, and yield of lean was 76.9, 78.0, 77.4 and 78.7%.

Ten Brangus x Jersey (F₁), 21 Simmental x Jersey (F₁) and 28 Limousin x Jersey (F₁) crossbred were studied (Ozbeyaz et al., 1997) at a state farm in Turkey. For the three crossbred type respectively, overall daily weight gain during the 510 day fattening period averaged 0.64, 0.59 and 0.54kg for males and 0.53, 0.54 and 0.54kg for females. For both sexes there were no significant differences between breed types in respect of daily weight gain. Brangus crossbred males had gained about 39.6kg more live weight than Limousin crossbred at the end of the fattening period, but difference was not significant. Brangus crossbred males were 64kg and Limousin crossbreds were 24.4kg heavier than Simmental crossbreds; these differences were significant. For groups of 4 Brangus x Jersey, Simmental x Jersey and

Limousin x Jersey bulls slaughtered at 457.5, 436.8 and 450.7kg respectively. Dressing percentage averaged 58.0, 56.1 and 58.2, skin weight 36.5, 37.8 and 39.3kg, bone percentage 16.0, 16.2 and 15.9 and rib-eye area 86.3, 96.4 and 95.6 cm².

Fattening performance from 181 to 540 days of age of 27 Polish Black and White and 20 Limousin x Polish Black and White heifers and bulls was compared (Nogalski and Kijak, 1998). Crossbred bulls and heifers were heavier at 540 days of age and had greater daily gains than the respective purebreds ($P < 0.01$). Feed conversion efficiency was also greater for crossbreds than purebreds ($P < 0.05$). Crossbreds had a lower percentage of internal fat in the carcass and a greater longissimus dorsi muscle area than purebreds ($P < 0.01$). The purebreds had a lower dressing percentage than the crossbreds ($P < 0.01$). Jorge et al. (1998) found from 36 months of age, 36 Gir, Guzera, Tabapua and Nelore bulls, with an initial body weight of 357.6, 362.0, 369.6 and 376.4kg respectively, were finished in a feedlot on a diet containing 50% concentrates. Bulls were slaughtered at a body weight of 405, 450 or 500kg. There were no significant differences among the bulls with the three slaughter weights in daily gain or carcass daily gain, but bull slaughtered at 500kg had a significantly longer period in the feedlot and a lower efficiency of gain than bulls slaughtered at lower weight.

Colpan et al. (1995) reported that male Limousin x Jersey beef cattle, from 12 to 18 months old in two groups of 6 each were fed on a diet containing 80% concentrates and 20% roughages containing of 85% sugar beet pulp and 15% wheat straw and that diet supplemented with 1.5% zeolite. Average live weight at the end of feeding was 333.25 and 354.80kg respectively and average daily gain 1132 and 1246g. The cattle took 7.860 and 7.418kg DM/kg gain. At slaughter, average cold carcass weight and average weight of meat in the carcass were 188.60 and 148.23 and 204.20 and 161.00kg respectively. The average hot and cold dressing percentage was 56.71 and 55.54 and 56.54 and 55.39. It is concluded that 1.5% zeolite had a favourable effect on performance and carcass quality of beef cattle. Rumsey et al. (1996) observed for the four fed groups, daily empty body weight gain averaged 1.26, 1.43, 1.63 and 1.78kg respectively ($SEM = 0.05$) and daily carcass gain 0.78, 0.97, 0.97 and 1.08kg ($SEM = 0.04$). Compared with controls, empty body and carcass gains were affected by treatment ($P < 0.01$ for SYN and Sbv). Non-carcass gain averaged 0.45, 0.48, 0.60 and 0.60kg/day ($SEM = 0.03$; Sbv, $P < 0.01$). Kang-Woosung et al. (1996) reported that castration decreased daily body weight gain and feed conversion efficiency, reduced retail cuts and loin, decreased meat yield, gave smaller rib eyes and increased back fat thickness and body fat ($P < 0.01$).

Caton et al. (2000) cited that a large portion of total energy expenditure associated with ruminant livestock production goes towards maintenance. Approximately 55% of whole body energy use is consumed by visceral tissues with the majority of this going to the liver and gastrointestinal tract. Muscle and adipose tissues consume about 27% of total body energy expenditure. Metabolic components within the viscera responsible for the majority of energy consumption include ion transport, protein turnover, substrate cycling and urea synthesis (liver). Within muscle tissue of growing animals ion transport and protein turnover account for most of the energy expenditure. Protein synthesis consumes approximately 23% of whole body energy use and visceral tissues account for proportionally more of whole body protein synthesis than skeletal muscle. Research efforts focused on improving energetic efficiency of the tissues and metabolic mechanisms responsible for the majority of whole animal energy expenditure should provide information leading to more efficient production of an edible product.

Problem faced in beef fattening: There are so many problems of beef cattle production in Bangladesh. A large population (120 million) gradually captures the arable land for residence and hence the land for pasture/fodder production becomes gradually

squished. The density of cattle per hectare of land (pasture and arable) is 2.49. The density is much higher in Bangladesh compared to that of many countries of Asia. But the beef and veal production per animal is much lower than many countries of the world. Hashem et al. (1999) observed that about 96.8% of farmers reported shortages of animal feed and 84% reported lack of credit as the major problems for cattle fattening. The major causes of lower production of beef per animal are shortage of grazing land (pasture land), lack of balanced feed and green grass and problem to rear hybrid cattle in our local atmosphere and weather. In 1990, the production of beef per animal is 80kg in India, 158kg in Pakistan, 240kg in Indonesia, 109kg in China, 232kg in Australia, 178kg in Newzealand, 247kg in Denmark, 284kg in U.K. and 297kg in the USA. Whereas the production of beef per animal is 62kg in Bangladesh (Alam, 1995).

Marketing problem has also a negative effect on beef production in our country. Ahmed (1992) found that the marketing and processing of beef products is entirely in the hands of private sector. The shortage of livestock products, prices of beef were relatively high, particularly in relation to average income levels and minimum basic rates of pay. Before slaughtering, cattle were transported mainly on foot from a long distance (Wahiduzzaman, 1981) and slaughtered them without any rest. During selling in the market, broker is common problem. He also found the single highest cost component of marketing beef cattle and beef, the market tolls amounting 63.68% of the total market cost. Illiteracy is also a problem. About 60% cattle traders are illiterate, a quarter have education up to third year in the school and the rest have education varying from third year class to H.S.C. level.

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ISSN : P-2409-0603, E-2409-9325

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Review Article

Vol. 1, No. 1, December 2014: 109-126

AN OVERVIEW OF FISHERIES SECTOR OF BANGLADESH

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ARTICLE INFO

ABSTRACT

Received
15.12.2014

Bangladesh is endowed with a vast expanse of inland open waters characterized by rivers, canals, natural and man-made lakes, freshwater marshes, estuaries, brackish water impoundments and floodplains. The potential fish resources resulting from these are among the richest in the world; in production, only China and India outrank Bangladesh. The inland fish diversity of is attributed to the habitats created by the Bengal Delta wetlands and the confluence of the Brahmaputra, Ganges and Jamuna rivers that flow from the Himalayan Mountains into the Bay of Bengal. There are, however, serious concerns surrounding the slow decline in the condition of open water fish stocks which have been negatively impacted upon through a series of natural and anthropogenic induced changes including large scale abstraction of water for irrigation and the construction of water barrages and dams, human activity resulting in the overexploitation of stocks, the unregulated introduction of exotic stocks and pollution from industry. Also, natural phenomena, regular flooding etc. cause rivers to continually change course creating complications of soil erosion or over siltation of waterways. As a consequence, many Bangladeshi species are either critically endangered or extinct. Aquaculture has increasingly been playing a major role in total fish production of the country and presently more than half of the total production comes from aquaculture. The sector provides living and livelihood for more than 11% people of the country. If the available resources are used sustainably with proper technological assistance, fish produced from aquaculture would efficiently meet the protein demand of growing population of the country. The needs of Bangladesh's poor fisher community to eat what they catch and lack of a legal legislative framework means the situation can only worsen. Hope, however, is offered through several new conservation initiatives including the establishment of fish sanctuaries at strategic points in rivers and floodplains, concerted breeding programmes and the maintenance of captive stocks and cryogenically stored materials.

Accepted
22.12.2014

Online
27.12.2014

Key words:
Fisheries
Aquaculture
Diversity
Bangladesh

To cite this article: MAR Hossain, 2014. An overview of fisheries sector of Bangladesh. Res. Agric., Livest. Fish. 1(1): 109-126.



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INTRODUCTION

Bangladesh is situated in the northeastern part of the South Asia and lies between 20°34' and 26°38' North longitudes and 88°01' and 92°41' East latitudes. The country is bordered by India on the West, North and North-East (2,400 kilometer land frontier) and Myanmar on the Southeastern tip (193 km land and water frontier). On the south is a highly irregular deltaic coastline of about 710 kilometers, fissured by many rivers and streams flowing into the Bay of Bengal. The territorial waters of Bangladesh extend 22 km, and the exclusive economic zone of the country is 370 km. The total landmass of the country is about 144,400 km² and extends 820 kilometers north to south and 600 kilometers east to west. The country stretches out at the junction of the Indian and Malayan sub-regions of the Indo-Malayan zoogeographic realm. Formed by a deltaic plain, Bangladesh is virtually the only drainage outlet for a vast complex river basin made up of the Ganges (local name the Padma), the Brahmaputra and the Meghna rivers and their network of tributaries. The Padma unites with the Jamuna (main channel of the Brahmaputra) and later joins the Meghna to eventually empty into the Bay of Bengal. The alluvial soil deposited by these rivers every year has created some of the most fertile plains in the world. Most parts of the delta are less than 12 metres above the sea level, and it is believed that about 50% of the land would be flooded if the sea level rise by a metre. Straddling the Tropic of Cancer, Bangladesh has a tropical monsoon climate characterized by heavy seasonal rainfall, high temperatures, and high humidity. There are three broad physiographic regions in the country. It is a country dominated by wetland having more than 50% of its territory under true wetlands that is freshwater marshes, swamps, rivers estuaries and the world's largest contiguous mangrove forest -the Sundarbans.

Bangladesh has a total inland water area of 6.7 million ha of which 94% is used for open water capture fishery and 6% for closed water culture fishery. The inland open water fishery resources have been playing a significant role in the economy, culture, tradition and food habit of the people of Bangladesh. Rivers and their ramified branches cover about 479,735 ha area of land. Seasonal floodplain expands over a massive 5.5 million ha for 4-6 months of the year. Inland open water also contains estuarine areas with semi-saline waters (0-10 ppt), huge number of *beels* (natural depressions often with permanent area of water) and *haors* (bowl-shaped deeply flooded depressions) in the north and east and the manmade Kaptai lake-the largest lake of the country in the south. The country is blessed with 0.26 million of closed waters in the form of ponds, ditches, oxbow lakes (channel of dead rivers) and brackish water farms.

FISH AND BANGLADESH

In the globe, fish provides the best protein food rich in essential macro- and micro-nutrient, vitamins and minerals. Fish farming and fishing create working opportunity and income to millions of poor, and trade in fishery products play important role in poverty alleviation and economic growth of nations.

The fisheries sector, in Bangladesh, plays a particularly crucial role among poor as a main or additional source of employment, livelihood and income. The sector is the second largest part-time and fulltime employer in rural areas. It provides a crucial source of income and food to Bangladesh, and is second only to agriculture in the overall economy of the country. Fish is a natural complement to rice in the national diet, giving rise to the adage "*Maache-Bhate Bangal*", literally meaning – 'fish and rice make a Bangladeshi'. Bangladesh produced 3.26 million tons of fish during 2011-12 from inland and marine waterbodies and aquaculture contributed more than 50% of the total production. (Table 1) Fisheries accounts for 4.4% of Bangladesh GDP, 22.8% of agriculture sector and 2.5% of total export earnings. It also contributes 60% of the animal protein intake in Bangladesh, and even higher in populations living in the coast.

Table 1. Fish Production of Bangladesh from different aquatic resources in 2011-12

Water Resources	Water area (ha)	Production (MT)	Production (kg/ha)	% Total
Capture - Open Waters	3,925,290	957,095	-	
River and Estuarine	853,863	145,613	171	
Sundarbans	177,700	21,610	122	29.34
Beel	114,161	85,208	746	
Kaptai Lake	68,800	8,537	131	
Floodplain	2,710,766	696,127	257	
Culture -Closed waters	774,055	1,726,067	-	
Ponds & Ditch	371,309	1,342,282	3,615	
Seasonally cultured waters	122,026	182,2930	1,494	52.92
Baor (Ox-bow lake)	5,488	5186	945	
Shrimp/Prawn Farm	275,232	196,306	713	
Marine Fisheries	-	578,620	-	
Trawler	-	73,386	-	17.74
Aritasanal Fisheries	-	505,2343	-	
Country Total		3,261,782		100

DoF (2013)

The overseas fish trade is an important source of foreign currency earnings for the country and provides benefits at both the macro and microeconomic levels. Fish is the third largest contributor to Bangladesh's export earnings and is growing annually by 5-8 %. Revenue from exports of non-fish agricultural goods is gradually being outpaced by fish products, to the extent that fish has become the most important primary commodity that Bangladesh exports (Dey et al. 2008).

Bangladeshi people largely depend on fish to meet their protein needs. Until 70s, there was an abundance of fish in the natural waters – the floodplain, rivers, rivulets, beels, lakes, ditches and canals of the country to well-satisfy the demand of fish. Presently, however, capture fish production has declined to about 50%, with a negative trend of 1.24 % per year. Despite the constant depletion of the natural water bodies for years, Bangladesh, globally, still holds one of the most diverse inland fisheries. However, the availability of many fish species has been drastically declined, and many are either critically endangered or regionally extinct. Both breeding and feeding migrations of the river and floodplain resident fishes of the country have been drastically cut off due to flood protection embankment with serious consequence on recruitment and production tonnage.

KEY WATERBODIES AND THEIR STATUS

The inland open water fishery of Bangladesh is composed of highly diverse and unique aquatic systems. It has an extensive network comprising of floodplains, large and small rivers, beels, haors and baors offering tremendous scope and potential for fish production. It has also large impounded water areas in manmade ponds, ditches, borrow pits, lakes and enclosures.

The Floodplain

Floodplains are relatively low laying land area, bordering rivers and seasonally over flooded by overspill from the main river channel. There are two distinct flooding patterns, one resulting in flow direction from the floodplains to the rivers (from flush flood due to local rainfall) and the other from

the rivers to the floodplains (river overspill due to the heavy rainfall in the upstream). The ecodynamics of floodplain are influenced by the river water incursion and retreat and the timing and intensity of monsoon. There are great differences in the area flooded from year to year, and this greatly influences the population dynamics of many fish species. The seasonally flooded area is highly productive for growth of fish and other aquatic animals. During the dry season, as pasture land, the floodplain receives nutrients in the form of animal dropping and rotting vegetation. As the monsoon approaches the accumulated nutrients rapidly enters into the solution combined with river-borne silt, led to an upsurge of productivity resulting in rapid growth of plants and other forms of aquatic biota. This productivity phase offers an ideal condition for feeding and breeding of many riverine fishes and other aquatic animals which migrate to floodplain with the rising waters. Floodplains inundated during monsoons are nutrient rich and play a significant role as nurseries for larvae and juvenile of many fish species (Junk et al. 1989). A large number of fresh water fish species migrate from rivers and beels to floodplains for breeding and grazing and are harvested by the rural professional and amateur fishers. The floodplains are essential for most of the rural people of Bangladesh for their livelihood.

The Rivers

Bangladesh is a riverine country. It has numerous rivers and their tributaries. The Ganges, the Brahmaputra and the Meghna are the mighty rivers. The three rivers along with their innumerable tributaries form one of the richest habitats of fishes in the Indian Subcontinent. In addition to three main rivers, the other main rivers are the Karnafuli, Matamuhuri, Halda and Sangu in the southern Chittagong sub-region. The major rivers are the Surma, Kushiara, Kangsha and Someshwari in the north-east region and the Tista, Korotoa, Atrai, Bangalee, Mohananda in the north-west. The total length of the network of about 310 rivers in Bangladesh together covers more than 24,000 km with a catchment area of 1,031,563 ha. Annual flooding of the rivers inundates about 70% of the total land surface. The total annual discharge passing through the rivers system into the Bay of Bengal reaches up to 1,174 billion m³ (Banglapedia 2004). The rivers are not evenly distributed in the country. For instance, the numbers and size of the rivers gradually increase from the northwest of the northern region to the southeast of the southern region. All the rivers, except those of Chittagong hilly sub-region, belong to three major river systems, the Ganges, the Brahmaputra and Meghna. In the global context, the Brahmaputra is the 22nd longest (2,850 km) and the Ganges is the 30th longest (2,510 km) river in the world. Rivers and canals roughly cover 5.8 % of the total area of the country. According to BWDB (2005), 57 of the rivers are trans-boundary – 54 originate from India and 3 from Myanmar. During rainy season, the rivers carry high amount of silt which makes the water turbid. In winter, the water level decreases and water becomes clear. The depth of the coastal rivers usually ranges from 2 m to 5.5 m and reaches up to 36.5 m near the Bay of Bengal. Salinity of about 1 ppt extends nearly 56 km upstream in these rivers.

The Beels

The *beel* is a Bengali term used for relatively large surface, static waterbody that accumulates surface run-off water through an internal drainage channel (Banglapedia 2004). This type of shallow, seasonal waterbody is common in low-lying floodplain areas throughout Bangladesh. The total area of *beels* in Bangladesh was estimated to be 114,161 ha, occupying 27.0% of the inland freshwater (Ahmed et al. 2007). The number of *beels* in the north-eastern part of the country recorded was 6,034 having an area of 69,870 ha (Bernaesek et al. 1992). The most famous *beel* in the country known as the Chalan *beel* is located in the northwest. The other major beels in this region are Hilna, Kosba, Uthrail, Manda, Sobna and Beel Mansur. In central region, Arial beel and Balai beel now lost their importance as natural fish habitat. Other important beels in this region are Chanda, Boro, Mollar and Tungipara beels. There are many beels in the south and south west and

the notable are Chapaigachi, Garalia, Panjiapatra, Chenchuri and Dakatia *beels*. The *beels* are parts of riverine floodplain formed due to changes in the river course or strengthening of river embankments for controlling flood (Saha et al. 1990). The *beel* water is very productive in terms of fertility and nutrient, full of organic debris and organic vegetation and provides food and shelter to many larvae and juvenile as well as adult fishes and other aquatic organisms (Graff 2003).

The Haors

The haors are back swamps or bowl-shaped depressions between the natural levees of rivers, or in some cases, much larger areas incorporating a succession of these depressions. The Bengali word *haor* basically derived from the word *sagor* (literally meaning sea) and dialectically *sagor - saior - haor* has been evolved (Khan et al. 1990). In terms of morphology and hydrology, a *haor* can be subdivided into three major areas, the piedmont area around the hill foot, the floodplains and the deeply flooded area (Hossain and Nishat 1989). The haors vary in size from as little as a few hectares to thousands of hectares. The haors flood to a depth of as much as 6 m during the rainy season and in many cases two or more neighboring haors unite to form a much larger water body. Greater part of the north east region of Bangladesh is characterized by the presence of numerous large, deeply flooded depressions, known as haors, between the rivers. There are altogether 411 haors (47 major and large sized) comprising an area of about 8,000 km² dispersed in the north-eastern Sylhet and Mymensingh districts. The *haor* basin is bounded by the several Indian states - hills of Meghalaya on the north, hills of Tripura and Mizoram on the south, and the highlands of Manipur on the east. The two big rivers in the region – Surma and Kushiya in association with several smaller hill-streams - Manu, Khowai, Jadhukata, Piyangang, Mogra and Mahadao form the dense network and supply the massive water to the *haors*. The rivers are primarily responsible for providing inputs - rainwater and sediment load to the haors. The *haors* remain flooded for about 7 to 8 months. During the rainy season, the *haors* look just like vast inland sea and the villages within appear as islands. In greater Sylhet the most prominent *haors* are Saneer, Hail, Hakaluki, Dekar, Maker, Chayer, Tangua and Kawadighi. In consideration of the environmental importance and heritage, the government has decided to save the Tanguar *haor* (9,500 ha) by symbolizing it as an internationally critical environment area under the Environmental Protection Law of 1995 and registered as a wetland of international importance (Ramsar site, site no. 1031, declared in 10.07.2000) under Ramsar Convention.

The Baors

In the southwest region of Bangladesh there are a number of meandering rivers changed their courses, part of the old course got silted up and cut-off from the main course. As a result horseshoe shaped oxbow lakes known as *baor* was created. A *baor* apparently looks like a lake, but unlike lakes, it remains connected with original river through channels during monsoon. This way, the *baors* annually receive fresh supply of riverine water carrying fry, fingerlings and adult fishes and other aquatic animals. *Baors* are very important wetlands of Bangladesh and support a wide range of aquatic flora and fauna. There are more than 87 *baors* in Bangladesh covering an area of 5,488 ha (DoF 2008). Most of the larger *baors* are in southwestern Jessore region. The *baors* range in size from about 25 ha to a maximum of 500 ha (Bhuiyan and Choudhury 1997). The important *baors* of the country are Arial, Bahadurpur Baluhar, Bookbhara, Harina, Habullah, Rustampur, Ichhamati, Jaleshwar, Jogini Bhagini, Joydia, Kannadah, Kathgara, Khedapara, Marjat, Pathanpara, Rampur, Sagarkhali, Sirisdia and Sonadia.

The Ponds and Ditches

There are more than 1.3 million ponds having a water surface of 0.3 million ha in the country (DoF 2008). Though in past ponds were constructed for washing, bathing and irrigation purposes,

recently, many ponds are being constructed absolutely for fish culture purposes. There are two types of ponds on the basis of water retention capacity – the perennial ponds - contain water round the year and the seasonal ponds - contain water at a certain times or seasons (mainly in monsoon). The pond culture fisheries have always been considered as being crucial for the livelihoods of the most vulnerable people of the country. In addition, it is also good for the fish diversity as it encourages the domestication of wild fishes through artificial breeding and rearing in the captivity. Selective aquaculture, however, could be detrimental for fish biodiversity as the culture technologies advice farmers to remove all small indigenous fishes from the ponds before releasing the fry of target fish. Farmers often use piscicide and insecticide to clean their ponds. The practice has been going on in Bangladesh since the carp polyculture being introduced in late 70s. As a result, though harvests from fish culture are rapidly increasing, the catches of small fishes are declining at an alarming rate.

PRESENT STATUS OF FISH DIVERSITY

Wild fish are declining for a variety climate change induced reasons. Most indigenous fish are migratory and rely on seasonal flooding for spawning cues and access to larval rearing habitat (floodplain). Almost all dams/embankment interfere directly with successful completion of fish migration (breeding and feeding). Agriculture (excessive removal of surface water and extraction of groundwater for irrigation), pollution (domestic and industrial), and unregulated discharge of untreated industrial and farm effluents, habitat destruction also have significant impact, as does lack of flooding/rain in last few decades. Once there were many isolated small depressions/water pools but those have since been converted into agricultural land. Since 1970, the annual flooding of approximately 2-3 million ha of floodplain has been either controlled or prevented altogether by means of sluice gates or pumps positioned along earth embankments or levees. This reduction in area is believed to be one of the major reasons for declining floodplain fisheries in Bangladesh. Introduced species are significant contributors to aquaculture production, but also threaten the biodiversity of indigenous fishes. In past, stocking of rivers and floodplain is carried out with both indigenous and introduced species by government and through different projects. The effectiveness of stocking activities has generally not been well assessed. Furthermore, the impacts of aquaculture (both commercial and small scale) have not been accurately assessed in this country.

The mounting pressure of the increasing demand for crop mainly rice to feed the hungry millions of Bangladesh is now being placed on the aquatic resources. The floodplains of the country are now among the fastest disappearing of all ecological systems. Fishing pressure from an ever-growing population has increased dramatically and has seriously affected the abundance of nearly half of the inland fishes of Bangladesh, particularly small fishes like minor carps, loaches, barbs, minnows, small catfishes, parchlets, gobies, featherbacks, snakeheads and eels. Most of the hill stream fishes of Bangladesh have either already been extinct or at the verge of extinction. As a whole, degradation of wetlands has caused several problems including:

- Extinction and reduction of fish and other wildlife
- Loss of many indigenous aquatic plants, herbs, shrubs and weeds
- Loss of natural water reservoirs and of their resultant benefits
- Increase in the occurrence of flooding
- Loss of natural soil nutrients and
- Degeneration of ecosystems, occupations, socio-economic institutions and cultures

THE MAJOR CAUSES OF LOSS OF FISH BIODIVERSITY

In the past the major source of fish production in Bangladesh was the inland open water capture fisheries. During 1960s, it contributed about 90% of the country's total fish production. Rapid growth of population coupled with lack of proper management policy, however, created increasing pressure on fish resources and aquatic environment. Due to over exploitation of fish including use of harmful fishing gears and system (fishing by dewatering), degradation and loss of fish habitats, obstruction of fish migration routes by construction of embankment and water control structures mainly to increase agriculture production and road communication, siltation of water bodies by natural process, introduction of a number of alien invasive fish species and water pollution by industry, and agrochemicals, the natural inland fish stocks have declined significantly and fish biodiversity and poor fishers' livelihood have been affected seriously (Ali 1997).

Fish stocks in the rivers and floodplains are declining for a variety of reasons. Most of the indigenous fish are migratory and rely on seasonal flooding for spawning cues and access to larval rearing habitat (floodplain). Almost all dams and embankment interfere directly with the successful completion of the fish migration (breeding and feeding). Agriculture (excessive removal of surface water and extraction of groundwater for irrigation), pollution (domestic and industrial), and unregulated discharge of untreated industrial and farm effluents, habitat destruction also have significant impact, as does the regular overflooding and lack of flooding rain in the last few decades. Introduced species (primarily tilapia, Chinese carp and Thai pangas) are significant contributors to aquaculture production, but also threaten the biodiversity of indigenous fishes. In past, stocking of rivers and floodplain is carried out with both indigenous and introduced species by government and through different projects. The effectiveness of stocking activities has generally not been well assessed. Furthermore, the impacts of aquaculture (both commercial and small scale) have not been accurately assessed in this country.

Most of the literal and floodplains areas are cultivated with rice and other crops, providing multiple annual harvests. Thus, government policy has always prioritized cereal food production. Consequently, most development initiatives in the country have focused on crop cultivation, rather than biological management of the rich floodplain system for fish production, ignoring the needs of poorer people for access to renewable protein sources. Capture fisheries in inland waters which are based on natural productivity generally have reached the level of overexploitation. The inland open water fisheries, where the floodplains assume an important position in the livelihoods and nutrition of the rural poor have now been under serious threat of resource depletion due to various man-made and natural causes. The majority of the waters of this type have been depleted to an alarming state and warrant urgent interventions for conservation and sustenance. Ecosystem integrity has often been destabilized and aquatic systems now fail to support decent levels of aquatic life. As a result the livelihoods of fishers and rural Bangladeshis, previously supported by the inland open waters, are seriously compromised (Coates 1995). Some rivers and floodplains have been modified to a level where they are only recognized as narrow ditches and paddy fields.

THE BACKGROUND OF AQUACULTURE IN BANGLADESH

Aquaculture, in simple sense, is the farming of fish and other aquatic organisms, with 'farming' implying - some form of intervention to increase productions, and some form of private rights of the stock under intervention (Beveridge and Little 2002). Although livelihood opportunities associated with aquaculture contribute to the food security of large numbers of poor women and men, the direct effects of consuming fisheries products are of even greater significance.

Aquaculture or fish farming has been the most rapidly growing agro-food sector in the globe over the last four decades 1970 and 2010. Production of farmed finfish and shellfish has been

growing at a rate of 8.1% per annum over this period. The aquaculture industry employs 23.4 million full-time workers globally, with Asia accounting for 92% of jobs. Aquaculture now provides around half the fish for direct human consumption and is set to grow further

The origin and developmental background of aquaculture practices in Bangladesh are not well documented. Historically, country's natural water bodies were stocked during the monsoon season through recruitment from natural spawning. Fish farming had been an age-old practice dating back a few centuries to when the country was ruled by Hindu kings. Many of the kings used to construct ponds and tanks for drinking, bathing and sometimes for small-scale irrigation, these ponds and tanks were also used for rearing fish although more from a recreation point of view than for commercial or nutritional purpose. Dr. Nazir Ahmed (1947–1960), the then Director of East Pakistan Department of Fisheries laid the formal foundation for fish culture in ponds and lakes in Bangladesh. He devotedly worked on the development of carp farming in ponds and beels and during the time between late sixties and early seventies considerable advancement were made in this area, eg., success in induced breeding of indigenous carp with pituitary gland extracts. Over the last few decades, however, fish habitats in Bangladesh have been degraded drastically by the development of flood control measures which resulted in a decline in natural fish production. As a result GOst, NGOs and private entrepreneurs have come forward to develop improved fish farming techniques especially in ponds and floodplains (FAO 2005).

There are two types of aquaculture practices are going on in Bangladesh - freshwater and coastal aquaculture. There is no marine aquaculture currently practiced in the country and no marine/coastal fin finfishes are farmed. Freshwater aquaculture comprises mainly pond farming of carps – (indigenous and exotic), Mekong pangasid catfish, tilapia, Mekong climbing perch and a number of other domesticated fish though in lesser scale. Coastal aquaculture is comprised mainly of shrimp and prawn farming in gher (coastal pond or enclosures).

In Bangladesh, aquaculture production systems are mainly extensive and improved extensive, with some semi-intensive and in very few cases intensive systems. The present unit area aquaculture productions (MT/ha) are 3.6, 1.5, 0.95 and 0.71 for pond, seasonal waterbody, baor (oxbow lake) and shrimp gher, respectively. Inland pond culture represents the mainstay of aquaculture in Bangladesh, accounting more than 80% total recorded aquaculture production and presently dominated by carps (indigenous and exotic), Mekong pangas and tilapia.

DOMESTICATION OF FISH FOR AQUACULTURE

Domestication of wild fishes in most cases benefits both the fish farmer and the environment (Hossain, 2010). Investments in domestication have to pay off; therefore, researches should take into account the biodiversity and production scenario and overall socioeconomic and environmental outcome at a broader scale. In Bangladesh, to date about 20 fish species have been domesticated and their breeding and rearing protocols have been developed. Around 50% of the domesticated fishes are cypriniforms and now under nation-wide aquaculture (Table 2). Though there is high possibility of working with reduced gene pool, it is optimistically believed that the biodiversity of the domesticated fish are well-preserved.

INTRODUCTION OF EXOTIC FISH IN THE NAME OF AQUACULTURE

All over the world the exotic species have been recognized as an agent of the loss of indigenous biodiversity. Alteration of species and ecosystem caused by exotic invasive animals and plants influence the functioning and overall health of the affected ecosystems (Ameen 1999). As a country of rivers and wetlands, Bangladesh is very rich in fish diversity. Even then, over the last six decades a total of 24 fishes have been introduced (Table 3). The invasive species rapidly

spread over the wetlands as biological explosives during the rainy seasons. Most of the introduced species were meant only for captive cultivation in closed pond systems but nobody succeeded to maintain the fish in captivity. During monsoon and/or flood the escapees easily found their ways to the rivers and floodplains throughout the country. This posed one of the major threats to the biodiversity of many indigenous fishes in this country.

Table 2. The domesticated indigenous fishes of Bangladesh

Order	Fish	Culture status
Cypriniformes	<i>Catla catla</i>	Country-wide commercial
	<i>Labeo rohita</i>	Country-wide commercial
	<i>Labeo gonius</i>	Country-wide commercial
	<i>Labeo bata</i>	Country-wide commercial
	<i>Labeo calbasu</i>	Small scale, sporadic
	<i>Cirrhinus mrigala</i>	Country-wide commercial
	<i>Cirrhinus reba</i>	Small scale, sporadic
	<i>Tor putitora</i>	Breeding protocol developed
	<i>Puntius sarana</i>	Small scale, sporadic
	<i>Lepidocephalichthys guntea</i>	Breeding protocol developed
	<i>Botia dario</i>	Breeding protocol developed
Osteoglossiformes	<i>Chitala chitala</i>	Small scale, sporadic
Siluriformes	<i>Ompok bimaculatus</i>	Small scale, sporadic
	<i>Ompok pabda</i>	Small scale, sporadic
	<i>Mystus vittatus</i>	Small scale, sporadic
	<i>Mystus gulio</i>	Breeding protocol developed
	<i>Clarias batrachus</i>	Small scale, sporadic
	<i>Heteropneustes fossilis</i>	Small scale, sporadic
Synbranchiformes	<i>Mastacembelus armatus</i>	Breeding protocol developed
	<i>Macrognathus aculeatus</i>	Breeding protocol developed
Perciformes	<i>Anabas testudineus</i>	Breeding protocol developed
	<i>Colisa fasciata</i>	Breeding protocol developed

Source: Hossain and Wahab (2009)

Several introduced species are highly carnivorous and predatory and eat almost everything including the small indigenous species of fish (SIS - which grow to a maximum length of 5- 25 cm (Felts et al. 1996). Several exotic species also compete with the SIS and gradually occupy their niches. The ecological, economic and biodiversity consequences of the introductions of exotic fish species have never been taken into consideration. It is very unfortunate that the long-term, and even short-term adverse effects were not considered while introducing the invasive species in Bangladesh. The excessive fecundity and growth rate of these species created pressure on the carrying capacity of the habitat, and the ecosystem balance itself by reducing the indigenous species diversity and population. Some of the negative impacts of exotic species on indigenous fishes are given in Table 4.

Table 3. Exotic fishes introduced into the freshwaters of Bangladesh

Common name	Scientific Name	Source	Year of introduction
Siamese gourami	<i>Trichogaster pectoralis</i>	Singapore	1952
Goldfish	<i>Carassius auratus</i>	Pakistan	1953
Tilapia	<i>Oreochromis mossambicus</i>	Thailand	1954
Guppy	<i>Poecilia reticulata</i>	Thailand	1957
Common carp	<i>Cyprinus carpio</i>	India, Nepal	1960
Mirror carp	<i>Cyprinus carpio var specularis</i>	India, Nepal	1979
Scale carp	<i>Cyprinus carpio var communis</i>	India, Nepal	1965
Leather carp	<i>Cyprinus carpio var nudus</i>	India, Nepal	-
Grass carp	<i>Ctenopharyngodon idella</i>	Hong Kong,	1966
Silver carp	<i>Hypophthalmichthys molitrix</i>	Hong Kong	1969
Nilotica	<i>Oreochromis niloticus</i>	Thailand	1974
Thai sarpunti	<i>Barbomyrus gonionotus</i>	Thailand	1977
Bighead carp	<i>Hypophthalmichthys nobilis</i>	Nepal	1981
Black carp	<i>Mylopharyngodon piceus</i>	China	1983
African magur	<i>Clarias gariepinus</i>	Thailand	1990
GIFT	<i>Oreochromis niloticus</i>	Philippines	1994
Genetically improved scale carp	<i>Cyprinus carpio var communis</i>	Vietnam	1995
Thai pangas	<i>Pangasius hypophthalmus</i>	Thailand	1990
Giant pangas	<i>Pangasius gigas</i>	Thailand	-
Mosquito fish	<i>Gambusia affinis</i>	India	-
Sucker mouth catfish	<i>Hypostomus plecostomus</i>	Hong Kong	-
Red piranha	<i>Pygocentrus nattereri</i>	Singapore	2003
Pirapatinga	<i>Piaractus brachypomus</i>	Singapore	2003

Modified from Rahman (2005)

PRESENT STATUS OF AQUACULTURE IN BANGLADESH

An estimated 1.2 million people of Bangladesh are fishers and earn their livelihood from fishing. A further 12 million people indirectly earn their livelihood from fisheries and aquaculture and related activities, and employed in the backward and forward linkages of the value chain such as the downstream activities of fish trading, fish seed production, collection of shrimp and prawn seed, fish handling, processing and marketing, net making, input supply and processing. The number of fish farmers and shrimp/prawn farmers presently are 13.86 millions and 0.83 millions, respectively. Among the people involved in the sector 10% are women.

During 1960s, the inland capture fisheries contributed about 90% of the country's total fish production. Production from inland capture fisheries has declined significantly over the years and in 2010-11 it accounted only about 42% (Fig. 1a). During 1960s, production from inland capture fisheries was almost 20 times higher compared to the then aquaculture production of the country (Fig. 1b). However, aquaculture production both in fresh water and brackish water has significantly increased during the last two and a half decades with development of technology. Due to the rapid increase of aquaculture production and sharp decrease of capture fishery production, in 2010-11, the aquaculture contributed (about 53 %) more than inland capture fisheries in total fish production of the country (DoF 2013).

Table 4. The negative impacts of exotic fishes on the indigenous fishes

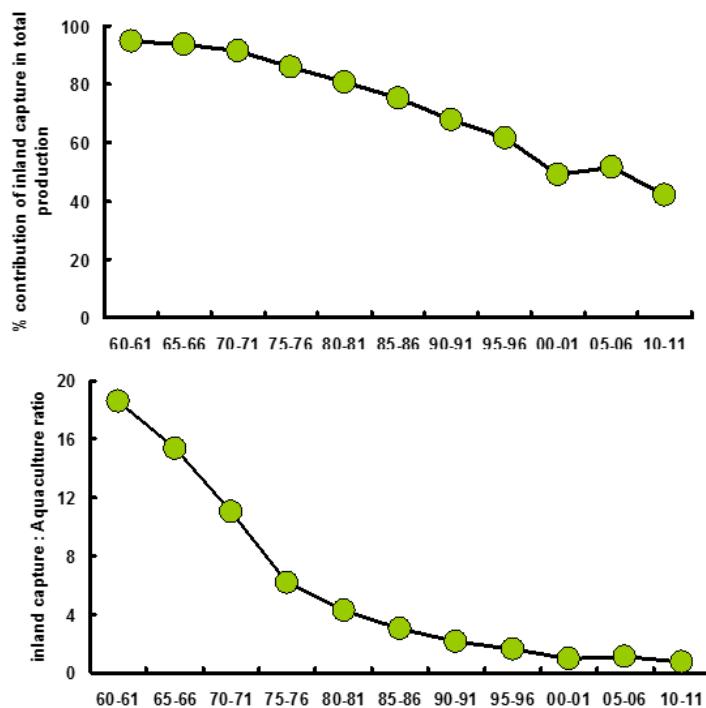
Exotic fish	Impact
Tilapia	Their prolific breeding surpasses the carrying capacity of the waterbody leading to stunting of tilapia and a number of SIS – mola, dhela, anju, darkina, chela, punti, chapila, tengra, buguri, chanda, chikra etc.
Common carp	Destroy pond embankments, make water turbid by stirring up mud. Reduce the water transparency and dissolved O ₂ in water. Destroy habitat of SIS living closed to the pond dyke and loaches in the bottom.
Grass carp	High feeding competition with many herbivorous small and large indigenous fishes.
Silver carp	Strong feeding and habitat competition with– catla in both captive condition and in the wild
Thai sarpunti	Compete with local sarpunti for foods and space
African magur	Predation and voracity of this catfish is legendary, predate on almost all small and medium fishes
Thai pangas	Natural diet is finfish, crustacean and insects, periphyton and benthos. This predatory fish is the major cause of disappearance of SIS from the pond system
Mosquito fish	They live in the littoral zone of the waterbody and compete with small fishes for food and habitat
Suckermouth catfish	One of the dangerous catfish, now found in floodplain allover country, feeds on small crustaceans and fishes like loaches and freshwater eel
Red piranha	One of the most dangerous and aggressive species of piranha, feeds on insects, worms and small and large fish. The cultured fish in the pond system and escapees in the wild actively predate on the indigenous fishes particularly SIS
Pirapatinga	Natural diet is terrestrial plants, fruits, insects and crustaceans, however, in captivity where natural food is scarce pirapatinga compete with SIS. The fish has strong, human like teeth to crush food items.

Source: Hossain (2014)

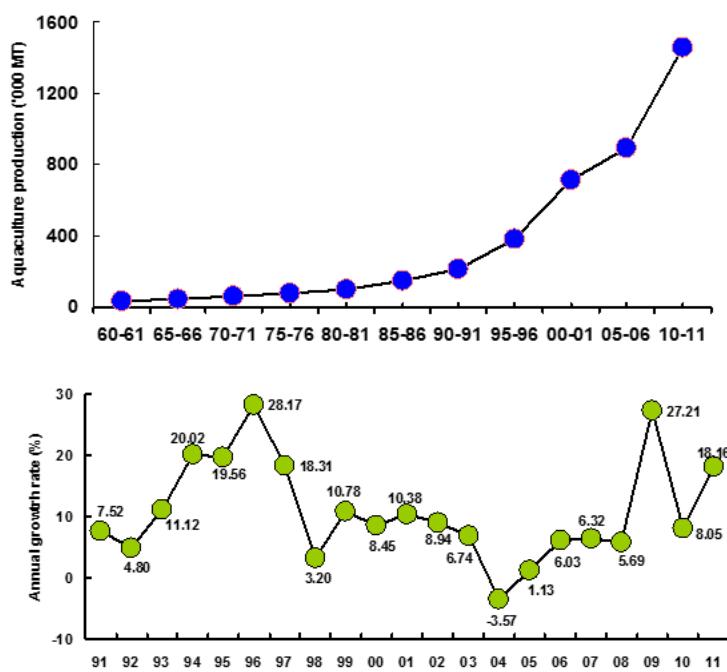
AQUACULTURE GROWTH

Over the last three decades aquaculture in Bangladesh has expanded rapidly. Aquaculture has increasingly been playing a major role in total fish production (3.26 million tons) of the country and presently more than half of the total production (52.92 %) comes from aquaculture (1.73 million tons). Although farming of fish in this country, yet a low intensity semi-subsistence activity, rapid commercialization, gradual intensification and specialization have taken place over the last decade, leading to unprecedented expansion in production of farmed fish (Belton and Azad 2012). Horizontal expansion of aquaculture has been taking place on the riverine floodplains which have been enclosed to facilitate the intensification of production (Sultana 2012). Over the last couple of years, significant numbers of crop farmers have been converting their land to fish ponds, mainly in Mymensingh and part of Rajshahi, what many think a natural phenomenon related to ever decreasing benefit-cost ratio farmers are receiving from paddy farming. Aquaculture production of 33000 MT in 1960, increased to massive 1.73 million MT in 2012. Average annual growth (%) of aquaculture is 10.81 ±1.79 since 1990 to date. The annual growth rate was only negative during 2003-04 and so far highest in 1995-96 and 2008-09 (Fig. 2).

Production of aquacultured shrimp and prawn also increased significantly from a mere 14773 MT to 137,175 MT in 2011 (Fig 3). The % contribution of farmed shrimp and prawn in total production is more than 60% and in recent years the wild catch has been gradually decreasing. The unit area production of farmed shrimp (300-700 kg/ha), however, is very low compared to fish produced in culture ponds. Mostly extensive form of culture is practiced to produce shrimp in gher and very few farmers practice even improved extensive method (Table 5).

**Fig. 1.** Trend of fish production in Bangladesh 1960-2011

a. Contribution of inland capture (%) in total fish production, and
 b. Inland capture to aquaculture ratios Source: Ali et al. (2009); DoF (2013)

**Fig. 2.** Aquaculture growth in Bangladesh

a. The real value of aquaculture production ('000 MT) during 1960-2011
 b. Annual growth rate (%) of aquaculture during 1991-2011. Source: DoF (2013)

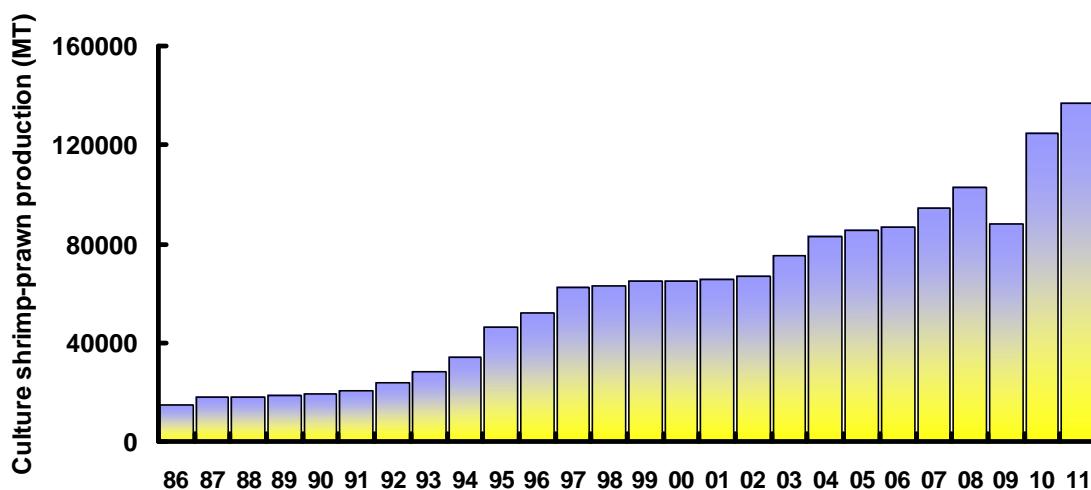


Fig. 3. Production of farmed shrimp and prawn in Bangladesh during 1986-2011

Table 5. Mode of shrimp culture in Bangladesh with production per unit area

Species	Mode of culture	Area under culture (ha)	Management	Production kg/ha
Bagda	Traditional (Extensive)	190,080	PL stocking and water exchange (marine fish in the gher)	300
Bagda	Improved extensive	25,380	Dyke elevation; healthy & virus free PL stocking; Supplemental feeding	600-700 kg
Galda	Integrated With rice, fish, vegetables	Nearly 60,000	Little or no management except PL stocking, occasional feeding	450-550

AQUACULTURE LIVELIHOOD

As the fish production from aquaculture has increased remarkably over the last few years, many poor and ultra-poor of rural areas of Bangladesh received the opportunity of fulltime and part-time employment to earn extra income. About 11% of the people of the country now directly or indirectly depend on the fish sector for their livelihood. Among the manpower associated with the fish sector, 10% are women (1% of total population). Moreover, 80% workers working for fish processing plants and fish drying centers are women. (DoF 2013; Hossain et al. 2013). Only during last 4 years, about 0.6 millions poor people found the work opportunity in the fish sector (DoF 2013). In Bangladesh, presently a total 14.7 million people have been involved in aquaculture in Bangladesh including fish farmers and prawn/shrimp farmers. The value chain from pond/farm to plate/fork and beyond the chain includes hundreds of stakeholders, whose livelihood fully depends on aquaculture. The major stakeholders include fish farmer, prawn/shrimp farmer, hatchery owner, nurserer, farm/hatchery technicians/workers, input (feed ingredient, fertilizer, hormone, chemical, instrument etc.) importers/suppliers, feed mill owners, homestead feed producer, fisher, fish processor, fish transporter, wholesaler, exporter, retailer, consumer, technology provider (government and non-government) and many more.

CLIMATE CHANGE IMPACTS ON OVERALL SETTING

Bangladesh has been experiencing serious environmental degradation in recent years. In many respects, the situation has reached crisis proportions. Several factors make Bangladesh particularly vulnerable to environmental damage. There are many dimensions of this environmental degradation. Ground water contamination, surface water pollution, encroachment of rivers and water bodies, improper disposal of industrial, medical and household waste, deforestation and loss of aquatic habitat and bio-diversity are just a few examples. The fragile ecology, delicate flora and fauna, alarming density of increasing population, reliance on foreign aid and poverty of the masses are few such factors. Considerable damage has already been done. With loss of wetlands and forests, Bangladesh is gradually losing its flora and fauna. Many aquatic and territorial species are becoming rare; some have already become extinct. Bangladesh is most at risk from climate change. The country will face the greatest danger from global warming in the next 3 decades. Poverty and large low-lying coastal regions prone to annual floods and cyclones were among factors making Bangladesh the number 1 exposed country to climate change. Other most exposed countries in the continent are India, Nepal, Philippines, Afghanistan and Myanmar.

CLIMATE CHANGE AND FISH SECTOR

Climate change impacts gradually cover a wide range of livelihoods in a number of aquatic settings. Drought coupled with siltation and lowering water level are reducing over wintering habitat for indigenous fish species resulting into less recruitment into grazing field to grow inland fisheries. Reduced water flow in major rivers has resulted in a severe depletion of riverine fisheries. Due to decrease in groundwater and surface water, extreme pressure has been exerted on floodplains to convert them to crop filed, brick klin and other infrastructures, resulting in an alarming decline in fish diversity and production. Indeed, there may be nowhere in world where effects of climate change on fish sector are more apparent than in Bangladesh.

Bangladesh in 2009 witnessed the least rainfall in past one and half decade (since 1994) with scientists attributing the unpredictable pattern to global climatic change. During June – September, 2009, 47,447 mm rainfall was recorded compared to 56,163 mm in the same period of 2008, 66,520 mm in 2007 and 60,551 mm in 2008. On the other hand, excessive rainfall in several parts of country affected standing aman rice crops while less rainfall affected the major crop in some other areas. Average temperature of the country has been increasing slowly (Fig 4). More and more intense and long droughts have been observed since 1970s in almost all areas especially in northern Bangladesh. Water with poor quality and less availability for aquaculture and reduced production of fish are very common. Loss of both wild and farmed fish stocks has long been going on. There are conflicts among different water users and irrigation to crop fields always gets the priority.

THE CONSERVATION MEASURES

The government of Bangladesh and a number of non-government organizations (NGOs) have taken a number of regulatory and development interventions for sustainable management of the natural fisheries. In order to reverse the loosing trend and ensure sustainability of fish biodiversity and production from inland open waters various measures for protection, conservation and management of fisheries resources have been adopted time to time. Among the measures are the implementation of Fish Protection and Conservation Act 1950 and related rules including new fisheries management policy (licensing the fishing rights directly to the true fishers), community

based fisheries management (CBFM), establishment of fish sanctuary in the strategic points of the rivers and floodplains, fish stock enhancement through releasing fish seed in seasonal floodplains, and fish habitat improvement through excavation of link canals (between rivers and floodplains) and beels. The Fish Act 1950 provides regulations for: (i) restriction on capture size of some fish for a specific period, (ii) restriction on catch of any species for specific time or season, (iii) closure of fishing in any water body for any stipulated time period, (iv) restriction of fishing by dewatering or any other destructive method, (v) restriction on the use of any kind of gear and mesh size of net, and (vi) restriction on placing fixed engine in a water course, which may restrict fish migration.

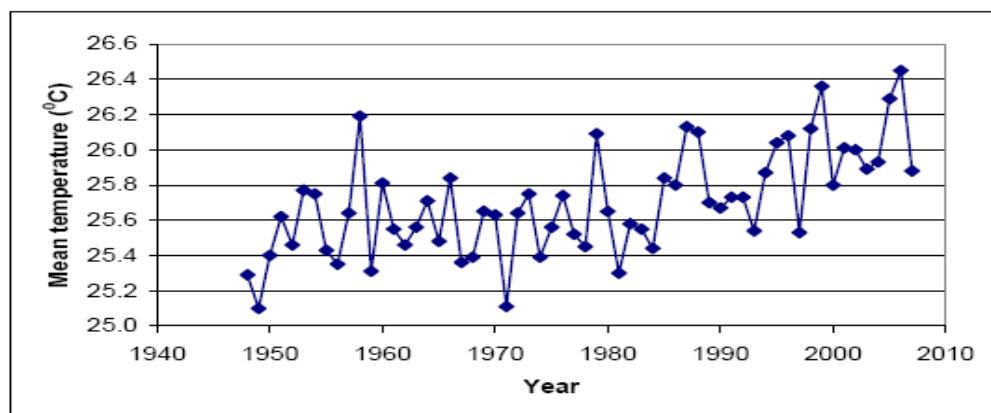


Fig. 4. Time series of all-Bangladesh annual mean temperatures 1948-2007 (CCC 2009)

Implementation of fisheries regulations has proved to be very difficult in this country due to institutional weakness of implementing authorities and the socio-economic conditions of the fishers. However, the Fish Act 1950 element – ‘closure of fishing in specific area for specific period’ as may be termed as ‘fish sanctuary’ is easier than applying other regulations of the Fish Act. Sanctuary has been tested and found as a powerful tool for protection and conservation of fish stock in Bangladesh. The dry season is the critical time for the fishes, when water levels in the rivers, canals, beels etc. recede drastically leaving a very few refuge for the inland fishes. Fish are exposed to greater predation and increased susceptibility to fishing pressure as the water level drops due to water extraction for irrigation and evaporation due to persistent heat of the dry season. Loss of surface water in the dry season results in the reduction in the brood fish stock. The fishes become increasingly vulnerable to intensive fishing and thereby the fish stock particularly the brood stock depletes to such a level that cannot sustain the fisheries and gradually fish diversity and production decline. Therefore, the major issue for biodiversity conservation is to provide sufficient dry season refuges to maintain the population at unstainable level.

Among all measures, fish sanctuary has been apparently found most effective for fish biodiversity conservation, when other measures are difficult to implement in the present administrative and social contexts. With this notion, Bangladesh government has established fish sanctuaries under different development projects following a number of management approaches since 1960 and more intensively in last decade. The NGOs like BRAC, CARITAS, CNRS, PROSHIKA and WorldFish Centre (CBFM project) have also been involved in fish stock development by establishing traditional sanctuaries in *beels* and rivers of Bangladesh. In addition, a number of silted up *beels*, *baors*, dead rivers and link canals have been re-excavated by the government under the food for work programs over the years. By 2000 a total of about 8,300 ha water area of borrow pit, *baors*, dead rivers, canals and *beels* had been excavated (DoF 2005). In the late 1990s the government approved a series of sectoral policies including National Fisheries Policy (1998), National Environment Policy (1995), and National Land Use Policy (2001) with a new

emphasis on maintaining and protecting the moribund inland waterbodies. Under the National Fisheries Policy, government has formulated strategies for inland capture fisheries and emphasized on fisher community participation in fisheries management, along with fish sanctuaries as a key management tool (DoF 2005).

CONCLUSION

The crucial step for Bangladesh now is to address and integrate natural disaster and reduce risks into development plans and processes, to safeguard the nation's wellbeing and to secure and sustained the livelihood of people for both present and future generations. This must be addressed systematically so that the country recognizes the risks to development and change the way it plans to develop. There is a crying need to adjust the existing laws and legislation of the country for integrated resource management to save the fisheries resources. Although much of the damage to the habitat and biodiversity of the inland water of Bangladesh over recent decades is likely to be irreversible, there is still time to act. From now on, Bangladesh government, the NGOs and national and international bodies should foster a social and technical environment in which the enormous richness of the fisheries resources can stabilize and eventually rebuild so as to continue to feed people of today and tomorrow. Poverty in fishing communities should be reduced in part by ensuring a stable supply of fish, something can only be achieved through improved knowledge, integration of fisheries and freshwater management, and greater public involvement. In case of fishing closure in areas or for certain time, the fishers should be provided with alternative income generating activities, credit with low interest and other sustainable means. Creating public awareness of the importance of maintenance of fish diversity in Bangladesh is extremely necessary and should be the first priority for a lasting change. Sustenance of fish diversity can only be achieved with public support. Bangladeshi fishers, fish farmers, traders, processors, and general people as a whole need - to understand the issues, to be involved in the formulation of management plans and to benefit from the whole process. A key step in building fisheries co-management and fish biodiversity conservation with community participation is to bring all the various stakeholders in a common front with a view to sharing resource and knowledge, creating an environment for meaningful discussion on cross-cutting themes and valuing each other.

A renewable resource like fish, when under intense exploitation, needs a management regime as it is not inexhaustible. Therefore, management measures should be applied in such a way that young fish are protected to grow before capture and enough are left as breeding stock for future generations. The management measures should include – regulate fishing intensity at sustainable level, control gear selectivity, gear type and size of fish, closed season, prohibition of destructive fishing, closed fish sanctuary, and allocation of resources to different types of fisheries. For sustainable and well-protected fish diversity for present and for future, the country should go for –

- Rational use of inorganic fertilizers and pesticides, and proper management of industrial effluents,
- Maintenance of minimum water depth (at least 1 m) during water extractions from critical waterbodies,
- Regulation of selective fishing gears, mesh sizes, and fishing by dewatering,
- Establishment of more fish sanctuaries and natural *beel* nurseries in strategic points,
- Stock enhancement programmes,
- Establishment of community-based organizations (CBO) among the fishers,
- Zero tolerance to new exotic fish introduction, and
- Strict application of existing fisheries rules and regulations.

This is the high time to care for the biodiversity of the indigenous fishes – the pride, heritage and livelihood of Bangladesh before they are lost forever. The researchers, policy makers, GOs and NGOs and national and international bodies should come forward to conserve the fish species using both *in situ* and *ex situ* approaches.

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Review Article

Fisheries and Aquaculture in Bangladesh: Challenges and Opportunities

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Abstract

The purpose of this paper is to review the performance of fisheries sector in Bangladesh and the challenges it is facing. Data and information were sourced from the publication of the Department of Fisheries (DoF) and related non-published grey literature. Bangladesh is predominantly an agrarian economy and is naturally endowed with a huge sweet water resources and the world's longest continuous sea beach. With the world's largest flooded wetland, the third largest aquatic biodiversity in Asia behind only to China and India, Bangladesh is considered as one the most suitable region for aquaculture and fisheries in the world. The country has an inland water area of about 45,000 km² and about 710 km long coastal belt. Given this extensive water resource, it is evident that fisheries play an important role in the economy and the diet of the population. Fish and fish products supply 60 percent of animal protein and around three percents of total export earnings. In recent years, however, the fisheries sector is confronted with challenges posed by numerous natural and anthropogenic causes such as climate change, natural disasters, unbalanced urbanization and industrialization, overfishing and environmental pollution. The combined effect of these factors is posing significant threat to the income and food security of the population and urges for immediate actions by government and policymakers.

ABBREVIATIONS

CBFM: Community Based Fisheries Management; CBOs: Community Based Organizations; DfID: Department For International Development; IUCN: International Union for Conservation of Nature; DOF: Department of Fisheries; NGOs: Non-Governmental Organizations

INTRODUCTION

Fish is the second most valuable agricultural crop in Bangladesh and its production contributes to the livelihoods and employment of millions of people. The culture and consumption of fish therefore has important implications for national income and food security. Bangladeshi people are popularly referred to as "Mache Bhate Bangali" or "fish and rice makes a Bengali".

The fisheries sector in Bangladesh is broadly divided into four sub-sectors- inland capture, inland culture, mariculture (artisanal fisheries) and marine industrial fisheries. Bangladesh is one of the world's leading inland fisheries producers and has a huge water resource all over the country in the form of small ponds, ditches, lakes, canals, small and large rivers, and estuaries covering about 4.34 million hectares. Freshwater aquaculture involves pond aquaculture especially the polyculture of native

and exotic species. The country also has a coastal area of 2.30 million ha and a coastline of 714 km along the Bay of Bengal, which supports a large artisanal and coastal fisheries. Bangladesh is considered one of the most suitable countries in the world for farming of freshwater prawn (*Macrobrachium rosenbergii*) [11].

Bangladesh is one of the resourceful countries with its wide range of marine aquatic bio-diversities. There are about 1093 marine aquatic organisms where 44.35% are finfish, 32.23% shellfish, 15.10% seaweeds and only 8.32% are other organisms including shrimps. In 2011, an area of around 276,492 ha was used for prawn and shrimp cultivation [3]. Aquaculture production in Bangladesh has shown an average growth of 28 percent from 0.12 million tonnes to 0.66 million tonnes during the period 1985 to 2000. Despite that, Bangladesh has so far realized only a fraction of its production potential.

Bangladesh has some 130 deep-sea fishing trawlers, 22000 mechanized fishing boats, and 25000 non mechanized fishing boats. Currently there are 133 fish processing plants in Bangladesh which are mostly located in port cities(Khulna and Chittagong) of which 74 processing plants are EU approved. Though the country is endowed with enormous fishery resources which are vital to the livelihood of millions of people and national food and nutrition security, the sector is facing major constraints including climate

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Submitted: 07 April 2014

Accepted: 07 June 2014

Published: 09 June 2014

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Keywords

- Fisheries
- Bangladesh
- Food security
- Nutrition security
- Water pollution
- Community based fisheries management

change, poor fisheries infrastructure, resource mismanagement, water and environmental population, natural disasters such as recurrent flood and cyclones, and lack of knowledge among farmers. Bangladesh is working with close collaboration with Department for International Development(DfID), World Fish Center and other international organization to develop the sector by building research partnerships and increasing investment. Community based management of fisheries is proving its potential to avert the longstanding political challenges farmers have been facing. The country, however, faces urgent imperatives to strengthen environmental laws to curb pollution which is significantly compromising the performance of the fisheries sector.

Importance of fish export in the economy

Fisheries and aquaculture sector have emerged as the second most important contributors in export earnings of Bangladesh. It is the second largest export industry in Bangladesh and produces 2.5 percent of the global production of shrimp. Though rice is the most widely produced agricultural crop in Bangladesh, fisheries has a unique feature for its role in providing an important source of animal protein and essential elements for the population. In 2010-2011, some 5.5 million people were directly involved in fisheries as the main source of earning. Table 1 shows the trend in export of fish products.

Bangladesh is considered one of the most suitable countries in the world for prawn and shrimp farming, because of its vast resources of shallow water bodies which provide a unique opportunity for prawn and shrimp production [1,2]. Prawn farming has brought about dramatic improvements in the livelihoods of the coastal poor, including women. During the 1990s, the rapid development of prawn farming in southwest Bangladesh has been likened to a "blue revolution" [7]. The migration of poor communities from the coastal region to the urban areas has reduced thanks to improved livelihood opportunities brought about by prawn and shrimp culture. The industry accounted for 22.21% of total agricultural GDP and 2.73% of total export income during the year 2011. USA and EU together account for around 80% of the total shrimp export. In 2011-2012, the European Union made up most of Bangladesh's yearly US\$500,000 shrimp export.

Trend of fish production in Bangladesh

Bangladesh ranks third among the world's largest inland fish producing countries after China and India. Table shows the trend in aquaculture production since. Around three quarters of rural households practice some form of freshwater aquaculture

covering some 10 million ponds and most of which measure less than 400 m².

Inland pond culture represents the most important part of aquaculture in Bangladesh contributing to around 86% of total production. Aquaculture accounted for about 43.5 percent of the total fish production during 2003-04, with inland open water fisheries contributed 34.8 percent. Fisheries in Bangladesh are diverse and there are about 795 native species of fish and shrimp in the fresh and marine waters. Besides that, there are 10 species of pearl bearing bivalves, 12 species of edible tortoise and turtle, 15 species of crab and 3 species of lobster. Most of the prawn and shrimp farms (~75%) are located in southwest part of the country, mainly Bagerhat, Khulna and Satkhira districts, with the remainders in the southeast region including Cox's Bazar and Noakhali district. In 2003, more than 0.6 people are engaged in shrimp farming activities [21].

Although inland capture dominate total production, aquaculture production has increased significantly with a threefold rise during the period between 1989 to 1999 [15]. The contribution of cultured ponds also increased substantially from 27% in 1984 to 52% in 1996 [16]. Production of shrimp has increased from 11,000 to 94,000 tonnes, recording an average annual growth of 45 percent during the same period [25]. In 2012, fish production reached a new record 3.22 million tonnes which was 5.2% higher than the previous year.

Hilsha(*Tenualoa ilisha*) is one of the most favorite fish species in South Asian fish consumers and is recognized as the national fish of Bangladesh. Despite being a marine fish, the Padma-Meghna-Jamuna delta is the main site for hilsha capture where they migrate for laying eggs. Hilsha contributes to nearly 16.4% of the country's total fish production. Though Bangladesh produces about 350,000 tonnes of hilsha fish annually, the amount is found to be decreasing in recent years due to conservation purposes.

Role of fish in diet

Fish is the primary source of animal protein for Bangladeshi population, especially poor rural households. Fishes are the major source of animal protein providing 80% of the animal protein intake and 7% of total protein supplies. Rice and fish constitute such an important part of Bangladeshi food culture that it has become a popular proverb- "mache bhate bangali," which means "fish and rice make a Bengali. In terms of weight, fish is the third most widely consumed food nationwide. But consumption pattern tends to vary among urban and rural areas and is shown to be lower among female members [13]. Per capita annual fish consumption in Bangladesh is about 14 kg against a

Table 1: Export of Fish and Fish-Product from Bangladesh.

Year	Frozen Shrimp/Prawn		Frozen Fish (Others)		Dry fish	
	Quantity (MT)	Value(Crore taka)	Quantity (MT)	Value(Crore taka)	Quantity (MT)	Value(Crore taka)
1992	19224	604.03	2704	38.31	1042	12.26
1995	25225	1106.39	8827	176.62	521	8.39
2000	29713	1885.15	9484	137.19	215	3.65
2005	46533	2281.6	15763	256.20	272	3.71
2009	50368	2744.12	19294	450.89	341	11.99

Source: DoF, 2009.

recommended minimum requirement of 18 kg/year. From the last national survey in rural Bangladesh, the mean total protein intake was 48 g/person/d, of which fish contributed 3 g [17]. Table 2 shows the contribution of fisheries sector in national food supply.

Prospects of integrated fish farming

Though rice monoculture is the main characteristic of Bangladeshi agriculture, rice-fish farming began to receive attention in the 1980s [23]. Integrated rice-fish farming offers better resource utilization, diversity and food supply as well. In Mymensingh district, which is considered as one of the rice bowls of the country, has been identified as the most important region for integrated rice-fish culture due to its favorable climatic conditions and availability of low-lying agricultural land. Though currently a small number of farmers are practicing this method, it has been reported that the cultivation of fish in rice fields increases rice yields by 8 to 15% and thus the scope of rice cropping with integrated fish farm is remains considerably wide [25]. Integrated fish farming can fully utilize the water body, the water surface, the land, and the pond silt to increase the food available for human consumption. Integrated farming reduces the need for pelleted grains, which is both economical and create less pressure on total grain supply for human consumption. Rice-fish farming is also being regarded as an important approach to integrated pest management (IPM). Integrated rice-fish farming is most technically and cost efficient, using the least inputs, in particular fertilizer and provides a sustainable alternative to rice monoculture. Researchers also suggest that integrated rice-

fish farming system is better than rice monoculture in terms of a range of social, economic and environmental measures [24].

Green revolution(GR) worldwide has increased staple crop production and greatly contributed to combat global hunger. However, now when the long term repercussions of GR are understood such monoculture, soil degradation, and extensive use of agrochemicals, all of which have had serious negative impacts on fisheries production, there is an imperative felt by agriculturists to find more sustainable strategies to reduce these negative impacts. Bangladesh has seen a dramatic rise in national rice production. Many watery areas have been brought under staple crop production to meet the demand of the huge population. Though fish production has also increased, but the its still far below the real potential of the country. Rice-fish farming can boost the production of both items which will help the country to improve food and nutrition security. The demand for rice and fish is constantly rising in Bangladesh with nearly three million people being added each year to its population [21]. Integrated rice-fish farming can help Bangladesh keep pace with the current demand for food through rice and fish production.

Increasing population translates to increasing demand for food and more pressure on land and water. If sustainable policies are not taken, rice demand may continue to compromise fisheries output in Bangladesh. Although official figures show that the number of floodplain fisheries increased in the 1990s, after decreasing in the 1980s, it is widely held that floodplain catches have been falling. Agricultural intensification has been proposed by researchers to meet the rising food demand for the huge population in Bangladesh. While rice production is still

Table 2: National Fish food supply (tonnes).

Items	1980	1990	2000	2005	2007	2009
Freshwater Fish	521,450	675,596	1,376,081	1,810,458	2,015,331	2,235,742
Marine Fish	40,106	51,018	72,506	130,618	120,840	203,513

Source: DoF, 2010.

Table 3: Annual growth rate of fisheries sector, 1994-2003.

Year	1994-95	1996-97	1998-1999	2001-02	2002-03
Growth(%)	6.79	7.6	9.96	2.22	2.33

Source: DoF 2005.



Figure 1 Inland aquaculture has improved the economic condition of many rural households.

Table 4: Shows the contribution of homestead pond aquaculture to household income and mean size of operation.

Source	Aquaculture as % HH income	Mean pond size (ha)
Thompson et al. (2006)	3	0.09
Jahan et al. (2010)	10	0.1
Hossain et al. (2010)	10	0.04
Winrock International (2004)	13.2	0.08
Karim (2006)	15.5	0.1-0.2

likely to increase, its also possible that it'll come at the expense of diminishing resources for fish production.

Challenges for fisheries sector in Bangladesh

The fisheries industry in Bangladesh is confronted with a range of economic, institutional and environmental concerns. According to a IUCN(International Union for Conservation of Nature) study, 54 floodplain fish species are in danger of extinction and the pressure of fishing is so heavy in the floodplains that less than 2% of produced fish survives the end of each year. Table 3 shows that growth in fish production has slowed since 2000. Recurrent floods and natural disasters are believed to be main underlying causes behind this slump. Bangladesh is a low-lying land which makes it extremely vulnerable to sea-level rise, and is ranked first among countries to be affected by the adverse effects of climate change [4]. Nearly 80% of total area in Bangladesh is regarded as floodplains, and its precarious geographical position makes it highly prone to natural disasters as well. Climate change have devastating impacts on fishery-based livelihoods and on domestic food supply. Vulnerability of fishery-based livelihoods may substantially increase in the coming decades due to climate change, and in the absence of adaptation, increased frequency and intensity of cyclones and floods would result in greater damage to fishing materials and loss of fish [27].

Mariculture is also at risk of increasing salinity and overfishing. According to FAO, globally, around a quarter of all fish stocks are overexploited and half of them are fully exploited. In Bangladesh, marine capture represents about 20% of total fish production. The floodplain and marine fisheries are under serious threat from overfishing. Overexploitation in the coastal region poses significant challenges on marine living resources and increases the dependency on distant water fishing in the long run.

Water pollution is another growing threat for the future of fisheries sector in Bangladesh and is fast becoming a serious public health issue and a constraint for food production. Industrial(especially textile and tannery) effluent, fertilizer and pesticide run-off, poor sewerage infrastructure and improper disposal of household waste are the major causes of water pollution in Bangladesh. Rivers and canals near the urban areas are threatened by sedimentation and siltation due mainly to soil erosion, and compounded by industrial expansion, most of these water bodies have already become to polluted to support biological system. Poor urban and industrial management and lack of enforcement of environmental laws are contributing to this pollution spree. The Buriganga river that flows through the

capital city is the most polluted river in the country, many parts of which have already turned coal black.

Besides these natural and chemical events, inadequate financial capacities, poor resources management and lack of research facilities are also responsible for underperformance of the fisheries sector and environmental degradation [20]. Researchers have shown that poor management of prawn and shrimp culture is having devastating effects on the Sundarbans (the largest mangrove forest in the world) [5] where an estimated 9700 ha of the forest-mass has been lost as a result of intense shrimp farming [6]. Conversion of many natural wetlands to prawn farms has resulted in impediment of water flows and also decreased the scope of migration for many fish species [8].

Community-based fisheries management, window of Opportunities

The Community Based Fisheries Management (CBFM) project was founded with an ambition to promote sustainable use of inland capture fisheries by empowering fisher's communities to manage their own aquatic resources [19]. Most fishers in rural Bangladesh operate on a small-scale basis(Table 4). Poor fishers suffer disadvantaged situations due policies that favor powerful players in the sector [18]. The CBFM initiative has developed a series of fisheries management approaches for ensuring equitable access to fisheries resources for community-based organisations (CBOs). Founded in 1994, the project supported by Department for International Development(DfID) and implemented by Bangladesh's Department of Fisheries(DoF) in partnership with the WorldFish Center and 11 NGOs adopted a research-based approach to promote equitable access and sustainable management of inland fisheries resources and to be run by the CBOs [14]. So far, a total of 164 fish sanctuaries have been established in over 80 water bodies under the CBFM approach. The project involved 14,000 CBO group members and a further 9,000 direct beneficiaries. In a survey conducted in 2007, the majority of CBOs reported increases in total production despite a 30 per cent increase in the number of fishers by then. Thus it appears that community-based fisheries management can offer significantly better utilization of the public water bodies covering over 4 million ha of floodplain wetlands in the country.

CONCLUSIONS

This article gives an overview of the fisheries sector and its challenges and opportunities in Bangladesh. It is evident that the performance of fisheries sector is crucial from a national macroeconomic and food and nutrition security perspective. Therefore it proposes that a more efficient and sustainable management of the aquatic resources will contribute greatly to health and economy of the country. Policy makers must spare no effort to ensure the functioning of this sector in full swing by enhancing investment and research infrastructure, more strict environmental policies, and introducing better storage and marketing facilities. More importantly, the situation of fishers must be taken into account and special task force should be build to assess their vulnerability and strategies to tackle them. In order to meet the soaring demand for food for the burgeoning population, there is a need for increased rice and fish production in Bangladesh. But attention should also be given to the negative

environmental externalities such as land and water biodiversity and water and air pollution which is inextricably linked with the success of agricultural sector.

ACKNOWLEDGEMENTS

We extend sincere thanks to World Fish Center for giving permission to reuse the photographs.

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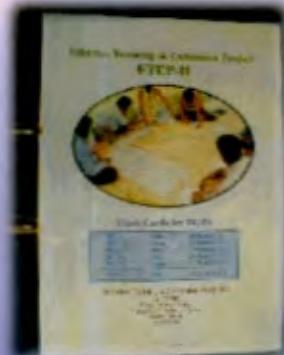
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Cite this article

Ghose B (2014) *Fisheries and Aquaculture in Bangladesh: Challenges and Opportunities*. *Ann Aquac Res* 1(1): 1001.



Fisheries Training and Extension Materials



Catalogue 2003

- Training Course Modules & Manuals
- Handbooks And Technical Manuals
- Extension Materials

- Videos
- MIS Databases
- CD-ROMs

Department of Fisheries

Foreword

During more than two decades of Government and donor assisted projects a plethora of extension and training materials have been generated for many different kinds of training interventions. Some of the materials would have been project specific and perhaps require little use thereafter. However, a significant amount of material has been either lost or is still archived since project closure. For many professionals working in training and extension, awareness of and accessing relevant materials has often proved to be difficult. This has invariably resulted in professionals unknowingly reproducing existing material. The Fisheries Training and Extension Project – Phase 2 (FTEP-II) has begun to establish an extension and training material Resource Centre for the Department of Fisheries. During the past two years the project has been collecting and archiving relevant material from the department, projects and relevant non-government organisations working in aquatic natural resource development.

This catalogue describes the materials collected, updating the first version published in 2001 with 141 more entries, most significantly from other projects and organisations and, for the first time, is presented in both English and Bangla. A wide range of materials are presented for reference and to aid the many training intervention approaches practiced e.g. 50 training course modules and Manuals, 11 extension packs and kits, 17 videos and dozens of booklets, technical handbooks, flashcards and posters etc.

This version is not to be regarded as the definitive version for the department. In fact it should be updated on a regular basis with inclusion of the most relevant material as tested and reviewed by DoF training and extension experts. It is hoped that the publication of the catalogue will help trainers, extensionists and planners with material development and perhaps most importantly, initiate the establishment of a training and extension material resource centre and a way forward to standardize and mainstream future material development.

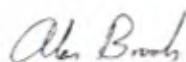
Acknowledgements

FTEP-II project management acknowledges with thanks deep gratitude to DoF, FFP, CARE-Cage/Interfish/ANR, BFRI, Proshika, World Fish Centre (ICLARM), BRAC, BASC, PBAEP, NFEP-2, IFADEP, MAEP, GNAEP and DAE for kindly contributing their valuable publications.

Thanks to all senior members of the staff of FTEP-II for their diligence and effort to prepare captions.

Thanks to Dr. David Brown, TCO, FTEP-II and Humayun Kabir, Training Consultant, FTEP-II as well for their significant input to design and content.

For graphics design, graphics editing and overall editorial responsibilities FTEP-II gratefully acknowledges the valuable contributions of Sultana Ahamed, Media Co-ordinator FTEP-II.



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Publisher: Fisheries Training and Extension Project Phase-2, FTEP-II

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TRAINING COURSE MODULES & MANUALS

(Modules prepared for 'modularisation' of courses i.e. link modules to form trainee specific courses. Manuals are generally prepared for known trainees and target groups).

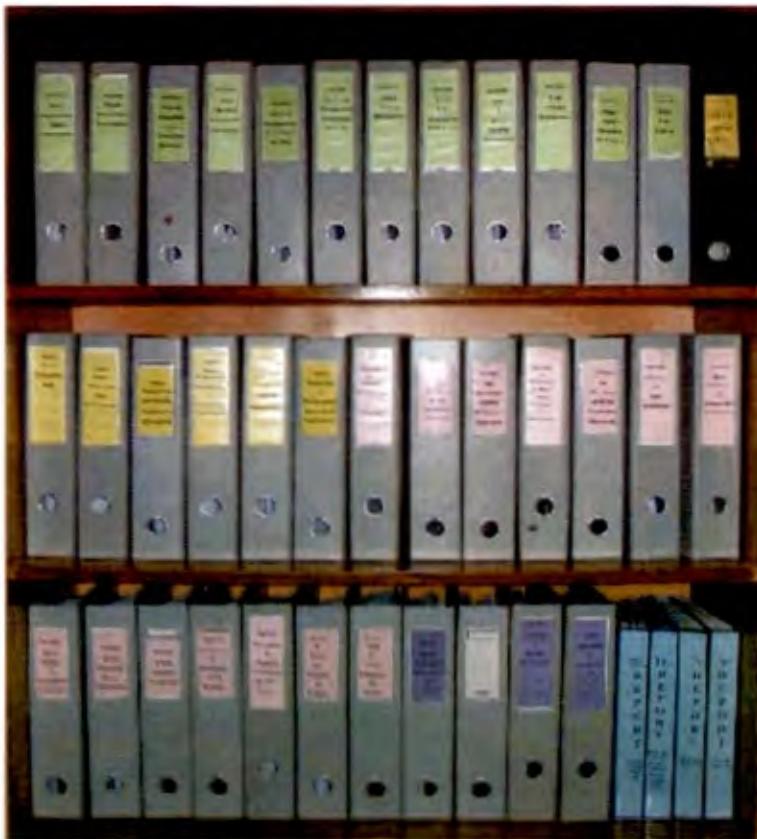
(Modules Developed by FTEP-II) Extension and Training

1. An Overview of Common Approaches Used for Extension Programme

(M/ET/D/01)

This is a three days course intended particularly for the managers or senior officers both of GO & NGOs who have the authority to choose suitable extension approaches for their working areas. The module focuses and compares methodologies, cost and impact of common proven previously implemented extension approaches e.g. Pond-side Group Training Session, Farmers Fish School, Model Village Programme, Trickle down and Mass Media.

Sessions include introduction to different extension approaches, implementation procedure of different approaches and their merits, demerits, cost and impact. Following completion of this course, participants will gain a greater understanding about the approaches and their effectiveness enabling them to be able to confidently select the most appropriate and cost effective approach for their locality. FTEP-2 developed this modules November, 2002.



The 37 Modules on display (all training centre) described herein

2. An Overview of the FFS Extension Approach

(M/ET/D/02)

This is a 2-day course module particularly planned for the extension managers such as DFO, UFO and NGO executives to improve their knowledge and awareness about the FFS extension approach. The FFS is completely a new approach in agricultural extension in Bangladesh. Recently the DAE and CARE GO-INTERFISH project used this approach very successfully to train farmers on Integrated Pest Management (IPM). Effectiveness of the approach in fisheries extension, implementation procedure, merits-demerits and required materials and cost has been elaborately discussed in this module.

The intention of the course is that upon completion extension managers should be in an informed position to decide on whether this type of approach, compared to others, would be the most appropriate for their circumstances. The Fisheries Training and Extension Project-II

3. An overview of the MVP Extension Approach

(M/ET/D/03)

This is a 2-day awareness raising course module designed to enable senior and mid-level zilla/upazilla fisheries and agriculture extension officers improve their knowledge and understanding of Model Village extension approach. The main course content of the module are: introduction of model village extension approach, implementation techniques and necessary resources of model village extension approach, merits and demerits of model village extension approach, economics aspects of model village extension approach, visit on model village extension activities and monitoring and evaluation techniques.

This is a residential course and requires both classroom and field facilities. After the completion of the course they will be able to develop their confidence on selection of model village extension approach as per need in their respective district and upazilla. FTEP-2 developed this modules July, 2001.

A. Trainer of Trainers & Training Managers' Development Programme (A.I Extension Approaches Awareness)

TRAINING COURSE MODULES & MANUALS

Extension and Training

4. An Introduction to Mass Media Approach for Extension

(M/L/T/D/004)

This is a 2-day awareness raising course module designed to enable senior and mid-level fisheries and agriculture officers to improve their knowledge and awareness on mass media extension approach. The main course contents of the module are; introduction, importance, merits and demerits of mass media, description, uses of methods and implementation procedures of different mass media, useful mass media method selection for fish culture extension, selected mass media method preparation, demonstration, case study and monitoring and evaluation of mass media.

This is a residential course and requires both classroom and field facilities. After the completion of the course the participants will be able to make valued judgements about whether use of mass media in their extension programmes has a role and thus warrants further training. FTEP-2 developed this modules July, 2001.

5. An Overview of the Pond Side Group Training Session Extension Approach

(M/L/T/D/005)

This 2 days course module is design for mainly DFO/UFO but also all persons involved in extension planning. As it is a short course the intention is to raise awareness in 'Pond side Group Training Session' or commonly known as 'PGTS'. The Participants will gain an insight and conceptual understanding of this approach such as, introduction to PGTS Approach, its significance, advantage and disadvantage, implementation strategy, comparative analysis with other extension approaches, monitoring and impact assessment.

The course described is residential and requires classroom and pond-side training venue. Session plans are detailed with recommended key points, handouts, exercises and flipchart plans. Course budget and training materials list assist the trainer and/or training manager prepare the course easily.

Upon completion of the course the participants will have sufficient knowledge regarding PGTS so that they will be able to effectively plan extension in their area and be able to make strategic decisions about extension workers needing to learn more about this course through the 'how to' 5 day programme (CM/D/02 & ET/D/15). FTEP-2 developed this modules November, 2002.

6. Introduction to PRA Techniques

(M/L/T/D/006)

This 6 days course module is designed for DT/SUFO/UFO/NGO workers involved in planning, decision making and programme implementation. The Participants will gain a comprehensive understanding on PRA tools and usage. The course content covers introduction to PRA approach, its history, evolution and significance, field of application, advantage and disadvantage, differences between PRA and others methods, triangulation and group dynamics, main procedures of PRA/PLA and their application in the field. To complement the theory, one and half days is fully and another day is partially allocated for field practices with different tools and techniques of PRA.

The course describe is residential and requires classroom and outside training venue. Session plans detail key points including a flipchart plan, which will be helpful for the trainers to deliver sessions effectively. Course budget and training materials list also included herewith to assist the manager coordinate the training more effectively. By the end of the course, the participants will be able to conduct PRA in their respective field confidently. FTEP-2 developed this modules July, 2001.

7. Basic Extension & Training Skill Development

(M/L/T/D/007)

This manual is designed to enable Upazilla Fisheries Officers to enhance their skill and knowledge on basic extension and communication principles and methods, adult learning theory, role and characteristics of ideal extension worker, adoption process of information, bottom-up extension approach, group formation and difficult group member management, target group profile, classroom presentation techniques, training aims and learning objectives, different stages of training cycle, participatory training techniques, participatory rural appraisal (PRA), disaster management, training file preservation etc. The participants, after attending a 12-day course, acquire necessary skill to plan, organise, run and supervise pond-side training on basic fish culture independently using and preparing simple training aids appropriate to small group of rural farmers adopting a participatory approach. They will also be able to assess the qualitative aspects of training using some indicators. The course described is residential and requires classroom and pond-side training venues. FTEP-2 developed this modules July 1999.

8. ToT Skill Development I -Theory & Classroom Techniques

(M/L/T/D/008)

This is a six day course intended for trainers who have already had experience in training and/or have had foundation training in ToT techniques. Part of the course and thus the manual focus on how to deliver the Basic Extension Skills Course and Aquaculture Extension Skills Course. The manual covers the relevant sessions on team building, managing learning environment, managing difficult group members, working with small training groups, training methodology, use of training materials and course evaluation techniques. Throughout the course participants are given the opportunity to practice their classroom and field training techniques. Guidelines are given in the manual on how to prepare this. FTEP-II has found this course particularly valuable for training UFOs to become trainers to deliver a number of technical and extension approach courses to other officers, school teachers and NGO extension workers throughout the country. FTEP-2 developed this modules November 2002.

TRAINING COURSE MODULES & MANUALS

Extension and Training

9. ToT Skill Development II-Practical Demonstration Techniques

(M/E/T/D/09)

This is a 5-day course intended for trainers who have already had experience in training and/or have had foundation training on ToT techniques. Part of the course and thus the manual focus on how to deliver classroom and practical training and module preparation. The manual covers the relevant sessions on participatory classroom and practical training techniques, training delivery skill, working with group and role of group members, preparation of simple visual aids, course and session evaluation techniques. Throughout the course, the participants are given the opportunity to practice their classroom and practical training techniques. FTEP-II expects that this course will be particularly valuable for training UFOs to become trainers to deliver a number of technical and extension approach participatory courses to a wide range of target groups. FTEP-2 developed this modules January, 1998.

10. ToT skill Development III – The Advance Techniques

(M/E/T/D/10)

This six-day module is designed to enable trainers having previously received basic ToT course and gained practical experience on formal training delivery and course management. The module places strong emphasis overall management of 'Training Cycle' e.g. from planning through to evaluation and point out the grammatical issues of different delivery techniques. The course also emphasizes on modern training module preparation with narrative session plans.

The module comprises of the following sessions i.e. theoretical discussion on education, learning & training, theory & principles of adult learning and its application in training delivery, covers all components of training cycle and their management strategies. Additionally, the module also incorporates the module preparation techniques, creation and management of learning environment and identification & management of different difficult members. This course is residential and would be suitable for both mid-level GO & NGO trainers. FTEP-2 developed this modules November, 2002.

11. Techniques in Monitoring PGTS Delivery to the Farmers

(M/E/T/D/11)

This manual is intended to develop Upazilla Fisheries Officers (UFO) skill and knowledge in monitoring 'Pond Group Training Session (PGTS) on basic fish culture activities; which are conducted by the Asst. Fisheries Officers and Field Assistants. The participants gather comprehensive knowledge on the 'different parts of PGTS along with time allocation, *modus operandi* of follow-up activities, PGTS evaluation aspects and exercise, FTEP-II reporting system and aspects of 'PGTS-6'. Special emphasis is put on co-operation and assistance from Follow-up team members at the field level. After attending this three day course, the participants will have a thorough understanding of field based FTEP-II training operations and how to use the 32 criteria 160 objective point monitoring forms and assessment technique. The course does not include too much of theoretical M&E aspects; but concentrates on direct field training delivery techniques. The form and its use many be adopted to all types of small group farmer training. The course described is residential and requires classroom and pond-side training venues. FTEP-2 developed this modules February, 2000.

12. Extension & Training for Field Staff

(M/E/T/D/12)

The manual is designed to enable Assistant Fishery officer/Field Assistant and NGO workers to enhance their knowledge on different extension approach, effective communication in extension role and characteristics of extension worker, group detail, group formation, group mobilization, managing difficult group member, participatory practical training techniques using small group pond-side training as an example (e.g. PGTS), visual aid, session preparation, gender in aquaculture, monitoring, evaluation, PRA etc. After attending 12 day's course participants successfully deliver training to rural small scale farmers through small groups (PGTS) using illustrated participatory learning sessions and 'hands-on' practicals.

This course is residential requiring both classroom and pond side training venues. Session plans are detailed with recommended key points, handouts, exercises and flipchart plans. Course budget and training materials list assist the trainer and/or training manager prepare the course easily. FTEP-2 developed this modules August, 2002.

13. A Guide to Training Fry Traders in good Transportation Techniques & Farmer Extension Messages

(M/E/T/D/13)

This course manual mainly divided into two parts. Part 'A' is residential training for mainly, AFO/FA/NGO staff delivered by DT and part 'B' is on pond side training for Fry Traders delivered by AFO/FA/NGO staff. Part 'A' is designed for 3 days attendance to improve the knowledge and skill of fry transportation and method of training delivery. Furthermore, the participants will be able to develop their confidence to manage the Fry Traders during training, debriefing and follow-up session.

The part 'B', manual describes one-day programme to develop practical skill and technical knowledge on fry transportation procedures and basic pond aquaculture technique. Basic technical messages to extend to the farmers will be supported by using a simple pictorial mini-album showing the basic steps of pond aquaculture (i.e. dewatering to harvesting including risk management) and importance of promoting quality fry supply. FTEP-2 developed this modules July, 2001. The Extension Pack EP/D/08 should be include for this course.

TRAINING COURSE MODULES & MANUALS

Extension and Training

14. A Training Course for Child-to-child (CtC) Extension Kit Users

(M/F/D/01)

This course manual is particularly planned and developed for rural children to stimulate their ability and knowledge on preliminary aspects of pond fish culture, using 'learn through fun' approach with a view to disseminating the learning among similar age groups and children who attend non-formal primary education schools. The participants get to know about the simple aspects of child psychology, children group formation techniques, pond ecosystems and the living communities there-in, different culturable fishes and their food, supplementary feed, fertilisation, vegetable gardening on pond dykes etc. Special cheaper tools like angling games and Ludu have been devised so that children become aware and get acquainted with basic fish culture in an amusing and competitive mood. The participants are required to produce attractive training aids for rendering sessions attractive to children. The target groups for this course will be extension workers and teachers/trainers in primary schools. FTEP-II targeted *Kishoree* girls for this course. The course described is residential and requires primary schoolroom and pond-side training venues. FTEP-2 developed this modules July, 2000.

Aquaculture Extension Course for AFO & FA

(M/F/D/02)

This manual is intended to help out extension trainers to enhance their skill and knowledge in delivering 'Pond Group Training Session (PGTS) on basic fish culture activities. The participants gather comprehensive practical and technical knowledge on the 'assessment of farmer's training needs, their present status and goals'; pre-stocking preparations involving removal of unwanted aquatic weeds, removal of predators, liming and fertilisation; stocking aspects; post-stocking measures involving judicious use of on-farm resources, risk management, partial and final harvesting. After attending this 5-day course, the participants can successfully deliver PGTS to rural farmers in small groups on 1. Training need assessment (TNA), baseline, goal and monitoring (BGM) and eradication of unwanted weeds and predators, 2. green water, 3. stocking management, 4. integrated resource management and 5. risk management. During this training course, the participants acquire skill on preparation of appropriate coloured attractive visual aids and other training materials suited to deliver PGTS. The target groups for this course will be all government & NGO officers and extension workers engaged in farmer level training, and preferably with science background. The course described is residential and requires classroom and pond-side training venues. FTEP-2 developed this modules January 1999.

(Note: The AEC Course for AFO and FA (CM/D/02) is the same modular course prepared for PGTS Training).

Games Trainers' Play

(M/F/D/03)

This is essential in the effective adult learning process to encourage participants to be more responsive and participative. For this purpose, the professional trainers usually use different types of games and warm-up activities for ice breaking and stimulating the participants. Considering this, the book on "Trainers' Play the Games" is designed to address the needs of trainers. Different games and small group formation techniques are incorporated in this book. Before delivering the session, the trainer selects appropriate games or group formation techniques from this book. So, in this connection, it would be a very useful book for the professional trainers. FTEP-2 developed this modules November, 2002.

An introduction to Participatory Rural Appraisal (PRA)

(M/F/D/04)

This course is designed for the DoF field level worker (AFO & FA) who are assigned for implementation of different activities in the field such as identify fisheries village, farmer group formation, farmer need identification, conduct training and provide follow up support to the farmer in the field. Duration of this course is two days. By this course participant will get basic concept in such as PRA definition, origin of PRA, differentiation between PRA and RRA, characteristic and principal of PRA, PRA applying aspects, limitation and advantage of PRA, three pillars of PRA, use of PRA in the development cycle and what should do or not do during PRA. Use of some PRA tools (Transect, social map, resource map, wealth ranking, mobility map, Venn diagram etc) also discuss in this course. At the beginning day all the subject discuss in the class room up to lunch. After lunch transect and social mapping tools practice in the field and prepare report. In the 2nd day resource map, wealth ranking, mobility map and venn diagram practice in the field and prepare report and after lunch participant present report in the plenary session. By this training participant will be able to identify fisheries village, farmer group formation, farmer need identification, provide follow up support to the farmer in the field and can be collect information from the field for prepare various report easily. In addition by this training AFOs and FAs will be capable to implement their respective departmental work through rapidly and correctly and also they can be supervise different activities in the appropriate way implemented by the different NGOs. The module is produced by FFP in 2002.

TRAINING COURSE MODULES & MANUALS

Extension and Training

Monitoring and Evaluation

(M/ET/D/18)

This course is designed for the DoF field level worker (AFO & FA) who are responsible for implementation different departmental and project activities. By this course participant will be able to understand and fill up different reporting format such as different extension format , baseline format and training evaluation format by which all information will present in the same way. Different extension format are AET/ME 002a this from will be used for compile reporting for the monthly implementation of extension activities in the upazila level and sent to the concerned district fisheries office and one copy will remain at the upazila office. AET/ME 002b by this form district fisheries officer will compile the monthly extension activities for all upazilas in the district and sent to the divisional deputy director and preserve office copy. AET/ME 002c this form is used for compile monthly extension activities of all district in the division and sent to the PMU in Dhaka and maintain office copy. Different baseline format are AET/ME 003a upazila team will fill in this baseline format for fisheries village and retain the completed form in the upazila office. AET/ME 003b this form will be used for compile all fisheries village information and sent it directly to the respective DFO, divisional DD, PMU and one copy will retain in the upazila office. Different training activities format are AET/ME 004a this format will give the picture of adoption level of different steps of fish culture, AET/ME 004b this form will give a general indication of the impact of the fisheries activities on trained farmers, AET/ME 004C this format will be used for measure fish production increase or decrease, AET/ME 004d will be used for recording the issues and constraints faced by the farmers of fisheries village and all these format will preserve in the upazila fisheries office. AET/ME 004c this format will be used for compile impact assessment survey in the fisheries village and sent it to the DFO, divisional DD, PMU and one copy will retain in the upazila office.

Farmer Exchange Visit (FEV)

(M/ET/D/19)

Farmer exchange visit is more effective good learning process, One success farmer can explain his knowledge, skill and success to the another farmer and another tour farmer can get an opportunity to explain their views, ideas, knowledge, experiences, success and failure with other farmers. As for their need, they could discuss and share their knowledge with success farmer so there believes could be increased, grow more interest to adopt a new technology and can play role for taking decision to accept the new technology among himself and the community.

By farmer exchange visit, Technology can transfer from farmer to farmer with in a few time, Farmer can observe and evaluate the success of succeeded farmer, trust can grow, don't make doubt/hesitate to adopt a new technology, knowledge & skill can increased by sharing and able to analyze the cost-benefit ratio.

FTEP-2 consider about this subject start this program by the farmer's need assessment of PGTS farmer through respective AFO and FA of the Department of Fisheries Field Staff. Tour farmers selection after discussion and nomination made with all group members; who has interested, socially accepted, can practice new technology, should have time to be a volunteer as a friend trainer for the rest of the members of the group as well as the welfare of community.

Knowledge score system here establish before and after farmer exchange visit to justify the improvement of farmers ability and impact of his program. So it may be considered one of a good and effective program for technology disseminate and socio-economic development of the poor farmers community.

Aquaculture Technologies

15. Basic Aquaculture Skill Development

(M/AT/D/01)

This is a 6 days course manual designed to enable AFO/FA to improve their skill and knowledge on basic pond aquaculture. The participants gather comprehensive technical knowledge on probable problem on pond aquaculture, benefit of pond fish culture, pond baseline, pond selection, pond design, pond construction, unwanted fish & predator control, liming and fertilization, nursery pond preparation, species selection and stocking density, fry transport and release, post stocking management, supplementary feeding, partial harvesting and restocking, small scale aquaculture economics, integrated resources management, farm and farmer visit and their need assessment and pond management checklist. This is a residential course and requires both classroom and pond side facilities. After the completion of the course they will be able to develop their confidence to manage their farmers need and farmers training.

16. Pond Preparation Techniques

(M/AT/D/02)

This is a 3-day course manual designed to enable AFO/FA/NGO staff to improve their skill and knowledge on pond preparation techniques. This is a link module to other courses for fish culture beginners. The main contents of the course are; overview of pond & aquaculture management methods, site selection, physiochemical factors of pond, steps of fish culture, dyke and bottom repair, weed and predator fish control, liming and fertilisation, natural food and toxicity test.

This is a residential course and requires both classroom and practical facilities. After the completion of the course the participants will have the necessary understanding, confidence and knowledge to advise pond operators on good pond preparation practices. FTEP-2 developed this modules November, 2002.

17. How to Establish a Low Cost Carp Hatchery

(M/AT/D/03)

This is a six-day residential training course developed mainly for AFOs, FAs (DoF) and NGO extension workers. It aims to improve the knowledge and skills of participants on low cost the backyard carp hatchery design and operation. This module consists of 14 sessions comprising of background and history of artificial propagation, introduction role and components of low-cost hatchery, brood care and brood pond management, brood fish selection, identification and transport, introduction to hormone, sources, doses for different fishes, preparation of hormone solution and techniques of injection, inbreeding, hatchling rearing and economics.

During the course one day schedule for out side private low-cost hatchery visits and meeting with hatchery operators for better understanding on different hatchery activities within the course participants should get the opportunities to practice the different skills used in hatchery operation. At the end of the course participants will be able to organise and implement low-cost backyard hatchery training courses for beneficiaries. The course venue requires both classroom and closer to a hatchery for support practical sessions. FTEP-2 developed this modules July, 2001. The Extension Pack EP/D/11 should be include for this course.

18. Nursery Production Techniques

(M/AT/D/04)

This is a 5-day course developed for field staff particularly Assistant Fisheries Officer & Field Assistant of DoF and NGO extension workers with a view of improving their knowledge and skills to assist farmers to produce quality fingerling/juvenile. The manual contains all the theoretical and practical aspects of carp, pungas and prawn nursery management. In addition, the course attempts to impart the importance of production economics to the target audience. The whole course is documented under the same cover keeping some common sessions for all species but at the same time separate session plans have been included where necessary, especially in stocking and feeding management. Elaborate session plans with key points, appropriate teaching methods, enjoyable group splitting techniques and separate exercise sheet for each group and pair work makes the course easy to deliver. Furthermore, a spreadsheet comprises the list of all necessary materials and equipment to help trainers organise the course easily. Upon receiving this course participants will gather outstanding knowledge and skills on pre-stocking, stocking and post-stocking management of carp, pungas and golda seed production. This is a residential course, being well balanced by theory and practical requiring both pond side delivery as well as classroom discussion. The manual is developed by FTEP-II, a DFID funded project in July 2001. The Extension Pack EP/D/06 should be include for this course.

Aquaculture Technologies

19. Nursery Management Techniques for Carp- Pangus-Golda

(M/AT/D/05)

The module entitled Nursery Management Techniques for CPG is particularly designed for AFO, FA and NGO extension workers to improve their knowledge and skills so that they may assist farmers to produce high quality fingerlings and juvenile of Carp, Pungas and Golda species. Many aspects of nursery pond management are the same for the three species groups. Therefore to avoid duplicity of training this module describes only the stocking and post-stocking management aspects of Carp, Pungas and Golda nursery highlighting variations in culture technology as appropriate. The module comprises all the theoretical and practical aspects of hatchling/PL stocking along with subsequent techniques of fingerling and juvenile production. Additionally attention has been given to provide a clear understanding relating to economics of these culture technologies. An additional feature of the course focuses on providing participants with exposure to real farming situations for all three types of culture technology with particular attention given to success and challenges experience by carefully chosen experienced small scale farmers.

Elaborate session plans with key points, appropriate teaching methods, enjoyable group splitting techniques and exercise sheet for each group and pair work makes the course easy to deliver. Furthermore, a spreadsheet comprises the list of all-necessary materials and equipment to help trainers plan and organise the course easily. Upon receiving this 6-day course, participants will gather an outstanding knowledge and skills on stocking and post-stocking management of 3 major types of seed production. This is a residential course, being well balanced by theory, practical and field visit. FTEP-II, a DFID funded project developed this module in August 2002.

20. Grow-out Management Techniques for Carp-Pangus-Golda

(M/AT/D/06)

This is a 6-day course module designed particularly for the AFO, FA and NGO extension workers. To avoid duplicity with other courses having similar pre-stocking requirements this module describes the stocking and post-stocking rearing aspects for three key economically important culture species groups; Carp, Pungas and Golda. Stocking density of mono culture and poly culture with appropriate ratio, post-stocking management such as supplementary feeding, natural food maintenance, some common hazards and disease with their controls and prevention, suitable harvesting size with marketing procedure have been elaborately discussed in separate sessions. Additionally the modules present important information on production economics of each type of culture.

The module is planned as a residential course requiring both classroom and pond facilities. Recipients of this training should have had a foundation course in basic carp culture (*Course M/AT/D/01*) or pond preparation module (*Course M/AT/D/02*) beforehand. Another important facet of the course is that it allows the participants to visit Carp, Pungas and Golda farms providing important opportunity to experience real life working examples. After attending the course, participants will be able to extend their training abilities to transfer skills and knowledge to farmers for all three species groups. The Fisheries Training and Extension Project-II developed this course in August 2002. The Extension Pack EP/D/02 and EP/D/04 should be include for this course.

21. Golda Culture Management

(M/AT/D/07)

This manual has been developed for the benefit of Government and Non-government fisheries extension workers to improve their present knowledge and skills on Golda culture. This is a 5 day course comprises of all necessary aspects of carp-prawn poly culture both in pond and gher systems. The prospects and limitations of prawn culture, social and environmental issues relating to the gher areas, characteristics of suitable water bodies both of pond and gher and different physico-chemical factors of water bodies with optimum range and control measures have been discussed in the introductory sessions. Pond/gher preparation techniques, appropriate species along with their food and habitat, appropriate stocking density and ratio, juvenile and fingerling transportation with releasing methods are described in the pre-stocking and stocking management sessions. Following pre-stocking and stocking management elaborate discussions are presented on supplementary feeding, maintenance of natural food, disease prevention, diagnosis and control, common problems encountered, pond economics, record keeping and suitable harvesting and marketing process in the later sessions.

This manual is planned to deliver as a residential course both in classroom and pond side. After receiving the course participants will be able to train end-users, mainly farmers in the culture and management of Golda in pond/gher systems. The Fisheries Training and Extension Project-II developed this manual in December 1998.

TRAINING COURSE MODULES & MANUALS

Aquaculture Technologies

22. Small Cage Aquaculture

(M/AT/008)

This manual is particularly designed and developed for extension workers to increase their knowledge and skills on basic cage aquaculture so that they can able to disseminate the technology to the farmers successfully. Course content includes appropriate site and farmer selection, easy access cage making materials, suitable species selection and stocking, low cost supplementary feeding, cage management and return of investment. During the course participants will learn how to prepare two types of cages using easy access low cost inputs and set in water with right direction. The course is mostly skill oriented but require both theory discussion and practical demonstration. This is a 5-day residential course developed jointly by CARE-CAGES and FTEP-II in April 2001. The Extension Pack EP/D/07 should be include for this course.

23. Soil and Water Quality Management in Aquaculture

(M/AT/D/09)

This is a 5-day duration course manual developed for Assistant Fishery Officer/ Field Assistant and NGO workers to improve their knowledge and skill on water quality management in aquaculture. The participants will gather comprehensive knowledge on importance of soil and water quality management in aquaculture. The sessions cover soil types and its components, soil-water interaction, effect of bottom mud on productivity and important physico-chemical parameters important to maintaining a good culture environment. Associated with this, the sessions attempt to provide participants with a basic understanding of essential nutrient cycles contributing to management of phytoplankton, zooplankton, benthos populations. Basic practical steps to maintain water quality for aid extensionists and pond managers to improve pond productivity. Results of survey report on water quality in Bangladesh are discussed to highlight pond productivity status. This course is residential requiring both classroom and pond side training venues. Session plans are detailed with recommended key points, handouts, exercises and flipchart plans. Course budget and training materials list assist the trainer and/or training manager prepare the course easily. FTEP-2 developed this modules August, 2002.

24. Fish Disease Management

(M/AT/D/10)

This is a 3-day course manual designed to enable AFO/FA/NGO staff to improve their skill and knowledge on fish disease control. This course will cover the following topics: importance of fish disease control, causes of disease in the pond, environmental and nutritional effect on fish disease, general symptoms of fish disease, different types of fish disease prevention and control, disease control checklist and disease prevention measures.

This is a residential course and requires both classroom and pond side facilities. Recipients of the course should be able to provide valued advice to pond operators on potential and actual diseases problems or recognise that a more detailed follow-up assessment is required by experts in this field. FTEP-2 developed this modules November 2002.

25. Pond Dyke Cropping Techniques

(M/AT/D/11)

This is a 4-day course manual designed to enable mainly, AFO/FA/ NGO staff to improve their skill and knowledge on Pond Dyke Cropping. The participants gather comprehensive technical knowledge on importance of PDC, selection criteria of PDC, classification and nutritional and economical importance, design and planning of dyke cropping, seasonal vegetable growing information, cultivation method of crop on dyke, collection and preservation of vegetable. This is a residential course requiring both classroom and pond side facilities. After the completion of the course it is expected that participants will be able to assist farmers develop their own pond dyke cropping systems appropriate to their own environment and resources. FTEP-2 developed this modules July, 2001. The Extension Pack EP/D/10 should be include for this course.

26. Rice Fish Culture

(M/AT/D/12)

This is a five-day training course developed mainly for UFO, AFO and FA of DoF. It aims to improve the knowledge and skills on the basic principles of rice-fish farming, environmentally friendly Integrated Pest Management (IPM) and inform on the contribution of paddy and fish to the National economy (food, nutrition and employment). The course incorporates an introduction to rice cultivation, with particular emphasis on any modification needed for rice-fish culture, and its economics. Details of fish species selection, stocking rates and post stocking management supported with field visits and interviews with farmers are also included. During the course the participants are given the opportunity to practice the different skills used in rice-fish farming. By the end of the course participants will be able to prepare, organize and implement rice-fish training courses for the beneficiary. The course is residential and requires both classroom and opportunity to excess in rice field for practical session. FTEP-2 developed this modules July, 2001. The Extension Pack EP/D/03 should be include for this course.

TRAINING COURSE MODULES & MANUALS

Social Development and Environment

27. Gender Awareness for Officers & Extension Workers

(M/S/D/01)

Though this 5 days course designed for mainly mid-level officers (i.e. UFO level) it can be used as a guide for different target groups. The following sessions are included with this manual- male-female participation in development work and its beneficiaries, position & situation of men-women, physical differentiation:-labour division, socialisation, patriarchy, excess to resource and controlling power, concept of gender, gender role, gender need, empowerment, women's advancement- national & international, gender language, gender policy of Bangladesh & DoF.

To present the course in a more participatory and enjoyable way, case studies, problem solution, role-play, sentence making are described as presentation and training techniques. Traditional and non-traditional work lists of men and women are attached with this manual. Beside this, a debate on, "Only woman awareness will Develop Gender relationship" included in this manual which could help to clear the Gender concept to the participants. FTEP-2 developed this modules with assistance of external consultant in August, 2002.

28. A Training Guideline on Gender Issues for Farmers

(M/S/D/02)

This is a three-day course module developed for both GO & NGO field workers who usually train both male and female farmers. Following the 'trainer's note' style it mainly focuses on contribution of man & woman in development activities, status of man & woman in the society, the causes of differences between woman & man in the society, conception of gender, the gender and development, gender roles, gender needs, overall achievement from implementation of gender, etc. are described clearly. The course described uses different types of visual aids, games and warm-up activities and that is not a residential requiring a village based training venue. FTEP-2 developed this modules November, 2002.

29. Savings and Micro-credit Management

(M/S/D/03)

This 5-day residential course is aimed specifically at small NGO field workers working with NGO organised poor groups involved in managing group's savings and micro-credit. The module covers the overall management of savings and micro-credit for rural poor people specifically roles of NGO workers in saving & credit management, sources, accounting and record maintenance of savings & credit, approval & disbursement of credit, calculation of interest, preparation of repayment schedule & procedure of credit, realisation of bad loans, roles of civil society in savings & credit management and how to manage the group.

FTEP-2 developed this modules November, 2001.

30. IGA Selection and Management Techniques

(M/S/D/04)

This module is intended to help out the NGO workers to enhance their skill and knowledge in selection and management of IGAs by the poor people. The participants could gather comprehensive knowledge on different types of IGAs suitable for the poor, selection procedure of adaptable IGAs for the poor, skill development of the poor in managing the selected IGAs, constraints of managing IGAs, roles of NGO workers in managing IGAs and the essential facilitation skills to manage the group. This is a five day course requiring classroom training only using a wide variety of participatory training techniques. FTEP-2 developed this modules November, 2001. The Extension Pack EP/D/09 should be include for this course.

TRAINING COURSE MODULES & MANUALS

(Manuals Developed by FTEP-II)

Extension & Aquaculture Technology Training

31. Basic Extension Course for AFO & FA

(CMD/D/01)

This manual is designed to enable participants to improve their skill and knowledge on basic extension and communication principles and methods, adult learning theory, roles and characteristics of ideal extension workers, adoption process of information, bottom-up extension approach, group formation and management, target group profile, training aims and learning objectives, different stages of training cycle, participatory training techniques, training file preservation etc. The participants, after attending a 12-day course acquire necessary skill to plan, organise and run pond-side training on basic fish culture independently using and preparing simple training aids appropriate to small group of rural farmers in a participatory manner, and also assess the qualitative aspects of training using some indicators. The target groups for this course will be all government & NGO officers and extension workers engaged in farmer level training. The course described is residential and requires a classroom and a pond-side training venue. FTEP-2 jointly with FFP, developed this modules June 2000. The Extension Pack EP/D/01 should be include for this course.

32. Aquaculture Extension Course for AFO & FA

(CMD/D/02)

This manual is intended to help out extension trainers to enhance their skill and knowledge in delivering 'Pond Group Training Session (PGTS) on basic fish culture activities. The participants gather comprehensive practical and technical knowledge on the 'assessment of farmer's training needs, their present status and goals': pre-stocking preparations involving removal of unwanted aquatic weeds, removal of predators, liming and fertilisation; stocking aspects; post-stocking measures involving judicious use of on-farm resources, risk management, partial and final harvesting. After attending this 5-day course, the participants can successfully deliver PGTS to rural farmers in small groups on 1. Training need assessment (TNA), baseline, goal and monitoring (BGM) and eradication of unwanted weeds and predators, 2. green water, 3. stocking management, 4. integrated resource management and 5. risk management. During this training course, the participants acquire skill on preparation of appropriate coloured attractive visual aids and other training materials suited to PGTS. The target groups for this course will be all government & NGO officers and extension workers engaged in farmer level training, and preferably with science background. The course described is residential and requires classroom and pond-side training venues. FTEP-2 developed this modules January 1999. The Extension Pack EP/D/01 should be include for this course.

33. Basic Extension Course for Extension Officers' of FFP

(CMD/D/03)

This is a 12-day course manual designed particularly for the Fourth Fisheries Extension Officers. According to the Fourth Fisheries working approach, these newly recruited extension officers will be mainly responsible to implement the Model Village Programme (MVP). To implement this Programme successfully, an extension officer should have adequate knowledge on basic extension theory and both sufficient knowledge and skills in training. To improve those two main aspects session content has been included for the course are basic understanding of extension, principles of extension, role and characteristics of a successful extension worker, adoption process and affordable extension message, extension methods and communication, bottom-up extension approach, gender awareness, survey and PRA methods, farmers' problems identification, group formation and management, adult learning theory, target group profile, participative training techniques, training aims and learning objectives and simple visual aids and session preparation. Moreover, a large session on office administration has been included in the content to improve the administration capacities of the newly recruited officers. During the course, the participants will be provided with the opportunity to demonstrate a model group training session. The model session will help participants to acquire necessary skill to plan, prepare and conduct a pond side training session and be able to evaluate training. This is a residential training course and needs to be conducted both in the classroom and at the pond side. FTEP-2 developed this modules in February, 2000 in collaboration with FFP staff.

34. Aquaculture Extension Course for Extension Officers' of FFP

(CMD/D/04)

A 5-day course manual designed to enhance the participant's skills in delivering pond side group training. From this course, the participants will gather comprehensive practical skill and technical knowledge on basic pond aquaculture. Further, they will be able to develop their confidence to manage medium size groups during training. The course content arranged in the manual are divided into two major sections, pond side practice and classroom discussion following the practice session. During the course, the participants will get an opportunity to practice the delivery of the sessions 1. Dike repairing, de-weeding and removal of unwanted fish and predators. 2. Green water (pond liming and fertilisation). 3. Stocking management (Species selection, stocking density, fingerling transport and release). 4. Farmers' resource management and 5. Profit in fish culture (Risk management, partial harvesting and restocking). In addition, the participants attending in the course will be enabled to prepare and use properly colourful and attractive visual aids appropriate to their target audience. The course is especially developed for the Fourth Fisheries Extension Officers, described as residential, and requires both classroom and pond side venues. FTEP-2 developed this modules in June, 2002 jointly with FFP.

Extension & Aquaculture Technology Training

35. Basic Extension Methodology & Carp Polyculture Techniques

(CM/D/05)

This manual is developed for NGO personnel to improve their skill and knowledge on introductory aspects of extension, roles and characteristics of ideal extension workers, adoption process of information, bottom-up extension approach, group formation and management, target group profile, simple visual aids, learning environment, participatory training techniques, training aims and learning objectives, different stages of training cycle, classroom presentation techniques, training need assessment and evaluation techniques, training file preservation etc. Each practice session is followed by comprehensive discussions on relevant technical issues. After attending this 5-day course, the participants can successfully deliver PGTS to rural farmers using appropriate training aids. The target groups for this course will be all government & NGO officers and extension workers engaged in farmer level training, and preferably with science background. The course described is residential and requires classroom and pond-side training venues. FTEP-2 developed this modules in January, 1999.

36. Basic Extension & Training Methodology, IPM & Carp Polyculture Techniques for Secondary School Teachers

(CM/D/06)

This manual describes a two-week course designed to improve the knowledge of aquaculture and extension & communication skills of Secondary School Science Teachers. It covers the associated theoretical and practical issues included in the agriculture curricula for classes 6-10. Initially, the course explores the role of teachers in extension, session planning and the preparation of simple visual aids. The next section includes training in the fishery resources of Bangladesh, water and soil quality related to fish culture and is followed by the main steps in pre-stocking preparation such as fertilisation, aquatic weed and predatory fish identification and control. Aspects concerning the improvement and measurement of natural productivity are incorporated into post-stocking pond management. Particular emphasis is placed on the selection and fish stocking regimes suitable to the availability of farmer resources and natural environment. Other topics covered are pond economics, nursery pond management, prawn culture, farm resource management and integrated pest management. Monitoring of teacher's performance after training has demonstrated a much improved delivery of these subjects to students, increased production from the school pond and its use as a training tool. Additionally the teachers are provided a 13 item 'Resource Box' of teaching aids. FTEP-2 developed this modules in January 2002.

37. Economic & Technical Aspects of Pond Aquaculture for Bank Staff

(CM/D/07)

The 5-day course, furnished in this manual is principally intended for bank staff involved in rural credit disbursement. It is designed to take the mystique out of pond aquaculture for people who have not had any previous exposure to the subject. The course gives the participants an insight into basic pond management strategies with particular emphasis on input costs, risk reduction and likely production targets, if correct pond management procedures are followed. By the end of the course, the participants will have the ability to assess the investment potential and viability of pond farmer application proposals for credit. FTEP-2 developed this modules in October 2002.

Trainer's Notes for PGTS

(TNA/001)

The farmers' training advocated by FTEP-II is small group participatory training over five two-hour learning sessions. A three hour review session (sixth session) takes place after one fish production cycle later. These training notes are essential for would be trainers who wish to deliver these highly participatory and entertaining farmer learning sessions. The notes act as a detailed guide through the five sessions:- 1. Training needs assessment and pond status/condition; 2. 'Green Water', prepares the pond prior to stocking; 3. 'Stocking Management' completes the fish stocking of the pond correctly and appropriately; 4. 'Farmer's Resources' identifies all resources and needs (given in session 1) and prepares farmers' for beneficial positive action for good pond management. It may include the traditional fertilising and feeding or may be more on-farm resource based and integrated with other systems depending on farmer's circumstances; 5. 'Profit in Fish Culture' enables farmer to understand the potential risks and conversely the potential high returns. Partial harvesting and re-stocking may be included. The sessions are flexible based on need identified in session one. These notes are detailed to the extent that every step is described, even questions to ask in the Q and A sessions. The notes tell you how to use the training materials. This guide will be best utilised by experienced extensionists. However, if the two courses listed in this catalogue (Basic Skills Extension Course and Aquaculture Extension Course) are done beforehand, the complete beginner can use these notes.

TRAINING COURSE MODULES & MANUALS

(Developed by other Projects)

Course on PRA, SLA and M & E

(TM/D/01)

This manual is developed by Fourth Fisheries Project for Upazilla level officials to improve their skill and knowledge on PRA, SLA and monitoring. Content of the course includes preliminary concept and principle of PRA, application and techniques of PRA, concept and techniques of M&E, steps of M&E. Course described is residential. It requires classroom, pond side and village venues.



Essential skill course for extension officers: (PRA, monitoring, office management)

(TM/D/02)

This manual is developed by Fourth Fisheries Project for extension officers to improve their skill and knowledge on PRA, monitoring and office management. This is 6-day course. It requires classroom, pond side and village. Content of the course are preliminary concept & principal of PRA, use of PRA, techniques of PRA. Extension & training activities, monitoring, introduce monthly monitoring format & fill up. Technological information collection (prepare format & fill up), impact indicator, production information (decrease-increase), job description of Upazilla team, create team inspiration, official communication, maintain papers and record financial and treasury role, recruitment role of govt. employee and leave role. After getting this training EO could understand about PRA, monitoring and office management.

Carp-Golda mixed culture

(TM/D/03)

This manual designed by Fourth Fisheries Project for Fourth Fisheries extension officers. This is a 8 day course. The contents of the manual are introductory and characteristics of Carp-Golda mixed culture, soil and water quality, pond preparation, transportation, pre-stocking management, risk and hazard management, prawn nursery management, record keeping of cost-benefit, importance of paddy cum fish, merits and demerits of culture, steps of culture method. Pre and post stocking management activities. After attending this course participant able to adopt carp-golda farming and paddy cum fish culture.

It's a residential course, require classroom and pond side venue.

Govt. of the People's Republic of Bangladesh
Ministry of Fisheries and Livestock

Patuakhali Barguna Aquaculture Extension Project
INTEGRATED POND FARMING GROUP FIRST YEAR
TRAINING MANUAL
For
Extension Trainer



Integrated Pond Farming Group First Year Training Guide for Extension Trainers – PBAEP (FFP)

(TM/D/04)

Patuakhali Barguna Aquaculture Extension Project (PBAEB) prepared this training guide. The objective of the training to manage the pond and pond dikes in a holistic farming approach. Contents are small livestock rearing, vegetable cultivation, compost preparation, disease management, harvesting and marketing, Optimum pond environment and green water, pond preparation, fertilizing and feeding, species selection and stocking. Training sessions take 3-4 hours that are explained in a classroom setting. Pond side training sessions take 1.5-2 hours.

TRAINING COURSE MODULES & MANUALS

লক্ষিত জনগোষ্ঠীর জন্য

জেন্ডার প্রশিক্ষণ
ম্যানুয়াল

বৃহত্তর নোয়াখালী জেলার মৎস্য চাষ সম্প্রসারণ প্রকল্প

প্রস্তুতি : গ্রেটার নোয়াখালী কামিটিনেকশনস

Training Manual on Gender for Farmers

(TM/D/05)

A farmers training manual on gender has been prepared for target group farmers by gender core team, GNAEP with technical assistance, Protikrti Communication. A couple of important issues of gender are included in farmers training manual. The messages on gender issues are described in simple and with practical examples. Present condition of women in Bangladesh, Role of women in aquaculture, activities of men and women and access to and control over resources are contents of the farmer training manual. These four issues on gender take place in 3 deferent sessions with one and one and half hours duration of each session. Participatory training techniques are used and a numbers of picture card related to the sessions are used in the farmers training.

Training Manual on Training of Trainer for Officers

(TM/D/06)

This is a 7-day course mainly intended for the Officers of DoF, DTA and NGOs who are working in GNAEP. The course is designed by GNAEP to help the participants to improve their training skill, knowledge and methodology, so that they can organize and carry out training activities effectively. It comprises the basic concept of training, target group profile, training need assessment, adult learning theory, managing difficult group members preparation of session plan, participatory training techniques, presentation skills, principle of extension and team building. Throughout the course the participants are given the opportunity to practice delivery in classroom training and farmers group training at the pond site. The course is designed and delivered fully participatory way. Based on last 2 years project experiences, the course is revised and developed in a new version in English in October 2002.

বৃহত্তর নোয়াখালী জেলার মৎস্য চাষ সম্প্রসারণ প্রকল্প
(জিএনএইপি)

সম্প্রসারণ প্রশিক্ষকদের
প্রশিক্ষক প্রশিক্ষণ কোর্স



কোর্স ফাইল

অক্টোবর ২০০২



বাড়ী-১৬, সড়ক-৩৬, হাটজিং এস্টেট, মাইজিবি কের,
নোয়াখালী-৩৬০০

Greater Noakhali Aquaculture Extension Component
(GNAEC)

Training Of Trainer (TOT) For Offices



COURSE MANUAL

October 2002



GNAEC
House No 16, Road No 36, Housing Estate, Majlinder Court Noakhali

Training Manual on Training of Trainer for Extension Trainer

(TM/D/07)

This is a 6-day course has developed by GNAEP for the Extension Trainer (ET) who are mainly involved in farmers training at field level. The course is designed to help the Extension Trainers to improve their training skill, knowledge and farmer group training methodology, so that they can organize and carry out farmer training at pond site effectively. It comprise the basic concept of training, target group profile, training need assessment, preparation of session plan, preparation of training aids, presentation skills, training session evaluation, adult learning principle, managing difficult group members. Throughout the course the participants are given the opportunity to practice delivery in farmers group training at the pond site. The course is designed and delivered fully participatory way. Based on project experiences, the course is revised and developed in a new version in Bangla in October 2002.

TRAINING COURSE MODULES & MANUALS

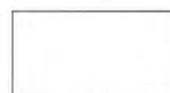
Basic Training Manual for Officers

(TM/D/08)

This a 10-days basic course developed by GNAEP for the officers of NGOs and DTA staff. This course is generally delivered to the newly recruited staff. It comprises the combination of the basic concept and methodology of formation and mobilization of Fish Farming Group (FFG), technical training in aquaculture and integrated rice-fish-prawn farming, role of gender in aquaculture and monitoring & evaluation system. Throughout the course participants are given the opportunities to filed visit field for acquiring practical knowledge. Based on project experiences, the course is revised and developed in a new version in Bangla in August 2002.

Greater Noakhali Aquaculture Extension Component
(GNAEC)

Basic Training Course For Officers



COURSE MANUAL

August 2002



GNAEC

House No 16, Road No 56, Housing Estate, Magdala Court Noakhali

বৃহত্তর নোয়াখালী জেলার মৎস্য চাষ সম্প্রসারণ প্রকল্প
(জিএনএইপি)

সম্প্রসারণ প্রশিক্ষকদের
বেসিক প্রশিক্ষণ কোর্স



কোর্স ফ্যাইল

সেপ্টেম্বর ২০০২



বাড়ি-১৬, সড়ক-৩৬, হাউজিং এসেট, মাইগ্রেশন কোর্ট,
নোয়াখালী-৩৬০০

Basic Training Manual for Extension Trainer

(TM/D/09)

This is a 10-days basic course has been designed by GNAEP for the Extension Trainers (ET) . This course is delivered generally to the newly recruited Extension Trainers. It comprises the combination of the basic concept and methodology of formation and mobilization of Fish Farming Group (FFG), technical training in aquaculture and integrated rice-fish-prawn farming, role of gender in aquaculture and monitoring & evaluation system. Throughout the course participants are given the opportunities to filed visit field for acquiring practical knowledge. The contents of basic training course for officers and extension are the same, but methods of delivery are considered in a simple way for Extension Trainers. Based on project experiences, the course is revised and developed in a new version in Bangla in August 2002.

Training Manual on Gender for Extension Trainer

(TM/D/10)

A two days gender training manual has been developed for Extension Trainer by Gender core team, GNAEP with technical assistance, Protikrti Communication. Most important issues of gender and related to the project objectives are included in the training manual. Introduction of gender, Condition and position of women in Bangladesh, gender role analysis, access to and control over resources women empowerment, gender needs analysis and role of women in aquaculture are the main sessions for the extension trainer training on gender. Participatory training techniques are emphasized to delivery the training course.

সম্প্রসারণ প্রশিক্ষকদের জন্য

জেন্ডার প্রশিক্ষণ
ম্যানুয়েল

বৃহত্তর নোয়াখালী জেলার মৎস্য চাষ সম্প্রসারণ প্রকল্প

প্রস্তাবনা : প্রতিকৃতি কমিউনিকেশনস

HANDBOOKS AND TECHNICAL MANUALS

Technical Manuals

Technical Manual on Fish Culture in Seasonal Ponds

(HTM/D/01)

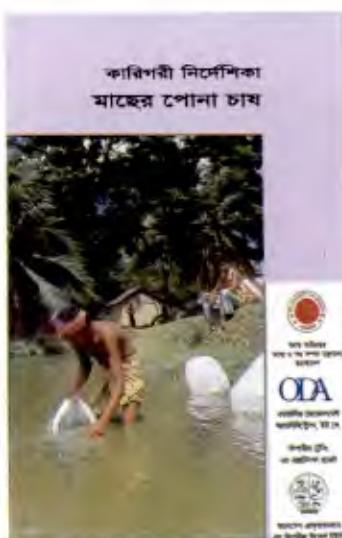
'Fish Culture in Seasonal Ponds' comprises of eleven chapters. Chapters 1-3 contain information on the classification and characteristics of seasonal ponds, major culturable species, and feeding ecologies of different culturable fish. Chapter four and five deal with different aspects of mono- & polyculture systems with particularly differing inputs needed for such culture system respectively. Different steps of pre-stocking, stocking and post-stocking management covering a full cycle of fish culture are detailed in chapter six. Aetiology, diagnosis and measures against different fish diseases are narrated in chapter seven. Some common problems of fish culture along with remedial measures, economics of seasonal ponds, calendar of fish culture, and checklist of different to-do lists have been detailed in chapters 8-11 respectively. Biology and culture methods of nilotica and silver carps are also detailed in annexes. This handbook is especially suited for trainers with science background but fish culturists, students and interested readers can also benefit from this handbook. Published first in June, 1995 by DoF/BAFRU, it was later republished in December, 1998 by FTEP-II/DoF. This manual is included in the extension pack EP/D/01.



Technical Manual on Fish Nursery

(HTM/D/02)

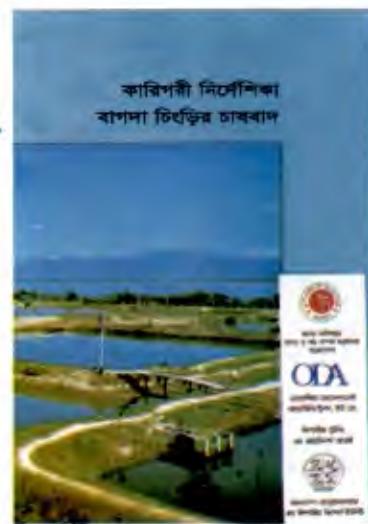
This technical handbook on fish nursery contains fourteen chapters. Basic information on different sources of fry, indigenous and exotic species suitable for nursery, characteristics of nursery and rearing ponds, different larval stages covering hatchling to fingerling, inputs needed for nursery, spectra of phytoplankton and zooplankton available in nursery ponds etc. are narrated in the first five chapters. Basic pre-stocking and stocking aspects with emphasis on identification of healthy fry, stocking density of different species, transportation and acclimatisation techniques with prophylactic treatments, and feeding at different stages are described in chapters six and seven. Pre-stocking, stocking and post-stocking aspects for prawn and African catfish are concisely described in chapters eight and nine respectively. Pond economics, record keeping and checklist of works are described in subsequent chapters. Information on length-weight relationship, tubifex collection, artemia hatching, breeding of carpio, preparation of compost and local measurement units are referenced in the annex portion. The handbook is suitable for trainers, interested educated farmers and graduate students with science background. It was published in June, 1995 by DoF/BAFRU. This manual is included in the extension pack EP/D/06.



Technical Handbook on Shrimp Culture

(HTM/D/03)

This technical handbook on tiger shrimp culture contains eight chapters. Basic information on the availability of the species, advantages and disadvantages of culture, biological characteristics etc. are detailed in chapter one. Characteristics of shrimp culture ponds along with ideal physico-chemical parameters, different culture methods and diverse level of inputs necessary for shrimp culture are elaborated in chapters two and three. Chapter four details the different steps involved in pre-stocking, stocking and post-stocking management of shrimp culture. Diseases commonly experienced by the shrimp farmers of Bangladesh have been elaborated in chapter 5 along with aetiology and diagnostic measures. Thirteen common problems faced by farmers and their probable solutions are concisely described in chapter 6. Chapters 7 and 8 take a look at pond economics, record keeping and checklist of works. Valuable information on life-cycle, mating, growth, moulting, basic engineering aspects of ponds, sampling and feeding techniques etc. may be referenced in annexes. The handbook is suitable for trainers, interested educated farmers and graduate students with science background. It was published in January, 1996 by DoF/BAFRU.



HANDBOOKS AND TECHNICAL MANUALS

Technical Manuals

কারিগরী নির্মাণকা
গলদা টিএফি-কার্প মিশ্র চাষ



Technical Manual on Prawn-Carp Polyculture

(HTM/D/04)

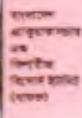
The technical handbook has been developed sharing practical experiences of different people and projects those who are working in fisheries sector in Bangladesh. So, more emphasis are given on the capacities of the Extension workers and their needs before selecting technical messages. The handbook comprises of 10 chapters covering all the necessary aspects of prawn-carp polyculture. Introductory aspects of polyculture; advantage-disadvantage, characteristics of suitable water bodies both of ponds and ghers, culturable species along with their food and habitat is described in chapter 1. Different chemical factors with their optimum range and control measures, required inputs and equipment, various culture management systems have been discussed in chapters 2-4, while chapter 5 elaborately describes pre-stocking, stocking and post-stocking management showing different steps chronologically. Concise discussions on disease prevention, diagnosis and control, common problems farmers encounter, pond economics and record keeping are detailed in chapters 6-9. Chapter 10 points out the summary of prawn-carp polyculture indicating daily and weekly tasks, checklist of tasks with a frequency and a proposed work planner. Some additional valuable messages e.g. Prawn life-cycle, suitable pond water colour; site selection, pond layout and construction; practical experience culture in gher and chemical measurement units have also been included in the annex. The handbook is suitable for trainers, extension workers and progressive farmers. This book was published in August, 1995 by DoF/BAFRU. This manual is included in the extension pack EP/D/02.

Technical Manual on Carp Culture

(HTM/D/05)

This technical handbook on carp culture is comprised of nine chapters. Basic information on different types of indigenous and exotic carps along with their food and habitats is specified in chapter 1. Pond typology with different types of culture methods and numerous inputs needed for growing fishes have been illustrated in chapters 2 and 3 respectively. Chapter 4 details the different steps involved in pre-stocking, stocking and post-stocking management within the fish culture calendar. General problems faced by farmers, their probable solutions and different types of fish diseases are concisely described in chapters 5 and 6 respectively. Chapters 7-9 take a look at pond economics, record keeping and summary of different fish culture steps. Valuable information on site selection, pond digging, desired pond water colours, control of aquatic weeds, compost preparation etc. are referenced in annexes. The handbook is suitable for trainers, interested educated farmers and graduate students with science background. It was published first in June, 1995 by DoF/BAFRU and later republished in December, 1998 by DoF/FTEP-II. This manual is included in the extension pack EP/D/01.

কারিগরী নির্মাণকা
পুরুষের উৎপাদন জীববিজ্ঞান



কারিগরী নির্মাণকা
কার্পের চাষবাদ



Technical Manual on Pond Production Biology

(HTM/D/06)

This technical handbook entitled 'Production Biology of Ponds' describes in four chapters,

- i- introduction to fish and fish culture (definition, history of fish culture etc.);
- ii- the fisheries resources and its importance, statistics on water areas, habitats, spawning grounds, problems of natural productions;
- iii- different types of ponds with their characteristics and
- iv- different abiotic & biotic factors affecting fish with measures to control them, phytoplankton, zooplankton, benthic and fringing communities, water and soil quality aspects and management systems of fish culture. The manual is especially suited for trainers with a science background who wish to enhance their theoretical knowledge on different aspects of pond production biology. The handbook also includes some indicators on the productivity of ponds and concise data on water quality parameters of ponds from the different districts of Bangladesh. The manual was first published in June, 1995 by DoF/BAFRU and republished in December, 1998 and in December, 2000 by FTEP-II/DoF. This manual is included in the extension pack EP/D/01.

HANDBOOKS AND TECHNICAL MANUALS

Farmers' Manuals



Farmers' Manual on Fish Culture in Seasonal Pond

(HTM/D/07)

This manual is essential for would-be farmers who wish to grow fish in seasonal ponds. The manual acts as a detailed guide through the content: definition of seasonal pond, pond characteristics, characteristics of culturable fish, species suitable for seasonal pond, weeding, removal of un-wanted fish, liming, fertilising, observation of natural food, toxicity test, fingerling release, transportation, acclimatisation, supplementary feed, harvesting and diseases. In addition, local measurement and every day activities for fish culture are included in this manual.

Farmers' Manual on Fish Nursery

(HTM/D/08)

This manual is designed to enable nursery farmers to manage their carp nursery pond properly.

Farmers can get information from this manual about local unit of measurement, classification and types of nursery, characteristics of nursery pond, necessary inputs, types of fry, steps of fry culture such as pond preparation (weeding, carnivore and weed fish removed, liming, contact with fish traders, fertilisation, natural food test, insect control, water toxicity test, etc.), identification of good and bad fry, transportation of fry, adaptation and release and then post-stocking steps (mortality rate check, post-stocking fertilisation, feeding and transfer to rearing pond). The manual also explains how to fertilise, feed, harvest and sale fingerling, manage hazards, keep records etc.

চার্চি সহায়িকা আছের পোনা চাষ



পানোন
বাস্তুবানার
এবং
বিপরীত
বিলু করণ
(১৯৯৫)



Farmers' Manual on Shrimp Culture

(HTM/D/09)

This technical handbook with 46 pages, most suited for common shrimp farmers, contains information on basic steps of shrimp culture. Different types of shrimp culture methods, basic characteristics of tiger shrimp, types of culture ponds, effects of tidal amplitude, diverse level of inputs, eradication of unwanted fish and predators from shrimp ponds, pond drying, application of fertilisers, observation of natural productivity, toxicity test etc. are lucidly described in the first half of the handbook. Identification of larvae on the basis of morphological characteristics, density of post-larvae, acclimatisation and transportation of fry, water exchange, feeding aspects, diagnosis and preventive measures against common shrimp diseases, common problems of shrimp culture and probable solutions, harvesting and marketing aspects etc. have been lucidly described in the second half of the book. The handbook with nice illustrations in each page is specially suitable for farmers of all level irrespective of literacy. It was published in January, 1996 by DoF/BAFRU.

HANDBOOKS AND TECHNICAL MANUALS

Farmers' Manuals

চাষী সহায়িকা
গলদা চিংড়ি-কার্প মিশ্র চাষ



Farmers' Manual on Carp-cum Prawn Culture

(HTM/D/10)

This technical handbook with 52 pages, most suited for farmers, contains information on basic steps of carp-cum-prawn culture. Advantages of polyculture, characteristics of species and ponds suitable for polyculture, basic pre-stocking steps covering dewatering, eradication of unwanted fish, liming and fertilization, test of natural productivity and toxicity, installation of shelters for prawn etc. are lucidly described in the first half of the book. Basic information on species selection and determination of stocking density, acclimatisation and transportation of fingerlings, post-stocking fertilisation and supplementary feeding, common problems of polyculture and probable solutions, harvesting and marketing aspects etc. are described in the second half of the book. The handbook with easily understood illustrations in each page is appropriate for farmers of all levels irrespective of literacy. It was published in July, 1995 by DoF/BAFRU.

Farmers' Manual on Carp Polyculture

(HTM/D/11)

The handbook entitled carp culture has been developed to help farmers to recall and/or learn technical messages needed to improve the management of pond. Simple technical messages on pre-stocking, stocking and post-stocking activities with colourful illustrations, tables and popular rhymes have been furnished in the book. Emphasis is given on farmers' ability and availability of resources locally. Some additional information about new pond excavation, water retention capacity of a pond, compost-making ingredients, quantity and methods are described in annex. The handbook was developed by DoF/BAFRU and first published in July, 1995.

চাষী সহায়িকা কার্পের চাষবাদ



Four Extension Booklet from Second ADP

(HTM/D/12)

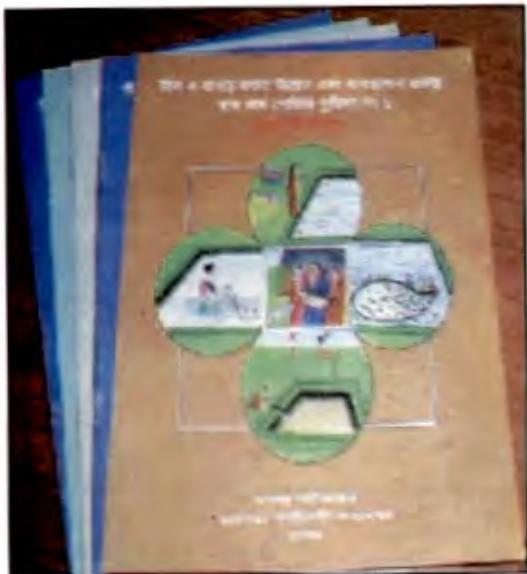
This project published four booklets on shrimp culture. These are 1. Shrimp fry nursing, 2. Introduction of traditional and improve extensive shrimp culture, 3. Improved extensive culture of shrimp, 4. Golda prawn and mixed culture of fisheries.

HANDBOOKS AND TECHNICAL MANUALS

Twenty three Booklets on Development for Aquaculture Entrepreneurs

(HTM/D/13)

Department of Fisheries published twenty-three booklets. Out of those twelve are reprinted by through National Package Program a DoF funded Development Project. These are-(i) Carp nursery management (ii) Carp polyculture (iii) Carp-Golda polyculture (iv) Sarputi culture (v) Paddy cum-fish and prawn culture (vi) Pangus culture and hatchery management (vii) Pan culture (viii) Nilotica culture (ix) Bagda culture and its management (x) Golda nursery management (xi) Golda culture (xii) Integrated fish culture. Three are reprinted by Upazila level Aquaculture extension project. These are (i) Carp polyculture (ii) Pangus culture in pond (iii) Integrated fish culture. These booklets are for all type of farmer, which cover culture techniques and cost-benefit analysis of different culture method. These also cover essential inputs and their sources for farming. These booklets encourage especially medium and large entrepreneurs.



Poster Booklets for Pond Fish Culture

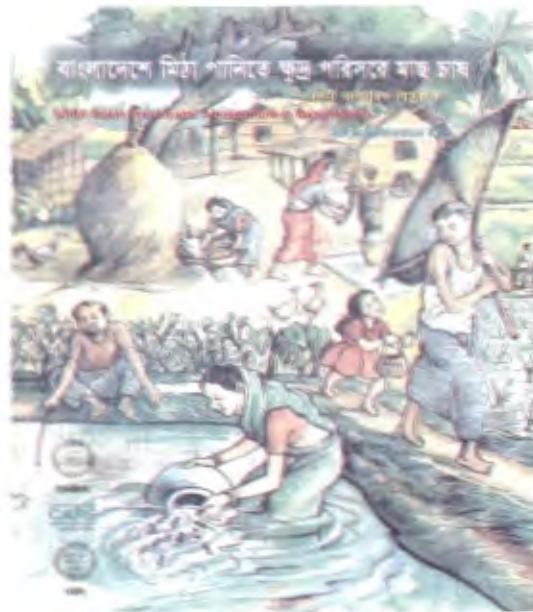
(HTM/D/14)

These poster booklets are designed to train farmers in pond fish culture pictorially. There are five booklets: (i) Pond Biology, (ii) Pond Preparation, (iii) Pond Stocking, (iv) Pond Fertilisation, and (v) Pond Routine Management and Harvesting. These booklets are well designed to train the illiterate farmers. The booklets are published jointly by DANIDA and BRAC.

Small-scale Freshwater Aquaculture in Bangladesh: An Information Kit

(HTM/D/15)

The contents of this information kit (199 pages) are generated from a 15-day long participatory workshop organised by Bangladesh Rural Reconstruction Association (BARRA), CARE-Bangladesh, International Institute of Rural Reconstruction (IIRR) in collaboration with ICLARM, ITDG & Dept. of Fisheries and patronised by European Union, DFID and Ford Foundation. The first chapter highlights the importance of fish culture in rural development, family nutrition, women employment; formation of model fishing village; environmental consideration in fish culture and a popular lyric. Chapter two elaborates on water quality aspects, characteristics of culturable species, cage culture, farming aspects of seasonal and perennial ponds, nursery ponds, culture of forage species, artificial breeding of carps, pangus culture, prawn culture, post-harvest cares, and flood plain fisheries. Chapter three provides information on integration of rice-fish and livestock. Chapter four describes substantial information on qualities of a good trainer, different extension approaches, mitigation of problems, role of fry traders, socio-economic analysis etc. A list of publications on aquaculture and organisations associated are annexed. This book is recommended for extension workers, entrepreneurs and university graduates.



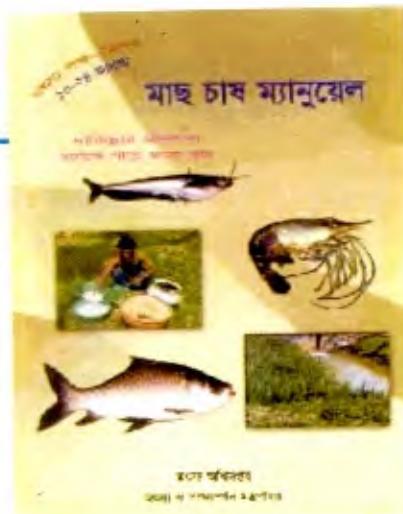
HANDBOOKS AND TECHNICAL MANUALS

Fish Culture Manual

(HTM/D/16)

The contents of the manual related to peoples role in fish culture, culturable water bodies in Bangladesh, culturable species, implement of fish culture techniques and management in rural pond, integrated fish culture in pond, commercial fish culture, paddy cum-fish culture, indigenous small fish culture, fish culture management in un-introduced water body, fish hatchery management and fry production, fish disease, control and treatment, technological package transfer, fish processing and marketing, system of getting bank loan, source of fish culture materials.

This is recommended for entrepreneurs, extension worker and fisheries experts. This manual developed by DoF in July 2002.



Guideline on Aquaculture – DoF

(HTM/D/17)

This guideline developed from collaboration with DoF, UNDP and FAO. Contents of the book are how can aquaculture help us, a skilled farmer, essential items, essential chemical for fish culture, idea before starting fish culture, how fish culture will start, summary of activities before stocking and after stocking, daily supplementary food, weekly activities, monthly activities, problems and prevention, reminder, summary of aquaculture, use of aquaculture technology and success. Any kind of farmer of minimum literacy may benefit from this book.

National Fisheries Policy: GoB/MoFL

(HTM/D/18)

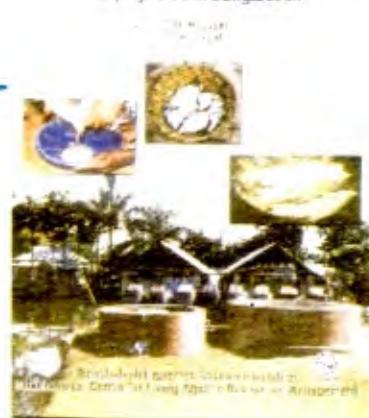
This is a complete fisheries act from MoFL, GoB. Contents are fisheries resource in Bangladesh, objectives of National Fish Act (NFA), legally covered NFA and area of NFA, Inland water resource management, preservation and harvesting role, inland water fish culture and management role, coastal shrimp and fish culture act, marine fisheries resource preservation, management harvesting role, fisheries related assisting role, another matters and implementation strategy of National Fisheries Policy.

Genetic Improvement and Conservation of Carp Species in Bangladesh

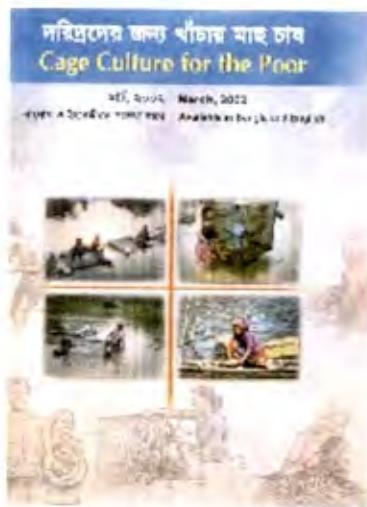
(HTM/D/19)

ICLARM and BFRI jointly published this book. It contains introduction, background information different endemic and exotic carps, Habitat degradation, carp bio-diversity in natural ecosystem, role of different carp species in fish production, biology of carp reproduction and artificial techniques for their seed production, fish hatcheries in public and private sectors, brood stock management scenario in the hatcheries, problems identified existing fish stocks and hatchery operation. Particularly breeding and genetic improvement of silver carp and major carp. Biology and artificial breeding techniques, conservation and management measures. This document is useful for hatchery operators, fishery biologists, researchers and planners for developing program.

Genetic Improvement and Conservation of Carp Species in Bangladesh



HANDBOOKS AND TECHNICAL MANUALS



Cage Culture for the Poor - 3 Volume

(HTM/D/20)

a. Technical recommendation with case study

This is a guideline about small investment in cage aquaculture with technical recommendation for extension worker. It contains - introduction, materials, and culturable species for cage. Alternate production technique, cage management, specified problems, harvesting & marketing and farmer case study.

b. Organizational extension in cage aquaculture

This guideline mainly for NGO's. Content of the course are what is cage aquaculture, information about cage aquaculture, cage aquaculture for NGO, NGO's role for developing cage aquaculture, legal entrance of water body, farmer selection, loan for NGO's and farmers and successful story of same NGOs.

c. Training guideline for extension worker and farmer

This is a four-day course for extension worker and farmer. It contains introduction (course, cage), cage setting, species and method selection, fry-selection, transport/ stocking, feeding, management and monitoring, farmer organize and training.

This three volume published by CARE Cages Bangladesh.

Information Kit on Cage Culture

(HTM/D/21)

Targeted for the general readers and published by CAGES project of CARE Bangladesh, this information kit comprises of 12 single sheets with basic message on introduction to the project, cage culture in different Asian countries; present, past and future prosperity of cage culture in Bangladesh, technology development and extension, caging materials and costs, species suitable for cage culture, of importance of cage culture, caging materials and preparation of cages, installation of cages, species suitable for cages, transportation and stocking of fry, home-based preparation of pellets and feeding, fry wintering and alternative production techniques, problems and solutions associated with cage culture and fish harvesting, NGOs as partner engaged in cage culture and marketing of fishes.

Basic Cage Culture Training- Guideline for Facilitators

(HTM/D/22)

This manual (version English) is developed for trainers with a view to update and participants' technical knowledge and skill in aspects of basic cage culture. Contents include site selection; farmer selection, cages construction and installation, species selection, fingerling transportation and stocking, feeds and feeding, cage management, main constraints, harvesting and marketing. After attending this 3 days course, the participants can successfully deliver training to their extension staff and also rural farmers using appropriate training aids. The course described is residential and requires classroom and paddy field. This manual has been published by INTERFISH Project of CARE Bangladesh supported by DFID.

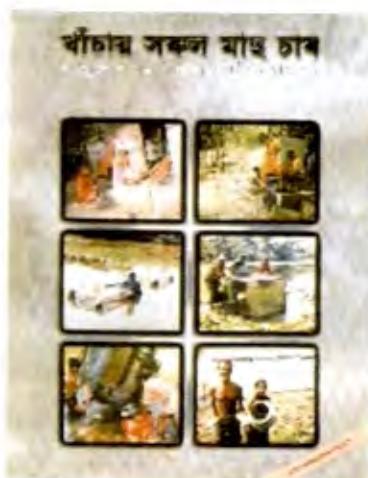


গাঁচা পেকে শাহু



ইনফরমেশন প্যাক

কেইজেস প্রকল্প
কেরাচির বাংলাদেশ



Fish Culture in Cages

(HTM/D/23)

Targeted for the general readers and published by CAGES project of CARE Bangladesh, this booklet snapshots on importance of cage culture, caging materials & preparation of cages, installation of cages, species suitable for cages, transportation and stocking of fry, home-based preparation of pellets and feeding, fry wintering and alternative production techniques, problems and solutions associated with cage culture and fish harvesting & marketing. This manual is included in the extension pack EP/D/07.

HANDBOOKS AND TECHNICAL MANUALS

Rice Fish and Fish Seed Production Manual

(HTM/D/24)

This tiny manual is developed for farmers and extension workers to improve their skill and knowledge on fish farming simultaneously or rotationally with paddy. The contents are- introductory aspects and scope of fish farming in paddy fields, aquatic ecosystem in a paddy field, characteristics and preparation of paddy fields, design and construction of dykes and trenches, pre-stocking, stocking and post-stocking aspects, supplementary feeding, fertilisation management, production techniques of *Tilapia* fry in paddy fields, general problems and solutions, disease management, community based paddy farming, planning and economics etc. This manual (31 page) has been published by DFID funded INTERFISH Project of CARE Bangladesh in December, 2000. This manual is included in the extension pack EP/D/03.



Technological Guideline of Fish Production -BFRI

(HTM/D/26)

Contents of the book are brood fish management and improve quality carp fry production, PG collection and preservation for artificial breeding, improved nursery management of carp fishes, carp poly culture in pond, breeding and fry production of gift tilapia, gift tilapia culture in seasonal pond, breeding and fry production of rajputi, rajputi culture in seasonal pond, pabda, gulsha breeding and fry production, improved hybrid magur culture, indigenous magur and shing fry production and culture, breeding, fry production and culture of pungus, golda fry production in backyard hatchery, carp-golda mixed culture in pond, fish feed production and application, duck-fish, poultry-fish, rice-fish, pen culture, preservation and development of *ilish*, flood land fisheries resource development and management, *Bagda* culture in *gher*, crabs fattening, marine shrimp and fish culture according crop cycle, vatki culture in pond using tilapia fry, fish Disease identification, prevention and health management, shrimp disease identification prevention and health management. Interested farmer, entrepreneurs, NGO, hatchery manager can use this technical guidebook.

খানকেতে মাছ চাষ
ও
স্পোন উৎপাদন সহায়িকা



Pond Dyke Cropping

(HTM/D/25)

This manual is developed for literate farmers, extension workers and entrepreneurs to improve their skill and knowledge on vegetable farming. The chapters broadly deal with leafy vegetables, fruity vegetables, spicy vegetables, oil seed production, lentils, pond dyke management, insects affecting vegetables, seed preservation and production calendar. Culture techniques of gourd, ladies finger, spinach, papaya, eggplant, bean, squash, cucumber, tomato, sesbania, neem, drumstick, red amaranthus, pumpkin, pea, maize etc. have been described in detail. Enriched with clear colour pictures, the manual will be appreciated by common readers also. This manual has been published by INTERFISH Project of CARE Bangladesh supported by DFID in September, 2000. This manual is included in the extension pack EP/D/10.



Guideline on Intensive Fish Culture and Annual Calendar

(HTM/D/27)

This booklet published from Fisheries and Livestock Information Department, DAE. The contents of the book are culturable fish in pond, pond classification in aquaculture, nursery pond, rearing pond management, stocking pond management, control and prevention of disease, annual calendar, production and cost-benefit analysis, *Raj Puti* culture, cost-benefit of *Raj Puti*, explain some biological and agricultural terms.



বান কেবকে তিংকি চাষ



বাংলাদেশ কৃষি শব্দেশন কাউন্সিল

Prawn Culture in Paddy Fields

(HTM/D/28)

Targeted for the general readers and published by Bangladesh Agricultural Research Council (BARC) in January 1992 under the auspices of 'Farm Management Research and Development Programme', the booklet contains two major parts- a) paddy cum prawn culture and b) rotational culture of paddy and prawn. There are detailed information on dyke development, trench and outlet excavation, ploughing, fertilisation, rice variety selection and plantation techniques, selection of size and species of prawn, pre-stocking precautions and activities, stocking density, water management, harvesting and economics.

Nilotica Culture

(HTM/D/29)

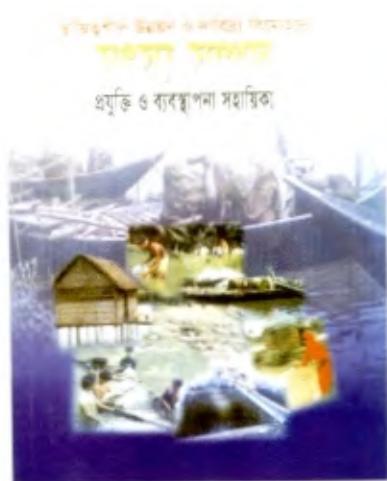
Targeted for the general readers and published by Bangladesh Agricultural Research Council (BARC) in January 1992 under the auspices of 'Technology Transfer Monitoring Unit (TTMU)', the booklet contains information on the salient features and life cycle of *nilotica*, preparation of brood pond, brood collection and stocking, supply of artificial feeds, fry management in rearing ponds, activities involved in semi-intensive management, preventive and curative measures against common diseases and economics of *nilotica* culture. This manual is included in the extension pack EP/D/05.

নাইলোটিকার চাষ



বাংলাদেশ কৃষি শব্দেশন কাউন্সিল

HANDBOOKS AND TECHNICAL MANUALS



Fisheries Resource

(HTM/D/30)

It is a fish culture technical and management related manual. The contents include constraints in development and technique removal of constraints. Method of pond re-excavation, classification of pond and fish culture in pond. Integrated fish culture and management, prawn culture and management. Different techniques of fish culture, breeding, hatchery construction, nursery pond selection, fry production and marketing, disease and control and fisheries resource management in open water, fish processing and marketing, feasibility study of the project, economical analysis, case study and fish culture slogan. Fish farmer, interested people and extension worker can use this book. Proshika published this manual in Bengali.

Thai Pungus Culture Manual

(HTM/D/31)

This manual is published by Business Advisory Services (BASC) in May 1998. It contains introduction, fisheries resource in Bangladesh and pungus culture, probability/benefit/problems of pungus culture, external and biological characteristics, male and female pungus, nursery pond, grow out pond, soil and water quality, culture method, management type, fry, fertilizer, supplementary feed, chemical materials, design and implement of an ideal farm, pre-stocking, stocking and post-stocking management. Introduction to hatchery, physibility, materials of different parts, brood management, problems and solution, diseases and its control. Interested entrepreneurs, extension worker, fish farmer and NGO's can use this manual. This manual is included in the extension pack EP/D/04

থাই পাংগুস মাছের
চাষ ম্যানুয়াল



BASC বিজ্ঞান একাডেমী সর্কিলেস সেক্টর (শাসক)
বাণিজ্যিক পণ্য ও পরিকল্পনা, প্রকল্প ও পরিকল্পনা, পরিকল্পনা পরিকল্পনা

Mymensingh Aquaculture Extension Project (MAEP) Produced Manual

(HTM/D/32)



The manuals published from MAEP are:-

- ◊ Aspects of producing table fish in ponds
- ◊ Works of table fish production in ponds
- ◊ Fish seed production in ponds
- ◊ Fish production in rice fields
- ◊ Specific fish production techniques
- ◊ Equipment and calculation of fish production.

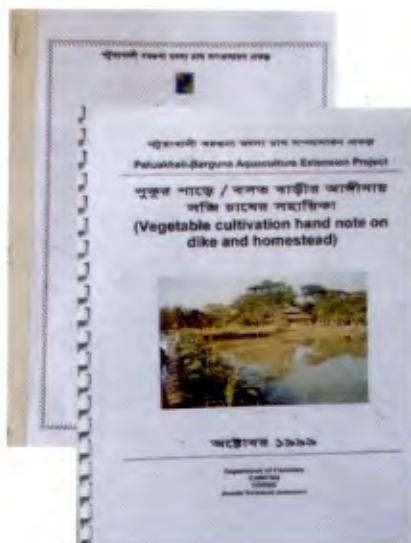
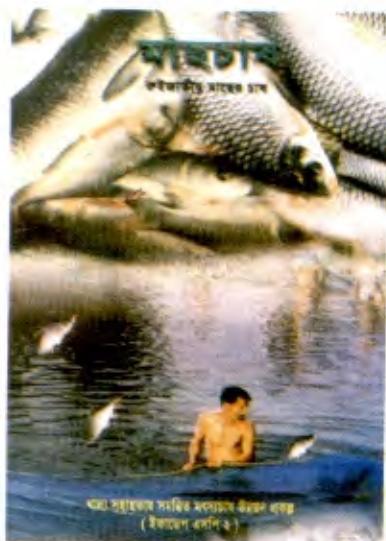
The materials contain technological information, production data, useable inputs, culturable species and different culture pattern. Farmers' record book that contain physical and biological parameter. These materials will be helpful for all aquaculturist.

HANDBOOKS AND TECHNICAL MANUALS

Carp Culture (*Rui-jatio Macher Chash*)

(HTM/D/33)

This is an extension carp culture manual published by the Integrated Food Assisted Development Project (IFADP). The manual contains pond preparation, fry collect and stocks, fertilization, use of supplementary feed, culture management, harvesting and marketing and finally keep accounts. Extension worker can benefit by this book. Literate and semi literate people can use this book.



Patuakhali Barguna Fish Culture Extension Project's Publications

(HTM/D/34)

Guideline on integrated aquaculture:

This book published from PBAEP for block supervisor of DAE. Contents are aim and objectives of PBAEP, concept of integrated aquaculture, pond preparation & fertilization. Introduce three layer, species selection & stocking, fry transport, supplementary feed, problems & solution, harvesting and marketing, rice fish culture, land selection, fry selection & stocking, take care rice & fish and harvesting.

Guideline on indigenous magur fry production and culture management :

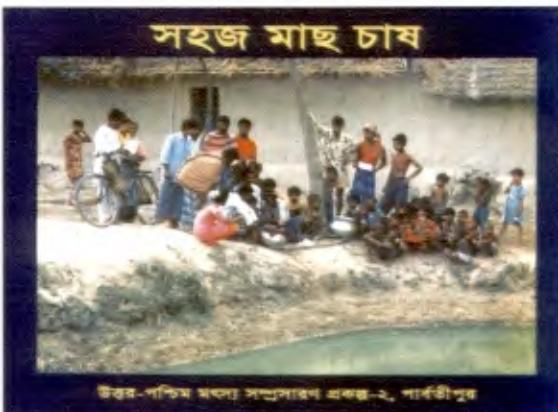
Contents are advantage and probability of magur fry production, construction of hatchery, brood management, artificial breeding, flow chart of artificial breeding, fry nursing and culture management.

Training guide on integrated pond farming group:

Contents of the book are introduction, compost preparation and vegetable production technique. Poultry & livestock rearing, practical-1, pond preparation & fertilization, practical-2, introduce three layers, fry stocking and feed application. Disease management and practical-3.

Vegetable cultivation hand note on dike and homestead :

Contents are nutrition value of vegetable, seed preservation method, variety of pumpkin culture, various vegetable culture, problems of different fruit trees and integrated pest management.



Easy Fish Culture (*Shahoj Mach Chash*)

(HTM/D/35)

This technical hand book Developed from Northwest Fisheries Extension Project-2 (NFEPE-2), this is for literate and semi literate farmers. Contents of this book are pond preparation, fry release, African magur culture, different feed for fish, take care of pond and fish, partial harvesting, fish disease and prevention, rice cum fish, cost - benefit analysis, this is a pictorial informative hand book.

HANDBOOKS AND TECHNICAL MANUALS



Technical Guideline for Extension Trainer on Carp Polyculture with Golda in Pond:

(HTM/D/36)

This technical handbook on carp polyculture with Golda in pond has been developed for Extension Trainer who are working with Fish Farming Group (FFG) in the field. Basic information on carp polyculture with Golda in pond is described in the book. This technical handbook is comprised of ten technical chapters. The important and benefit of carp polyculture with golda in pond is highlighted in chapter-3. The different steps involved in pre-stocking, stocking and post-stocking management within the polyculture is described in chapters 4 -9. Water quality & management and different type of fish disease & prevention measure are described in chapters in 10 and 11 respectively. Fish harvesting and marketing has been discussed in chapter 12. Fish culture activities calendar is referenced in table-4. The technical guideline is helpful for Extension Trainer to train the fish farmers. It was published first in April 2000 by GNAEP. Drawing illustration was used in first edition. The second edition was published in November 2001 with reviewed of some technical recommendation based on field condition and illustrated with photographs.

Technical Guideline for Farmer on Carp Polyculture with Golda in Pond:

(HTM/D/37)

The technical guideline on carp polyculture with Golda in pond has been developed to help farmers to recall and/or learn technical messages needed to manage carp polyculture with Golda in pond. Simple and key technical messages on pre-stocking, stocking and post-stocking activities with appropriate photographs and tables have been provided in the book for better understanding of the farmers. The inputs for fish culture are given emphasis on farmers' ability and resources availability in locally. General problems faced by farmers, their possible solutions are described in table-4. The daily route work and fish culture activity calendar also included in the farmers' handbook. It was published first in April 2000 by GNAEP. Drawing illustration was used in first edition. The second edition was published in November 2001 with reviewed of some technical recommendation based on field condition and illustrated photographs.



চারী প্রশিক্ষণ ম্যানুয়াল

নথ্যবাজি ব্যবসায় কর্মসূলীর



Farmer Training Manual to be used by Extension Trainer

(HTM/D/38)

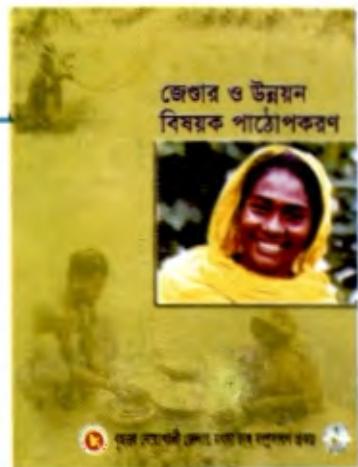
The farmer training manual has been developed as a session guide for Extension Trainer to conduct farmer training effectively. The training manual is included ten learning sessions (each session is mentioned as a module). Pre-stocking, stocking and post-stocking management is covered by 6 learning session, social and gender awareness is covered by 2 session and one session is included as review session in the manual. Each session is delivered to the farmer group at pond site and takes place 2-3 hours. In this manual each session is described particularly the sequence and methods of session delivery to the farmers group. One session takes place in a month and finally completed in 10 months. It was published first in April 2000 by GNAEP. The second edition was published in December 2001 with some modification based on field recommendation.

HANDBOOKS AND TECHNICAL MANUALS

Reference Book on Gender and Development

(HTM/D/39)

The book has been prepared as a reference book on different issues of gender & development. Conceptual ideas on gender and development, National and international observation of women development, Women & Law and Women in aquaculture issues are mainly included in the reference book. The information of the book was collected from different media and publications. The main purpose of the reference book is to increase the knowledge on gender and development for all level staff and extension trainer and also assist to conduct gender training staff, Extension Trainers and farmers.



Manual on Integrated Prawn Farming

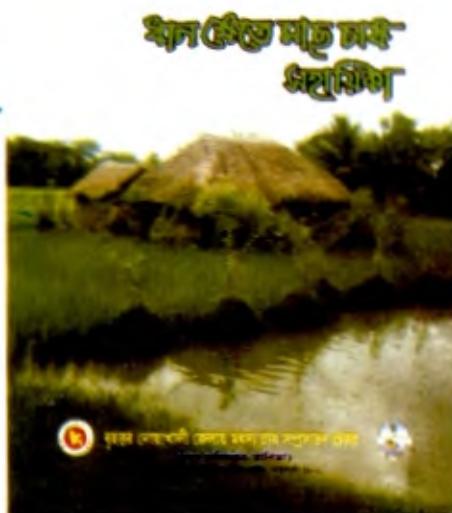
(HTM/D/40)

Integrated rice-fish cultivation manual illustrated the discussion with simple language on rice field base integrated prawn farming considering the local ecological condition. This manual mainly focuses the technique of prawn cultivation using low external inputs and integration techniques of rice, carps and dikes crop in the same plot. Farmers' friendly this manual emphasizes on reduction of risks associated with prawn by lowering the production cost and increasing income through integration of other crops. The manual contains plot configuration, prawn nursery system, homemade prawn feed preparation, dike cropping, cultivation management etc. It was published in January 2002 by GNAEP and PBAEP.

Manual on Integrated Rice Fish Farming

(HTM/D/41)

This manual has been developed with an aim to assist farmers in their decision making and management of their rice-fish farming. The manual basically focuses the practical field experiences of rice-fish cultivation gathered by farmers and staff. The document has been written using very simple language and examples with the support of relevant photographs easy to understand by all categories of readers. This document contains the elaborate discussion on feasibility, rice field ecosystem, field configuration, and total cultivation management, conservation of wild fish and different critical aspects of rice-fish farming. It was published in January 2003 by GNAEP.



EXTENSION MATERIALS

Extension Packs



Carp Polyculture by PGTS

(EP/D/01)

The farmers' training advocated by FTEP-II is small group (<15) participatory training over five two-hour learning sessions. A three hour review session (sixth session) takes place after one fish production cycle later. The pack containing training notes, leaflets, farmer record sheet, flashcards and technical manuals (TN/D/01, LF/D/01, LF/D/03, HTM/D/01, HTM/D/05, HTM/D/06) is designed to provide the trainers with all necessary materials to conduct this training. The highly detailed **training notes** guide the trainer through the five learning sessions viz:- 1. Training needs assessment and pond status/ condition; 2. 'Green Water', prepares the pond prior to stocking such dyke maintenance, predator removal and necessary inputs; 3. 'Stocking Management' completes the correct fish stocking of the pond; 4. 'Farmer's Resources' identifies all resources and needs (given in session-1) and prepares farmers' for beneficial positive action for good pond management. It includes the traditional 'recipe' pond inputs using chemical and animal wastes fertilizers but also attempts to develop farmer understanding of use of on-farm resource

based integrated systems; 5. 'Profit in Fish Culture' enables farmer to understand the potential risks but conversely the potential high returns. Partial harvesting and re-stocking may be included. The session content is flexible based on identified need in session one.

To provide useful information for farmers, four colour illustrative **leaflets** are distributed to farmers corresponding with the topic presented in sessions two to five titled: **II. Green Water, III. Farmers Resources, IV. Stocking management, V. Profit and Risk management in aquaculture**

A set of 106 thoroughly researched and field tested **flash cards** covering an extensive range of subjects relating to fish and fish culture activities are designed to present key messages and link together develop complex ideas about what the farmer is practicing now, intends to do and later, in session six, discuss what actually happened, the so called BGM (Baseline-Goal-Monitoring). The cards are prepared as line drawings which the trainers colour themselves for greater impact.

One double sided **Farmer Record Sheet** enables farmers to be able to record their present, intended and actual activities, input rates etc. Thus replacing the old farmer diary system with a quick referencing record on one sheet for the whole production cycle.

Anyone with knowledge in basic pond fish culture can use the training notes but complete implementation of the training sessions involving BGM will require additional training of trainer.



Golda-Carp Polyculture

(EP/D/02)

This package contains all necessary materials to enable trainers deliver five-quality 2½-hour small group pond side learning sessions for farmers wishing to learn more about Carp-Golda farming. An evaluation session follows the five learning sessions and upon completion of the production cycle.

The sessions are highly participatory requiring a number of teaching aids especially flash cards and real materials. For even experienced trainers delivery of high quality participatory training requires a detailed guide and provision of all materials. To overcome this the extension package comprises of 126 flash cards to illustrated essential learning points during the sessions, detailed trainer's notes, set of five leaflets for the farmers, farmer record sheet to enable them to maintain production activity records and a trainer's tally sheet to record the information of whole group.

The notes act as a detailed guide through the five learning and one evaluation session as with "Carp polyculture by PGTS" (Reference EP/D/01) but relevant to the Golda Carp polyculture training practices.

EXTENSION MATERIALS

Extension Packs

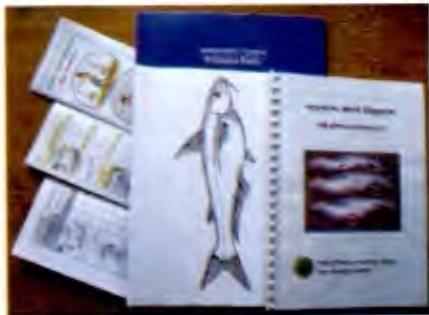
Rice Fish Culture Technique

(EP/D/03)

Rice-fish farmer's extension training pack is prepared to carry out the aims of improving the farmers knowledge and skills on the basic principles of rice-fish integrated farming, environmentally friendly integrated pest management (I.P.M.) and inform on the contribution of paddy and fish to the National economy. This extension pack targeted to DoF upazilla level AFO/FA and NGO workers to train the farmers so that suitable rice farmer can involve confidently rice-fish integrated farming in their areas.

This extension pack consists of five sessions. 1st session is group formation and awareness arising where trainer discuss with the farmer on basic nutritional message, Gender awareness and participation, group formation stepwise approaches etc. The 2nd to 4th sessions are mainly on basic rice fish farming (identification of farmer baseline and goal, Land preparation, Plantation and Stocking, Post stocking rice and fish management) and 5th session is monitoring and evaluation to review the result with the farmers and plan for future. In all sessions trainers note is designed to provide the trainer with an easy to follow step by step guide, many tips and relevant information, flash card (14 Nos.) to illustrate key learning points.

The training method used in small group (10-12 farmers). Every technical session includes the practical session guideline to accomplish the realistic outcome. Three leaflets include for the use farmer after training where simple methods of rice fish integrated culture is explain in plain language. The duration of all sessions are between 3 to 3.5 hour. A set of monitoring and evaluation tools is included to measure the output of the training. Overall this extension pack is highly helpful to conduct farmer training effectively in field for trainer.



Pangus-Carp Polyculture

(EP/D/04)

This extension pack is essential for extension trainers wishing to deliver highly participatory, interesting and entertaining training on Pangas-Carp polyculture. This package contains all necessary materials to enable trainers deliver five quality 2- 2½ hour small group pond side learning sessions for farmers wishing to learn more about Pangas-Carp farming. An evaluation session follows the five learning sessions after completion of the production cycle.

The extension pack consists of six useful training materials-a) the Trainer's note to guide the extension trainer session format as Carp Polyculture (Reference EP/D/01) Flashcards to

illustrate essential learning points during the training sessions; c) Technical manual originally published by BASC, to provide additional technical information for the trainer; d) set of Four leaflets containing essential information for the farmer to keep; e) Trainers Tally Sheet to maintain all farmers production activities of each group and f) Farmer record sheet for individual farmers to maintain production activity records for easy reference and improved performance for subsequent production cycles.

Tilapia Polyculture

(EP/D/05)

This is an extension pack about "Tilapia polyculture" in seasonal ponds designed for extension workers who wish to train small scale fish farmers in pond side groups of 8 to 12 persons. Tilapia polyculture is presented as an opportunity to maximunt utilization of resources such as ditches, very small ponds, derelict ponds and unutilized small water bodies for rural people. This type of culture technology is especially important for women who play an important role to produce fish in their homestead seasonal small ponds providing fish easily for family consumption and for sale for the family purse.

The extension pack consists of six useful training materials; the trainer's note to guide the extensionist, flashcards to illustrate essential learning points during the training sessions, technical manual originally published by BARC, to provide additional technical information for the trainer, set of four leaflets for the farmer to keep, a Trainers Tally Sheet to maintain the all farmers production activities of each group and a farmer record sheet for individual farmers to enable the farmer to maintain production activity records for easy reference and improved performance for subsequent production cycles.

The trainer's note comprises of 6 sessions. Each session 2-2.5 hours of different 6 days in a year as per requirement and season based. These sessions follow the same format as Carp Polyculture pack (Ref EP/D/01)



EXTENSION MATERIALS

Extension Packs



Nursery Management

(EPD/06)

This "Nursery management pack" is an excellent way to improve the quality fingerlings for farmers. Through ensuring the optimum size and timing as per requirement for fish culture. This extension pack targeted to extension workers to train interested farmers in good nursery operation. As a result pond farmer should get good quality fingerling for them.

The extension pack consists of five useful materials; the trainer's note format is designed to provide the trainer with an easy to follow step by step guide throughout the all sessions with numerous tips and pertinent information, flashcards to illustrate essential learning points during the training sessions, technical book, to provide additional technical information for the trainer (originally published by BAFRU), farmers manual, to provide additional information for the farmer (originally published by BAFRU), farmer pond record book, to enable the farmer to maintain pond expenditure and production activities records.

The training method used is small group (1-3 farmers). Theoretical and practical training requiring one trainer/extensionist located near examples of best practice if possible. There are five short learning sessions. Duration of each session is one and half to two hour. After the completion of one production cycle a 90-minutes evaluation session will be conducted with the farmers for result review and future planning. January-April is the best time to conduct this training.

The main content of the course are; nursery pond preparation, pre-stocking management, natural food test, fingerling transportation, stocking, post-stocking management and economics importance of fry and fingerling production

Cage Aquaculture

(EPD/07)

Cage aquaculture extension package contains a set trainer's notes, one farmer's record sheet, one trainer's record sheet and 59 flash cards. The trainer's notes is a complete guideline for the trainers to deliver four learning sessions and one evaluation session- i) Water body selection and cage making materials and equipment ii) Cage making and installation into water body iii) Fingerling stocking and feeding the cage iv) Cage management, Fish harvesting and marketing v) Farmer's training evaluation and identify future training needs. Despite of the culture technology the trainer's notes also contains simple nutritional messages and gender awareness issues and group formation techniques trainers needs to follow. These notes are very descriptive and provide step by step forward instruction to the trainers what points to be discussed. Even the notes tell the trainers what question to be asked to the participants with probable answers. This package will be best utilised by the experienced extensionist but the complete beginner who has little training skill can able to train farmers well using it.



Fry Traders

(EPD/08)

This "Fry Traders Extension pack" is an excellent way to improve the Fry Traders fingerlings transport quality. This extension pack targeted to extension workers to train interested Fry Traders in good fry transport operation. As a result pond farmer should get good quality fingerlings.

The extension pack consists useful training materials; trainer's note to guide the extensions, flash cards to illustrate essential learning points during the training sessions, one pictorial mini-album provide additional & pictorial technical information for trainee and farmers.

The training method used is small group (8-10 fry traders). Theoretical and practical training requiring one trainer/extensionist located near examples of best practice if possible. There are three days on three short learning sessions. Duration of each session is two to two and half-hour. After three to four month of releasing the fry a 60-minute debriefing session is conduct to review result verify the knowledge, achievement and plan for future. The best time to conduct the training is before fry stocking.

The main contents of the course are; fry transportation procedure, pre & post stoking management of pond aquaculture and risk management.



EXTENSION MATERIALS

Extension Packs

IGA and Micro Credit Management

(EP/D/09)

The extension pack entitled "IGA and Micro Credit Management" is particularly developed for the training of unemployed/part time unemployed peoples those who are unable to maintain their family expenditure through their present activity. At the end of the training beneficiaries will be able to select suitable activity for them to meet up their family demand.

The extension pack consists of four useful training materials; the trainer's note to guide the extensionist, flashcards to illustrate essential learning points during the training sessions, technical manual originally published by CARE, to provide additional technical information for the trainer, set of two leaflets for the participants to keep.

The training method uses small group and there are six useful short two or two and half hour sessions conducted during relevant times of the year followed by an evaluation session to share lesions learnt and consider future training needs.

The main content of the course are; The way to survive, general income generating activities in rural Bangladesh, selection of more suitable activities, fixed-up budget for selected activity, capital needed for the selected activity as initial cost and running cost, general discussion on micro credit and group activities to get credit.



Pond Dike Cropping

(EP/D/10)

Pond dyke cropping is an excellent way to improve on-farm production and resource utilisation by use of the normally redundant pond banks (or dykes). This extension pack is designed for extension workers to train farmers how to integrate their vegetable and fish production systems through use of the pond dyke for improved food security and profit.

The extension pack consists of six useful training materials; the trainer's note to guide the extensionist, flashcards to illustrate essential learning points during the training sessions, technical manual originally published by CARE, to provide additional technical information for the trainer, crops seasonal calendar for trainer and farmer to discuss cropping strategies along the pond dykes, set of four leaflets for the farmer to keep and

a farmer record sheet to enable the farmer to maintain production activity records for easy reference and improved performance for subsequent production cycles.

The training method uses on-farm small group practical training requiring one trainer/extensionist located near examples of best practice if possible. There are four short two hour sessions conducted during relevant times of the cropping season followed by an evaluation session to share lessons learnt and consider future training needs.

The main content of the course are; basic nutritional message, gender awareness and participation, group formation, use of integrated resources, cultivation methods for suitable crops, risk-management, useful and harmful insect identification, pest control and economic analysis of dike cropping.

Low Cost Carp Hatchery

(EP/D/11)

Establishment of a Low cost Carp Hatchery is an effective way to make available the quality fry & fingerlings in the near by locality. The extension pack is designed for extension workers to train interested small entrepreneur how to establish a small carp hatchery through one to one training approach:

The extension pack consists of three useful learning materials; the trainer's note to guide the extensionist, technical manual originally published by BRAC to provide additional technical information for the trainer and hatchery record sheet to enable the operator to maintain production activity records for easy reference and improved performance for subsequent production years.

The training method uses on-farm one to one practical training from designing to production and overall operational management. Actually, this is a long-term learning process and no specific sessions. But there is issue-based discussion and demonstration during construction and production.

The main content of the extension pack are; designing the small scale carp hatchery, construction of the hatchery, brood stock management, hatchery production techniques, overall hatchery management issues and the spawn rearing and marketing.

EXTENSION MATERIALS

Leaflets and Flash Cards



FTEP-II Leaflets

(LF/D/01)

Four useful and informative leaflets for farmers taking part in "Pond Side Group Training Sessions". Although these leaflets form parts of the FTEP-II pond-side training, they would be appropriate for most carp-polyculture extension programmes. Distributed after the appropriate practical session as a reference for the farmers.

Green Water: Explains simply and clearly for the farmers the importance of fertilisation and liming during fish production. The objective is to maintain good green water quality with correct use of inputs. Key messages for the farmers are not to use fertilisers and lime if it is not needed although recommended doses for lime, inorganic and organic fertilisers are given for "More fish for less investment" are stressed in this leaflet.

Farmers Resources: Introduces the farmer to the concept of using 'on-farm' resources for fertilisation of ponds and feeding of the fish. These sources include for example, leaves and livestock/poultry manure, composts and left over food from the kitchen etc.

Stocking management:- A particularly useful leaflet for farmers with simple texts and pictorial explanations on how to work out the correct stocking density of fish, species ratio and also how to manage purchase and selection of healthy fry.

Profit and Risk management in aquaculture:- Outlines the main considerations and risks in fish farming, covers financial issues, disease, drought, flood and water quality problems. A short note on how partial harvesting and restocking can improve fish production and profitability is provided.

BAFRU Leaflets

(LF/D/02)

Five technical leaflets on fish culture management practices for rural small-scale pond farmers were developed by DoF/BAFRU in 1996 and were widely distributed to DFO, UFO and NGO offices for farmer training.

The leaflets are still useful today. They are concise, colourful, attractive and highly informative, although do require a minimum level of literacy to be used effectively.

Eradication of predatory and unwanted fish: This leaflet contains basic messages on importance and methods of eradicating unwanted fish.

Liming: This pictorial leaflet snapshots on the importance, factors affecting dosages, timing, preparation and precautions involved in liming. It also contains three popular thought-provoking rhymes.

Stocking: This leaflet contains information on species selection, stocking density, different models of stocking with size and species variation. One blank table is added for use by farmers.

Observation on the natural productivity of ponds: This leaflet provides basic information on the significance of checking natural productivity and simple ways of assessing productivity. Farmers can easily adapt the techniques described in the leaflet.

Regular fertilization: This leaflet provides basic messages on the significance, types and quantity of fertilisers, methods of fertilisation along with some factors effecting fertilisation. It contains two rhymes. One blank table is added for use by the farmers.



Flash Cards

(LF/D/03)

106 thoroughly researched and field tested flash cards covering an extensive range of subjects relating to fish and fish culture activities. The flash cards relating to seasons and non fisheries subjects would be useful for any extension officer. The cards are prepared as line drawings which the trainers colour themselves for greater impact during sessions. These cards have been designed for use with the FTEP-II "Pondside Group Training Sessions" but would be applicable for most small to medium sized farmer group training and extension programmes. These can also be used effectively for stimulating discussions within feedback or discussion groups of farmers.

EXTENSION MATERIALS

Leaflets

Fish Disease: Prevention and Cure

(LF/D/04)

Published by 'Thana Level Fish Culture Extension Project' of DoF in June, 2000 for the farmers. The leaflet contains information on symptoms, causes, preventive and curative treatments of some common diseases viz. Epizootic Ulcerative Syndrome (EUS), tail rot, gill rot, white spot, black spot, argulus & leech infestation etc. The leaflet also contains information on some disinfectants and anti-parasite chemicals occasionally used in pond aquaculture.



Commercial Production of Pungus

(LF/D/05)

Published by 'Thana Level Fish Culture Extension Project' of DoF in May, 2000. the leaflet contains basic messages on advantages of pungus culture, pond selection and preparation, liming and fertilisation, toxicity test of water, species selection, prophylactic treatment, stocking, feed formulation and feeding, pond bed management, growth rate of fishes, harvesting & marketing techniques and economics.

Nilotica Culture

(LF/D/06)

This colour leaflet published from DoF, Matsya Bhawan. It contains introducing Nilotica, benefit of Nilotica culture, culture method, liming, fertilization, fry release, supplementary feed, fish harvest, life cycle and cost-benefit analysis.

Fish Act (DoF)

(LF/D/07)

This leaflet published from DoF for DoF Officers. Here some laws are executed, on importance of fisheries resource, its current and future demand, availability and development.

- | | | |
|----|---|------|
| 1. | Fish Protect act | 1950 |
| 2. | Pond development act | 1939 |
| 3. | Marine Fish act | 1983 |
| 4. | Fish and fish products (inspection and control) ordinance | 1983 |
| 5. | Fish hatchery and Aquaculture introduce as an industry | 1991 |

This leaflet also contains some awareness slogan.

New Water Body Act for Closed and Open Water

(LF/D/08)

This leaflet published from DoF in May-2001, under Fisheries Resources Development Project in Open and Closed *Jalmohals* under New *Jalmohal* Policy. Contents are introduction, project objective, cost and implementation period of project, water body covered by project, participation of national fisheries society, project implementation and water body management.

Carp Polyculture

(LF/D/09)

This leaflet published from Upazila Level Aquaculture Extension Project, DoF in February 2000 for farmer. Content of the leaflet are mixed culture, species in mixed culture, benefit of mixed culture, pond selection, pond preparation, fry stock in pond, stocking density per decimal, nursing after stocking, fish diseases control, treatment for unhealthy fish, harvesting and cost benefit analysis.

EXTENSION MATERIALS

Leaflets



FFP Leaflets

(LF/D/10)

Pond preparation for fish culture :

This leaflet prepared in colour by Fourth Fisheries Projects (FFP), DoF, Bangladesh. It contains importance of pond preparation, physical development, de-weeding and removal of unwanted fish. Maintain water quality and increase fertility. All type of farmer can use this leaflet.

Fingerling stocking in pond : This colour leaflet contains importance of fingerling stocking, species selection, individual stock able species number, seasonal/perennial pond, size and health of fingerling, transport and release in pond.

Female participation in fisheries village activities:

This colour leaflet it contains necessity of female participation in fisheries village activities, facilities, female participation in training and extension activities, increases

female participation in fish culture and constraints.

1PM for Paddy Cultivation

(LF/E/11)

Published by 'SPPS Project' under DAE in February, 1998, the leaflet contains pictorial information on the preliminary concept and significance of adopting 'Integrated Pest Management (1PM); conservation of beneficial insects, cultivation of resistant varieties; manual, mechanical and chemical control of insects and steps involved in controlling harmful *parni* insects in paddy field. This leaflet is using for rice-fish training purposes.



Control of Brown Grasshopper Through 1PM

(LF/E/12)

Published by 'DAE-UNDP/FAO 1PM Project' under DAE in February, 2000 for rice-fish training purposes. The leaflet contains pictorial information on the life cycle of grasshopper, variety of rice resistant to brown grasshopper, control by spraying insecticide with modest doses, natural agents controlling grasshopper (e.g., spider, lady bittle, mind-bug etc.) and light trap for controlling grasshopper.



Go Inter-fish -"A Maser Chash" CARE

(LF/E/13)

This colour leaflets published from Go Inter-fish Project CARE for farmer. It is written like poem. Contents are rice fish culture, fry production of carpio, reduce mortality rate, fry transport, ulcerative diseases.



EXTENSION MATERIALS

Leaflets

GNAEP Leaflets

(LF/D/14)



Three technical leaflets on fish culture management practices were developed by GNAEP in 2001 and widely distributed to the farmers during the training as well as in farmers Field Day. Three main areas of fish culture i) pond preparation for fish culture, ii) stocking and iii) food and feeding management were illustrated in three different leaflets. All the leaflets were prepared in four colors with concise information with suitable photographs.

Pond Preparation for Fish Culture: This leaflet contains basic information of pond preparation steps; importance of pond repairing, methods and importance of eradicating unwanted fishes, Liming and fertilization and its precaution.

Stocking: This leaflet contains information on species selection, species density, and different recommendation of stocking with species variation. Importance of stocking density & ratio and methods of fingerlings release are also described in the leaflet.

Food and Feeding Management: This leaflet provides basic information importance and types of natural and supplementary feed for fish, simple ways of assessing productivity and farmers can take necessary action is described in the leaflet. Type of supplementary feed, preparation and application are also described in the leaflet.

BFRI Technological Leaflets

(LF/E/15)

i). **Rice fish culture** - Contents are advantage of rice fish culture, culture method, site selection, rice field preparation, species selection, fingerling stocking, management, diseases control and prevention, production and cost benefit analysis.

ii). **Improved hybrid Magur production technology** - Contents are advantage, brood fish collection and nursing, selection male and female for breeding, prepare hormone solution, injection push, egg collection by stripping and sperm solution preparation, egg fertilization, fry rearing, fingerling production, fry diseases control and prevention.

iii). **Pungus culture techniques** - Contents of the leaflet are pond preparation, source of fry, fry stocking, use supplementary feed, nursing, disease and control, harvesting and production, cost benefit and conclusion.

iv). **Nilotica culture technology in seasonal pond** - Contents are advantage of Nilotica culture, culture method in stock pond and cost benefit analysis.

v). **Culture Techniques of Gift Tilapia in Seasonal Pond:**

The leaflet describes the advantage of gift Tilapia culture, culture method of gift Tilapia in stock pond, diseases and prevention, cost benefit analysis. Any sort of fish farmer can use this leaflet.

vi). **Poly Culture Technology in Pond:**

Describes poly-culture of fishes, objective of poly culture, pond selection and management, species selection and fry stocking, apply supplementary feed, disease and control, harvesting, production and cost-benefit analysis. Farmer who are interested in poly culture they can use this leaflet.

vii). **Fish Disease Control:**

It contains name of the diseases, symptoms, control/ prevention of fishes that are seen in Bangladesh. Name of the disease are alser, tail and fin rot, reduce scale, gill rot, dropsy, parasitic, argulosis, fungus, mal nutrition, poisonous and oxygen deficiency.

viii). **Effect of Pesticide on Fish:**

Here it introduces pesticides, effect of pesticide on fisheries resource, harmful, pesticide, comparatively safety pesticide, effect of pesticide on fish health, needed conscious using pesticide.

ix). **Fish Culture Technology in Pan:**

Content of this leaflet are introduction, site selection, prepare pan, remove of predatory and unwanted fish, species selection, fry stocking rate, provide feed in pan, harvesting and production.

x). **Preparation and Application of Supplementary Feed:**

It contains nutrient demand of fish, feed composition, preparation of feed formulation, method of feed preparation, application rate and method of feeding, fish production and recommendation for farmer. Those leaflet's target group are farmers.



EXTENSION MATERIALS

Leaflets

Pungus Polyculture in Pond

(LF/E/16)

Another leaflet from BFRI, Chandpur. It contains benefit of pungus culture, pond preparation, source of fry, fry stocking, use of supplementary feed, nursing, worship, disease and prevention, harvesting and production, lastly cost-benefit analysis. Fish culture related anyone could use this leaflet.



Different Leaflets from PBAEP For Farmer

(LF/D/17)

Patuakhali Barguna Aquaculture Extension Project (PBAEP) is distributing leaflets to the farmers and service providers after conducting training. Every leaflet is 1 page A4 and contains key messages of a particular issue, this helps farmers to remind the training knowledge. PBAEP developed 11 different leaflets up to now.

- Integrated Pond farming
 - Optimum Pond environment and green water concept
 - Three layer concept
 - Activities in pond farming
 - Happy duck rearing
 - Dyke cropping
 - Rice-fish-vegetable management
 - Optimum environment in rice field
 - Simple messages of pond farming
 - Derelict pond improvement
 - Native magur (*C. batrachus*) breeding and grow out

Low Cost *Hapa* System for Quality Tilapia Seed Production

(E/F/D/18)

Published by CAGES Project, CARE-Bangladesh, NFEP-II and Institute of Aquaculture, Sterling University, Scotland, this pictorial leaflet contains brief information on advantage of culturing GIFT (Genetically Improved Farm Tilapia), preparation of *hapa*, scope of and materials needed for GIFT fry production in *hapa*, differentiation between male and female tilapia, steps involved in and factors affecting seed production and economics of seed production.



Fry Transport NFEP-2

(AE/D/19)

Fish production depend on health and morality of fry, health and morality depend transports, so it is one of the most important factor. This Leaflet describe how should fry transport, it also describe very simple language.

EXTENSION MATERIALS

Posters

DoF

(P/D/01)

1. Maintain Fisheries Act -

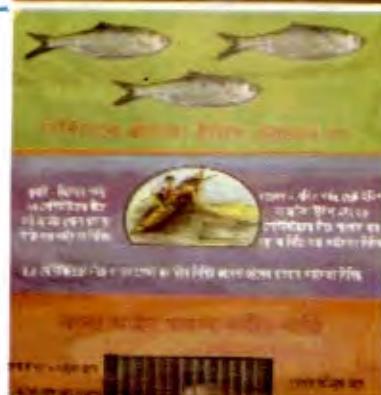
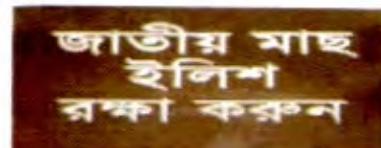
This is published from DoF. It is colored. It shows two pictures, harvesting under size fish, punishment for that. It is awareness creative poster.

2. Protect National Fish Ilish -

This is published from DoF. It is colored. The poster says two things with picture, not harvest zatka (small) Ilish, let them chance to give nutrient and money.

3. Culture Carp Fishes -

This is published from DoF. This poster says pictorial message from pond preparation to harvest. It is colored.



FFP

(P/D/02)

1. Fish fortnight – 2002

This is published from FFP, DoF. Here poster shows poverty can alleviate through fish culture and shows some picture like releasing fry, economically valuable fish. It is colored.

2. Women in aquaculture

This is published from FFP, DoF. It is colored and completely pictorial message. Here picture shows how women participate in aquaculture activities. This is very useful for semi-literate women.

3. May sanctuary safety habitat for fishes

This is published from FFP, DoF. The poster shows a sanctuary in a large waterbody and an extension worker briefing on sanctuary to the farmer.

4. Fisheries Village

It is a new concept for aquaculture who have pond in a village, they organized for training. The poster contain a slogan aquaculture in village create job and investment. This is colored and published form FFP, DoF.

PBAEP

(P/D/03)

1. Stock forty species per decimal

Poster express with pictorial messages more stock - more expenditure turns less production - less profit. Stock right number - less expenditure becomes more production - more profit.

2. Timely stock in pond

Stock right number, species and size in every layer. Acclimatize in hapa before stocking.

3. Timely and regularly fish culture become wealthy

This poster contains aquaculture activities with pictorial message. Here describe eight aquaculture management activities.



EXTENSION MATERIALS

Posters & Fish Cards



GNAEP

(P/D/04)

Seven posters have been developed by GNAEP in 2001 as a training & extension materials and distributed widely in the rural areas. Four posters are designed on pond aquaculture and project introduction i) Project objectives ii) steps of pond preparation iii) stocking and iv) supplementary feeds. Other three posters are designed on integrated prawn farming and natural fish conservation. All the posters are designed with four-color attractive photograph with simple extension messages.

IPM

(P/E/05)

Poster on beneficial and harmful insects:

1. Published by 'DAE-UNDP/FAO IPM Project' under Dept. of Agriculture in December, 1998, the poster in two sections snapshots on beneficial (spiders, lady bittle, carabid bittle, minidbug, demsel fly, microvelia, mesovelia) and harmful insects (*majra*, brown grass hopper, *pamri*, hymoneptera, thripes, *leda*, *gandhi*, *galmachi*). The poster serves as an instant source of taxonomic guide for farmers.

2. Published by 'DAE-UNDP/FAO IPM Project' under Dept. of Agriculture in April, 1998, the poster depicts on significance of conservation of beneficial insects, cultivation of resistant varieties (BR-25, BR-26, BR-27, BRI-27, BRI-28, BRI-29, BRI-31, BRI-32), adopting modern agro-fanning system, mechanical control of insects, and modest use of insecticides. The poster emphasises on the fact that adoption of IPM by farmers will lead to enhanced production and a pollution free environment.



Fish Cards

(F/D/01)

A set of fish cards is prepared for using farmers training session. The fish card set comprises nine species of carp fish and nine species of unwanted fish. Two sets of fish cards are distributed to each Extension Trainer for using in farmers training session.

EXTENSION MATERIALS

FlipCharts



GNAEP (Flipchart)

(F/D/02)

A colorful flipchart on carp polyculture with Golda in pond has been developed and distributed to the Extension Trainer. The flipchart illustrated with 29 pages on important of fish culture, pre-stocking, stocking and post stocking management. The flipchart is mostly using in farmers group training at pond site. It was published in January 2001.

BAEP (Flipchart-1)

(F/D/03)

This is a flipchart describing pond preparation techniques and fingerling stocking through picture and text. NGO staff trained by PBAEP use this flip chart during their target group training.

This is a 12 page flip chart. Each page contains A4 size colored picture and relevant text for the facilitator.



(Flipchart-2)

(F/D/04)

This is a flipchart on pond management. It includes regular fertilization, feeding, cash and non cash inputs, partial harvesting, disease control, dike cropping, poultry rearing etc. NGO staff trained by PBAEP use this flip chart during their target group training. Other service providers can also use this material.

This is a 12 page flip chart. Each page contains A4 size color picture and relevant text for the facilitator on the opposite side.



For more contact:

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Department of Fisheries
Danida Technical Assistance
College Road, Patuakhali
Tel: 0441-62169, 62098
Update December 2002

District Fisheries Office
Fire Service Road
Patuakhali
Tel 0441-62501

EXTENSION MATERIALS

Extension Kits and Games

Fishing Game

(EK01)

The objective of this game is for the players to learn which natural food items in a pond are favoured by commonly stocked species. Each player (maximum four) is given a card with pictures of five commonly stocked fish and a picture depicting their favoured food item at their head. In the "pond" (box) are placed identical individual pictures with a paper clip attached. The players attempt to catch a fish or food item with the magnet on the end of their fishing rod. The winner is the first person to fill their card with matching pictures of fish and feed. Each card has a slightly different combination of fish species to illustrate that some species feed on the same food item and therefore the stocking combination can be varied.



Ludu

(EK02)

Children learn more through playing a game than from just listening. This game was designed to help children understand the principles of basic pond management. The materials and playing procedure of this game are like the traditional "Ludu" game. Four children can play at a time. Each box on the board shows an activity and gives an instruction. Children play the game according to the instruction. It was observed that children enjoy playing the game very much. Children like to play with their friends and family members and through the game the simple sequential steps of pond aquaculture are passed on to other players.

Extension Kit for Nursery Owners and Fry Traders

(EK03)

This pictorial kit contains information on some basic steps of pond aquaculture viz- dewatering, eradication of predators and forage fishes, dyke repairing, stocking considerations, providing leafy vegetables for herbivores, assessing productivity, fertilization, pond dyke cropping and partial harvesting. Ten principles to be practised by an ideal fry trader have also been listed in the last page. Each page contains 5R picture and relevant literature, duly laminated and affixed. Published by Patuakhali-Barguna Aquaculture Extension Project in collaboration with DoF/CODEC/CARITAS/DANIDA, this tiny kit is suitable basically for small pond owners.



Extension Kit for Farmers

(EK04)

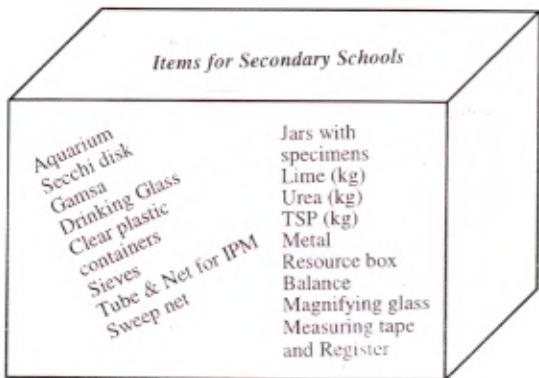


This pictorial pocket booklet contains information on pond aquaculture activities viz- dewatering, eradication of predators and forage fishes, dyke repairing, stocking requirements, providing leafy vegetables for herbivores, assessing productivity, fertilization, pond dyke cropping and partial harvesting. It also contains brief information on rice-fish integrated farming. This kit is enriched with small popular rhymes. Each page (2 1/4 by 4 inches) contains condensed picture and relevant literature. It is published by North-West Fisheries Extension project in collaboration with DoF/DFID. During the project period the booklet was sold to farmers by fry traders for a small profit.



EXTENSION MATERIALS

Extension Kits and Games



Resource Box

(EK05)

This resource box was developed in direct response to requests from teachers trained by fisheries projects. The equipment is simple and cheap yet can effectively help the teachers to practically illustrate the principles of pond management and Integrated Pest Management. It also gives students the opportunity to practice these skills during formal teaching periods and be able to utilise learned techniques in their domestic environment. NGOs have also found this equipment extremely useful for field extension officers involved in pond aquaculture and rice-fish extension.

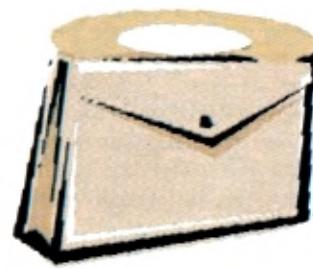
CtC Kit Box

(EK06)

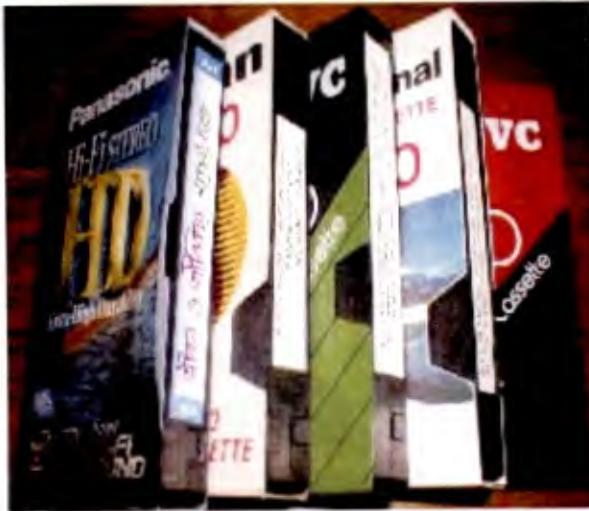
This is an essential resource for trainers of primary school children and complements the Child to Child trainer's manual. It enables trainers to practically deliver training of children in the basics of pond management.

Items for Child to Child Trainer's Kit

Plastic Jar, Seive, Colour pencil, Flash Card, Paper, Chalk (Pack), Newsprint, Bag, Ring Binder, Clip Board, Pen, Pencil, Line pad, Gamsa, Glass, Magnifying Glass, Petridish, Forcep, 4 Paper, A5 Card, Plastic Wallet, Urea, TSP



VIDEO



EEC-Tilapia Hatchery, Asian Institute of Technology, Bangkok, Thailand

(VD01-/E)

Intensive hatchery production of tilapia fry is described at AIT hatchery complex in Bangkok, Thailand. Morphological differences in broodfish are shown followed by a detailed description of spawning techniques used in brood-tanks and hapas. Egg collection techniques are shown prior to incubation in hatchery jars leading to fry rearing in trays, small octagonal tanks and hapas. All hatchery components and systems are shown and described.

This 45 minute video is very useful for hatchery operators with pre-requisite knowledge in hatchery production technology. However, the sound and picture quality is below standard worsened by excessive hatchery background noise.

Small Scale Fish Farming in North-East Thailand

(VD02-/E)

This is a 20 minute video about the traditional fish culture practices in the north-East of Thailand. It shows how farmers have developed indigenous low cost and low risk sustainable fish culture practices using locally made resources and integrating on-farm by-products. Interviews with farmers highlight and focus on some of the difficulties that farmers face with this type of production technology particularly stocking of small size of fingerlings and concomitant high mortality soon after stocking.

To overcome these problems early rearing of fry is conducted in hapas set in the rearing pond. All aspects of design and culture techniques are shown and narrated.

Although the video is narrated in English the concept of early hapa rearing can be easily understood by non-English speaking viewers. All types of technologists, researchers and most of all extensionalists would find this video very interesting and informative.

Fish Doctors to the World

(VD03-/E)

This is a promotional video made for the Institute of Aquaculture, Stirling University. Lengthy interviews with the Institute's director and deputy director are combined with scenes taken from the disease diagnostics laboratory, tropical aquarium and university fish farm and hatchery at Howietoun. Much of the discussion focuses on the status of aquaculture, problems faced by the industry, future of aquaculture and a lengthy description of the historical background of Howietoun.

It is professionally filmed and narrated in English. Sound and picture quality are good. Persons wishing to learn more about the Institute of Aquaculture, Stirling University and/or improve their knowledge of tilapia culture would find this video useful.

BAFRU Information Video 'The Culture of Carps in Bangladesh'

(VD04-/E)

A short 18 minute overview of carp culture in Bangladesh. The full cycle from hatchery production to grow-out is described, albeit briefly and ostensibly with referral to Indian Major carps (Catla, Rui, Mrigal & Calbasu) and Chinese Carp (Grass carp, Bighead carp, Silver carp & Common carp). The culture of carp is described in eight parts:- 1. Introduction of different carp species. 2. Polyculture. 3. Carp Breeding (weight, age and shape of the body). 4. Induced breeding (pituitary gland extraction, dosage, hormone preparation and timing of injection). 5. Hatchery operation (hatching time, collection and transport). 6. Pond preparation (Nursery and grow out pond). 7. Pond Nutrition (organic and inorganic fertiliser and supplementary feed) and finally 8. Harvesting (timing, method and expected yield).

The film is well presented and quality of high standard. It is suitable for non-fish culturists and all interested persons involved with fish culture new to Bangladesh.

A film about Tropical Aquaculture - In the Water are Fish

(VD05-/E)

This is a film about tilapia culture in Thailand. It is set in the north eastern part of the country which is the poorest part of the Thailand often facing hardships of long dry seasons and very wet rainy seasons. The tilapia is presented as an opportunity to improve rural livelihoods for the people of this region.

The history of the culture is described before detailing the species' feeding and breeding ecology. The techniques of breeding and culture are presented as well as marketing strategies and extension approaches practised. To improve production mono-sex culture is introduced with information provided about the gene bank set up in Stirling to provide 'genetically pure' strains for the promotion of this technology.

This video is ideal for those interested in basic tilapia culture and wish to learn more about fish culture practices in Thailand. The sound quality is good but picture quality moderately good.

VIDEO

Aquaculture in Bangladesh (DANIDA Support)

(VD06-B/E)

A 30 minute video narrated in Bangla specifically detailing the sequential steps of carp polyculture hatchery and grow-out cycles. These steps are demonstrated pond side by farmers and extension officers. The type of training conducted described and demonstrated covers eight topics:- 1. Rotenone application, 2. Predatory and weed fish control, 3. Use of lime and fertiliser, 4. Fingerling release methods, 5. Supplementary feed, 6. Compost Preparation, 7. Sampling, 8. Harvesting techniques. Interviews and feedback from farmers is given.

Fry production is also covered in this video through three main activities which are practically demonstrated:- 1. Injection of brood fishes, 2. Egg collection by stripping, 3. Hapa preparation for hatchlings.

Sound and picture quality is good. Ideal for extension officers and newcomers to fish culture particularly NGO, school teachers and bank staff. Since the language of narration is Bangla, farmers would also appreciate and learn from its content.

Documentary Film on Fish Culture Management

(VD07-E)

This film covered fisheries resource of Bangladesh and its management. Duration is 35 minutes and is in two parts. Part One leads with the contribution of inland water bodies, role of capture fisheries, importance of shrimp production and its contribution in national economy. The film also shows the constraints and opportunities of open water bodies, different traditional and mechanised fishing gears used by the fisherman in the Bay of Bengal, and fish marketing channels. This part ends by showing the risks and coping strategies of fishermen who live on the sea shore and impacts on their livelihoods.

Part Two introduces the fisheries resource of inland closed water bodies e.g. ponds, tanks, dighi etc. It also covers the importance of induced breeding in fish culture especially the contribution of hatcheries for extending the availability of fingerlings. The narrator highlights the importance of training in modern fish culture with references to outputs and practices of traditional fish culture. This film also briefly covers the steps of modern fish culture management, such as removing of aquatic weed, predatory fish, liming, stocking, post stocking fertilisation. Overall quality of this film is good and its intended target audience would be all levels working in basic aquaculture.

Folklore Opera on 'Save Fish, Save Your Country'

(VD08-B)

Produced by FEMCOM, the video of 22 minutes duration presents a case of classic example of how simple story-based artistic performance can leave an emotional impression on those who witnessed it. The video is based on the fact that a corrupt minister misguided the king with false information on the fishery and fishermen. He allowed some fishermen to use current net for clandestine fishing after being bribed by them despite the repeated request from so many corners. The shrewd people soon became rich and thus the economic condition of the professional fishermen began to decline. The king receive 'divine' sounds; he became aware and investigated into the matter. He caught the shrewd fishers and discarded the minister. At last, peace and happiness again started to prevail. The video is recommended to be presented on screen in open field for rural people with a view of growing awareness on sustainable use of fisheries resources.

Bangladesh Open Water and Flood Plain Fisheries and CBFM Activities

(VD09-B)

This documentary film of 30 minutes duration, produced by FEMCOM, is based on community based efforts of managing natural resources. The use of traditional fishing using crafts and gears by the fishermen is shown. The role of NGOs in organising, mobilising and building strong solidarity among the surrounding communities is demonstrated. The community's efforts in protecting the sanctuary and its significance in restoration of resources are documented. The common people, especially traditional fishermen of open water areas will be interested about the documentary.

Intensive Culture of Black Tiger Shrimp in Indonesia

(VD10-E)

The documentary is based on basic steps of intensive shrimp culture. The very high yields attained from this culture technique show how entrepreneurs accrue high profit at the expense of the environment. The documentary shows the methods of aeration, intensive supplementary feeding, managing day to day management problems, harvesting methods etc. The film is attractive for the entrepreneurs who are in a position to invest, although it might not appear to be appropriate to common farmers of Bangladesh. It requires a basic level of understanding of English and shrimp culture technologies.

Rice Fish Culture

(VD11-B)

This video attempts to cover too many topics. It is recommended that parts may be shown in any training intervention. The presentation starts by describing fish feeding ecologies especially species having a planktivorous diet. This leads to a demonstration involving fertilisers in jars to promote plankton blooms. This is well linked to the effect of pesticides, demonstration particularly pesticides (e.g. sumithion) that can have a devastating effect on insects, (both helpful and harmful) and plankton. The narration then moves to new topics; the spawning of common carp and tilapia so that hatchlings may be released in the rice field. The video may be useful for extension, workers technicians, and trainers.

VIDEO

Thana Fishery Officer's Development Programme

(VD12-B/E)

This is a 23 minute video intended for Thana Fisheries Officers who have a background in Aquaculture. The film is about a ToT course which focuses on training delivery techniques, technical information and basic extension concepts and principles. The technical session show a balance between theory and practice. Participatory training techniques are used in this course i.e. group work, role-play etc. This training is divided into three parts. Firstly, participants learn about how to conduct target group profile (TGP), training needs assessment (TNA), session preparation and visual aids preparation. Secondly participants are divided into two groups so that they practice session delivery among themselves and provide feedback. Finally, they conduct TGP & TNA and delivery session with a real farmers group which is evaluated by the trainer. Other contents covered through this course are communication, work plan & programme, maintain training file and technical information i.e. feeding, fertilising, natural food observation, stocking, harvesting and marketing.

Aquaculture and Rural African Farmer. ICLARM/ GTZ

(VD13-E)

A two part 35 minute video made in 1990 by the department of Fisheries Malawi sponsored by ICLARM and GTZ. The first part (25 min.) describes the participatory and collaborative research program undertaken at the National Aquaculture Centre, Domasi, Malawi. A range of eight different technologies are being developed at the centre. These are described by the researchers involved: i) Performance of fallow grasses (*Uapir sp.*) as feed and fertiliser in pond systems, ii) Development of terrestrial composting as a pond input, iii) Use of wood ash as a lime replacement, iv) Improved rice-fish systems, v) Use of a reed fence instead seine net, vi) Development of indigenous species for culture e.g. *Oreochromis karongae*, vii) Improved dike cropping with vegetables, viii) Development of 'FishBase', a database for African fishes. The value of farmer open days to improve farmer participatory involvement in the research is highlighted.

For the second part of this video, farmers and researchers demonstrate Pictorial Modeling of Pond Systems. This allows researchers to elicit indigenous knowledge to show resource flows in farming systems. Three phases are demonstrated, 1) Farmers conceptualise the model of their farm, 2) Elaborate inputs and linkages with actual objects, 3) Complete outputs from the system.

This video will be useful to junior fishery and extension officers, undergraduates and researchers seeking to develop new ideas for research and extension approaches. In some parts, the picture is not clear and sound from interviewees is occasionally indiscernible. Otherwise, a good insight into the Malawian fish culture scene.

Understanding Rural Livelihoods on Bangladesh Floodplains

(VD14-E)

In the past there has been a tendency for rural development to be driven by sectoral or single commodity approaches with the aim of increasing production. Since this does not always equate with positive livelihood outcomes, greater understanding of the complex systems and interdependence are needed. The holistic sustainable rural livelihood approach attempts to address this need for pro-poor growth policies and integrated initiatives to equitable and sustained development. This video examines how this approach can be better understood by reviewing the livelihoods on Bangladesh floodplains.

The livelihoods of four different groups are described in detail through the three main seasons of a floodplain in Bangladesh. These groups are i) fishers, ii) landless iii) sharecroppers and iv) wealthy landowner. The descriptions of their strategies and inter-dependencies are aided by contributions from the representatives from these groups.

Contributions from experts in rural development on how the understanding of these different livelihoods can assist in planning and monitoring of development programmes complement the descriptions of the different stakeholder groups.

Seed of hope

(VD15-B)

A documentary film has developed basically focussing the prospect of prawn farming in greater Noakhali area namely "SEED OF HOPE" in June 2002. 17 minutes length this documentary captured the movie shots of existing problems encountered by the farmers due to waterlogging of vast agricultural land in the area. The film also tried to illustrate the opportunities available for the farmers for addressing the problems through rice-prawn and rice-fish farming. This documentary film also focused the extension or farmer education strategies undertaken by GNAEP to support the farmers by filming the ongoing project activities to address the issue.

VIDEO

Wind of Change

(VD16-/B)

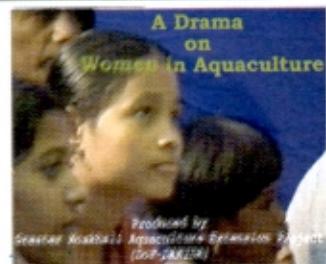
A documentary film focusing the people participation in the program initiated by GNAEP as livelihood option for char dwellers of greater Noakhali area. This is a 10 minutes film contains the major strategies following by the project to comprehensive support the poor household for enhancing wider adoption of rice-fish or rice-prawn suitable for local char area. Project believes that undertaken support will empower poor people to increase household income to meet up their livelihood needs and raise their voice. It is published in January –2003



Women in Aquaculture

(VD17-/B)

A drama has been produced on women in aquaculture. The main theme of the drama to aware and motivate the rural women to active participation in aquaculture. It is also focusing the empowerment of women and women participation in development activities. It is an about 1-hour drama and played by a local drama group. It is produced in September 2001.



MIS DATABASES

(Developed by FTEP-2)

Training Information Management System (TIMS)

(TMS/D/01)

The Training Information Management System (TMS) is developed as a part of the development of the Management Information System (MIS) for HRD/M process of the Department of Fisheries (DoF). It deals with the overall human resource development/management activities of the department. TMS consists of three independent sub-systems: Training Need Assessment System, Training Database System and Monitoring & Evaluation System. An user manual has been developed that covers complete instruction for operation of the systems.



Training Need Assessment System (TNA)

As the title suggests this system may be used to assess employee training need. To this end, detailed personnel information including training histories of all registered personnel are maintained. If the information is kept update trainee population lists may be compute generated automatically. In addition to identifying need, the system may also be used to determine suitable resource persons and specialists for specific courses. A number of customized reports are generated from the system using multiple selection criteria for filtering data. Also customization options have been kept so that it can be implemented with other organizations.

Training Database System

The Training Database System is used essentially a performance management tool to evaluate the course content, session and participants of the course. It is useful to improve to course module according to the feed back given by trainers as well as the participants. The System makes comparative analysis of course budget and trainee performance within and between the training centers and courses. A number of customized reports are generated from the system using multiple selection criteria. Some of the main reports are; participant list, course evaluation report, session evaluation report, cost analysis, grade analysis, training summary report within course and between training centers and so on. Customization options have been kept as like as the TNA system so that it can be implemented with other organizations.

A screenshot of a Windows application window titled "TDS - Faculty - Course Information". The top section shows course details: "Course Name: T22 Agriculture", "Training Venue: T110 C Faculty", "Sharing Date: 22/01/07", "Duration: 5 days", "Total Participants: 14", and a checkbox for "DMPDS Course". Below this are tabs for "Trainee & Expenditure", "Course Information", "Problem Analysis", and "Session Trainee". Under "Trainee & Expenditure", there are two dropdown menus: "STEP-II Trainers" and "Divisional/Other Trainers", each listing names. Under "Expenditure", there are fields for "Management Fee", "Allowances", "Materials and Equipment", "Transport", and "Relief Allowance", each with a corresponding input field. At the bottom, there are buttons for "Add New Course", "Participants Information", and "Close". Record navigation buttons are at the bottom left, and a status bar at the bottom right shows "Record: 111 of 129".

Monitoring and Evaluation Database System

A screenshot of a Windows application window titled "Evaluation Form by TFO". The top section says "Evaluation of AFO/FA monitored by TFO". Below is a table for "Session Score" with columns A, B, C, D, Total, and Percentage. The table shows values: Score (22, 24, 29, 56, 131), Percentage (73.33, 80.00, 82.86, 86.15, 81.88). Below the table are sections for "Details of Evaluator and Trainer", "Evaluator Address e.g. FTEP-II Centre or District/ Division HQ", "PGTS Details", and "Group Address". There are dropdown menus and input fields for each section. At the bottom are buttons for "Add New Record", "Close", and record navigation buttons.

The M&E system is used to evaluate the training delivery performance of the trainers. It is particularly useful to identify the strength and weakness of the training sessions and topics delivered enabling concomitant action from the training team and also identify the individuals that are competent trainers and those that require further monitoring and support. The system covers the trainers as well as evaluators information and also some monitoring characteristics for sessions of the training delivered. A number of report modules have been implemented in the system with a multi-select criteria form. Some of the main reports are; trainer performance, trainer list as per scoring level, lacking identification, score analysis by station, variance analysis for measuring the variation of score given by different evaluator in different time and so on.

MIS DATABASES

(Developed by GNAEP)

Baseline Pond Survey Database in Greater Noakhali:

(FMIS/E/01)

This is an MIS database developed for storing baseline information of all pond and ditches of GNAEP working area before project intervention. The database covered pond owners/operators address, physical condition of pond, fish culture practices and overall pond management systems. Fourteen numbers of report were generated for 14 upazilla based on the information from this database. This database is mainly used for target group selection, pond selection and feasible area selection for project intervention and also the information will be used in future

Database on Market Price of Fish in Greater Noakhali:

(FMIS/E/02)

This database is mainly used to store fish price in different market under project area in different months. From March 2001 to till date information on 14 upazilla market are available in this database. The main areas of information stored in this database are, price of different size of fish by species, sources of fish comes to the market, other substitute commodities (Meat, Egg, Dry fish etc). This data is using to monitor the price fluctuation of fish in different seasons and the reasons for price fluctuation. And also the immediate effect of GNAEP intervention on local fish market.

Farmers Database:

(FMIS/E/03)

This database is mainly used to store and process ongoing activities of Fish Farming Group (FFG) and the group members. The main areas of information stored and used in the database are; Group name, address, and formation date, weekly meeting days, savings rate, nos. of male and female members of the FFG, basic information of the FFG members like as age, landholding, pond/field area, pond ownership, housing condition, occupation, annual HH income, health care and sanitation status of members HH.

Baseline Socio-economic Survey

(FMIS/E/04)

This database is used for store and process the socio-economic baseline information of sample farmers under project working area from different strata. The main areas of information used in the database area, farmers basic information (name and address, age, sex and education etc.), Socio-economic information of the HH, culture, management, production and cost benefit of different agriculture and non-agriculture enterprise of rural HH, health and sanitation facilities, nutritional status. A final analytical report is under process which is prepared by the Winrock International. The database will be very use full for project monitoring purpose and also useful for future impact evaluation.

CD-ROMS



Contents

FTEP-II

(CD/D/01)

- ◆ 37 Course Modules
- ◆ A 4- sets Leaflets
- ◆ 109, Flashcards
- ◆ 11, Extension Packs
- ◆ Photo/Image bank
- ◆ Full Catalogue
- ◆ MIS Database
- ◆ Newsletters up to 2002, 2001, 2000 1999.

BAFRU

(CD/D/02)

- ◆ Training Manuals
- ◆ Leaflets
- ◆ Technical Handbooks
- ◆ Image Bank
- ◆ Reports

PBAEP

(CD/D/03)

- ◆ Training Materials
- ◆ Leaflets
- ◆ Handbooks
- ◆ Pictures
- ◆ Reports

NFEP-2

(CD/D/04)

- ◆ Monitoring & Evaluation Database
- ◆ Leaflets
- ◆ Course Manuals, Leaflets
- ◆ Pictures
- ◆ Research/Technical/Project/
- ◆ Survey Reports
- ◆ Microcredit Prog. Report
- ◆ Model Village Program

GOLDA-CARE

(CD/D/05)

- ◆ Report
- ◆ Technical Handbooks
- ◆ Training Modules
- ◆ Images/Photos
- ◆ Monitoring & Evaluation System

CAGE-CARE

(CD/D/06)

- ◆ Images/Photos

How to Order

Fill in the catalogue order form and send to any of the three addresses shown below. You will be contacted when your order is complete. Make your own arrangements to collect the materials along with the necessary payment. Please note that the CD-ROM contains all the materials except videos and games.

Department of Fisheries

Matsya Bhaban, Shaheed Capt. Mansur Ali Saroni, Ramna, Dhaka

Deputy Director, Aquaculture, Department of Fisheries

Deputy Chief, Training Cell, Department of Fisheries

Library, Department of Fisheries

ERRATUM

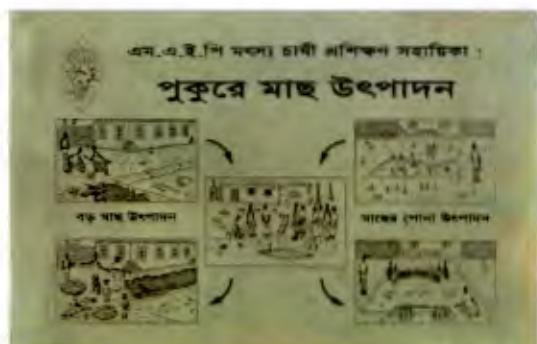
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MAEP Fish Farmers' Manuals - Fish Production In Pond

(HTM/D/32)

The booklet has been elaborated for farmers of different social, economic and environmental background in order them to become technically sustainable and successful on profitable pond fish culture after training. It is very useful and informative for both the trainers and the farmers, which during and after training remains with them for future reference. Since the farmers are mostly illiterate or semi-illiterate it contains explanations with short texts and about 450 illustrations easy to depict the aquaculture principles and process. In this process a farmer could understand and follow the techniques even if she/he cannot read it. The training materials thus produced can be taken as an ideal one and can be followed by any aquaculture extension projects.

The booklet provides for both understanding and know-how of pond fish culture in general and table fish and fish seed production in particular. It contains all of the most frequently applicable/used intensive fish seed and environment friendly extensive, semi-intensive and intensive table fish (and Golda) production patterns (about 40 different choices), as well as provides detailed guide how to plan, follow up and evaluate fish production in pond both technically and economically. (It was first published, both in English and Bangla, in the present consolidated form in 2002.)



Trainers' Guide for MAEP Fish Farmers' Manuals - Fish Production In Pond

(HTM/D/42)

MAEP aimed that its trainers on pond fish culture would become fish culture subject specialists on farmers' level, which is considered as a very prestigious social and technical status in the rural society. The best chance for gaining improved social appreciation of trainers and their activities is to improve their creditability by removing possible sources of failing as trainer or/and subject specialist. Considering that the one of the most obvious way of doing so is improving their technical knowledge and training and advisory skill the present booklet has been elaborated.

This booklet is a complete trainer's guide, providing overall information how to conduct participatory group training on pond fish culture, as well as how to perform professional pond visits. It also contains a detailed list of standard field equipment of trainers and needed/useful measurements and calculations. (It was first published, both in English and Bangla, in 2002.)

MAEP Knowledge and Adoption Test of Trainers, Surveyors and Farmers - Fish Production In Pond

(HTM/D/43)

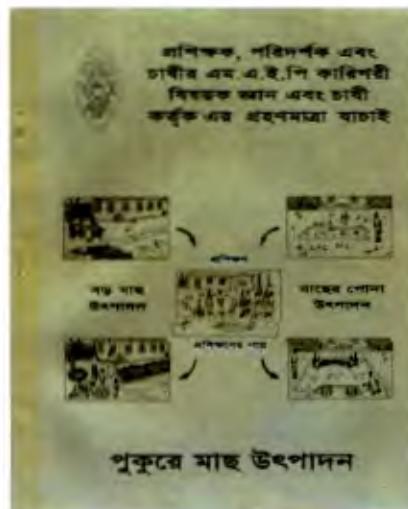
MAEP has designed and made an overall technical curriculum for pond fish farmers, then has completed the relevant teaching book for the farmers/trainers, as well as the trainers' guide presented above.

This third part of the overall training package on pond fish culture has been elaborated in order to provide uniform guidance and criterions to verify the knowledge of both trainers and farmers, as well as how and in which extend the farmers have adopted the received technical knowledge. Accordingly there are three main chapters in the booklet.

The first chapter is the knowledge test of trainers, while the second one is the knowledge test of farmers, which is recommended being done in a participatory manner, giving chance to the farmers to give account about their knowledge in group.

The third chapter of the booklet is the adoption test in order to assess whether and how the farmer uses/applies the received technical knowledge on pond fish culture. As the objective of the pond fish culture is to produce fish, the adoption test concentrates on this prime objective.

Accordingly direct and indirect indicators, already known from the pond visit section of MAEP Trainers Guide, are listed and suggested being used in order to assess whether the fish production is proportional to the intention/plan of the farmer. (It was first published, both in English and Bangla, in 2002).





Cast Net Making, Repairing, Preservation and Traditional Fishing Gears in Bangladesh (HTM/D/44)

This manual, illustrated with about 60 pictures and the required diagrams, has been designed and elaborated for both trainers and interested farmers in order to provide the technique of cast net making, maintenance and preservation. Accordingly the different types of preservation techniques, preservatives, materials with specifications are detailed in addition to the know-how of cast net making.

Even if traditionally the fisher communities of Bangladesh know the technique of cast net making, this manual, first of its kind, aims to provide a systematic knowledge for those, who do not belong to these communities, such as women of households, where pond fish culture is practiced.

Therefore the manual is both an ideal training guide and systematic information kit, which actually enables those being successful in making and preserving cast net, who would do this either for own use or as an income generating activity.

The manual also contains the illustrated inventory of traditional crafts and hand made gears, which are widely used for fishing in rural Bangladesh. (It was first published in Bangla in year 2001).

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In addition to the HRD MIS Databases, FTEP-2 has also developed a number databases for Monitoring and Evaluation of Farmer Training-

1 Extension Management

- | | |
|----------------------------------|-------------|
| 1.1 Farmer Training Database | (FMIS/D/05) |
| 1.2 Payment Database (DoF) staff | (FMIS/D/06) |
| 1.3 Farmer Baseline | (FMIS/D/07) |
| 1.4 Impact Assessment | (FMIS/D/08) |
| 1.5 Post Training knowledge test | (FMIS/D/09) |

2. FTEP-II Programme Specific Databases

- | | |
|-----------------------------|-------------|
| 1.1 Credit survey | (FMIS/D/10) |
| 1.2 Fish disease | (FMIS/D/11) |
| 1.3 Pre-School | (FMIS/D/12) |
| 1.4 School & Child to Child | (FMIS/D/13) |

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Patuakhali and Barguna Aquaculture Extension Project (HTM/D/34)

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IPM (Integrated Pest Management) (LF/E/11 & LF/E/12)

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CtC (Child to Child) Kit Box (EK06)

Blogs

1. How to Start a Cow Agro Farm in Bangladesh at a Low Investment?

Being financially independent will always give you a different pleasure. Whether you are doing any job, running a grocery store, clothing store, poultry farm, or even a cow agro farm.

Are you thinking of starting a cow agro farm and your investment is low? If yes, you are going to love this article because here we'll discuss how to start a cow agro farm in Bangladesh at a low investment.

Is Cow Farming Profitable in Bangladesh?

Bangladesh has around 15,00,000 cow farms across the country. According to the Department of Livestock Service's direct-general Abdul Jabbar Sikder on 10th January 2021, of these farms, only 6 were of a large scale.

Our deshi breeds of cows are low in yield and give around 2 to 5 liters of milk each day. If you can develop new breeds of cows, they will be able to offer even 14 to 15 liters of milk each day. Research says that the weaning rate is estimated at 85 percent means that you can expect that a calf can be weaned and sold from the cow's 85 percent. Depending on these assumptions and after making adjustments for this weaning rate, calf revenue on average is around BDT 57,797.

The farmers get the total amount of food for their cows at a quite high rate. So, the production returns on cow farming in Bangladesh are not extremely profitable. Still, the domestic milk price is quite high in this country which makes cow farming on average profitable.

Again, the annual demand for meat (including cattle and poultry) consumption in Bangladesh is 7.3 million tons. Bangladesh even exports the surplus of its production. According to Bangladesh Meat Trade Association's President Farid Ahmed, Bangladesh can earn BDT 60,000 to BDT 70,000 crore each year by exporting bones, meat, entrails, leather, and horns abroad if cattle are reared well and the products are processed in the right manner.

So, as a whole, you can call cow farming in Bangladesh profitable.

How to Start Cow Agro Business in Bangladesh: Step by Step Guide

No matter whatever business you are going to perform in Bangladesh or any other country you need to know these basic things for sure:

- What do you exactly want to do?
- How you are going to do it? and
- Let's have a look at the following discussion to get an idea of how to go ahead with your dream of starting a cow agro-business in this country.

1. Business Plan:

You may think that starting a dairy farm won't require that type of business planning. But the reality is something different because whatever business you are going to do, you need to have a business plan. This plan will serve you as a road map that you can follow and also present to investors if you require any funding help.

The business plan needs to consist of the below-mentioned sections:

Company Overview- It will inform your cow agro farm's history and what kind of cow agro farm you run. For instance, is your farm calf cattle, dairy, or beef farm?

Executive Summary- It will give a summary of your whole business plan so anyone reading this can easily understand your cattle farm's main details.

Industry/Market Analysis- Here, you need to keep the main information regarding the cow agro-industry. Perform market research. Then note down the size of the industry, the current trends that can affect the industry, strengths, weaknesses, opportunities, and threats of this industry.

Customer/Consumer Analysis- You will figure out here who will be your target or ideal customers, and keep all the relevant information about your target or ideal customers, and also their demographics. For instance, what's their age? Where are their living places? What's important to them while buying such products that you are going to offer?

Competitor Analysis- You are going to note down your indirect and direct competitors here and the way you will develop a competitive advantage.

Marketing Plan- In the marketing plan you need to address the following 4Ps:

Ø Product- Decide and include what services/products you are going to offer.

Ø Price- Note down the prices of your services/products.

Ø Place- It will inform your business location and also the way it will help your business to enhance sales.

Ø **Promotions-** You will document the promotional methods you will apply to draw consumers to your cow agro farm. For instance, you can like to apply public relations, leaflets, social media marketing, search engine optimization, pay-per-click ads, and the like.

Management Team- This part will contain your farm's management team's background.

Operational Plan- You will decide here, your main required processes to operate daily operations. If you need any staff, you will also note it down here. Most importantly, you will develop an expected growth timeline displaying your desired milestones in the future.

Financial Plan- Last but not least, your financial plan will answer the following questions:

Ø What will be your incurred startup costs?

Ø How will the farm generate money?

Ø What will be the projected expenses and sales for the coming five years?

Ø Do you require raising funds to start your business?

2. Choose Your Cattle Farm's Name:

Choose a suitable name for your business that is memorable and meaningful. Consider following these tips:

- **Available**- Check out whether the name you like is available or not i.e. check the name against the list of registered names of businesses in your state. It means checking whether anyone has already used the name.
- **Simple**- Keep the name simple. Generally, the most appropriate names are simple to pronounce, spell, and remember.
- **Marketing Theme** Choose a name that represents your business or the cattle farm.

3. Have a Thorough Market Research:

Market research is quite a lengthy process that requires a lot of effort. Many companies are available on the market that can do this research work on your behalf. It will cost you some money but can accelerate your business starting process.

You also have the option to do it yourself. Doing it will help you understand the process from the root level.

Ask yourself what your product will be. Is it going to be cattle meat or milk? After settling your product, search your focused market and your targeted buyers. Perform a SWOT (strengths, weaknesses, opportunities, and threats) analysis of your business concept.

Let's make it easier for you. Suppose your product is milk but your area doesn't have enough dairy industry or local demand. This situation will create the hassle of transporting it to other places, thus making your cost increase.

Again, when it comes to beef, there is always some local demand. Except for some religious reasons, some people don't have beef, but that's quite rare.

While milk production is also a year-round business if the market demand is there.

4. Know The Challenges You Will Face

We have already discussed the profit and potential, but knowing more about the challenges is also vital. Because when you know about the problems, you will be prepared enough to tackle them. Thus, your cow farm will become more sustainable. Common issues that you will probably face are-

- Sudden price hike of cow foods

- Unstable economic conditions after the pandemic
- Changing market situation of supply and demand
- Inflation
- Cattle health issues and diseases
- Extreme weather conditions and calamities
- Reduced price of cattle, especially on different occasions
- Unwanted situations like war, political unrest, etc.

5. Make Your Budget Thoroughly

You always need to keep the budget in your mind. Because the budget is the main fuel for a business whether it is service or product based. Starting any business requires initial capital. But this is not the end. You will have to bear a lot more cost than that of your initial capital. Affording a day-to-day cost needs plenty of money.

Now you can ask what's the budget. It's really tough to answer because it'll depend on you. 10 lacs taka is a good amount for starting a small cow farm. It's also possible to start with less amount. What are those costs and where will your budget be spent?

- Building house for cattle
- Buying the cattle
- Cow food cost
- Food and water feeding accessories
- Veterinarian fees for regular check-ups
- Vaccines and medicines cost
- Pasturing land cost

There will be some other small costs for you like an electricity bill if it's there. A cow weighing around 200 kg can consume the feed that is worth 6000-7000 taka. While budgeting, make sure that you are counting all kinds of costs even if they are a few pennies. And keep the money inflation in mind as the global economy is rapidly changing due to the pandemic, and other unwanted situations such as war, political unrest, and the like.

6. Sourcing The Budget

You might have some savings of your own. If it's not enough then how will you get your capital? This is probably the first thing that comes into mind while starting a business especially if you are lacking in monetary issues. In that case, you might need a loan.

Banks can be good sources of loans but they charge a high-interest rate. They have also less flexibility towards the debtors. So, you need to try to collect loans from your friends and family, NGOs, and local co-operative society. These options will be far better for a small entrepreneur than financial service providers like banks.

How to Take Bank Loans?

But if you can't manage the budget from easy sources then you have to come under the shed of banks and financial institutions. You might be thinking about the difficult procedures of taking bank loans. Wait, don't panic. Let's discuss the basic documents you will need to take a bank loan-

- National ID Photocopy of both applicant and guarantors.
- 2 copies of a recent lab-printed passport size photograph
- 1 copy of a recent lab-printed passport size photograph of the guarantor
- Copy of recent Tax Return / Income Tax Clearance Certificate/ the Applicant's Tax Acknowledgement Receipt (for loan amount exceeding Tk.5.00 lac)
- Bank statements of 6-12 months
- For job holders, a salary certificate from the authority
- For businessmen, valid trade license for the last two years and income statement.

For House / Flat Owner, Electric Bill / Gas Bill / Municipal Holding Tax Receipt/ Mutation Parcha/ Rent Receipt in the name of the applicant/spouse/parents.

7. Search for an Affordable Location

You can make a cow shed anywhere if you have the capital. But here, we are providing guidelines that how you can start a cow agro farm with low investment.

Lands and properties usually are very costly in urban and developed areas. Of course, these kinds of places are better as electricity, transportation and communication are easier.

But it's not your cup of tea because you have a low investment. Try going to rural villages and different remote areas to find cheap places to build your cow shed.

If you can buy land, that will be great. But what if even the cheapest land is not meeting your budget? No worries! In the villages of Bangladesh, you can get some great land leasing offers and they are actually very much affordable.

Depending on the area, terms and conditions can be different but most of them are pretty buyer friendly.

You can save a lot of money by leasing land rather than buying one. It'll enable you to spend more on other required fields.

At this point, my suggestion would be to lease land. To be honest you won't be able to buy one with that small amount.

8. Choose Your Cow Agro Farm's Legal Structure

Choose your farm's legal structure whether it's a sole proprietorship, LLC or Limited Liability Company, Partnership, and the like. All of these legal structures have their own terms and conditions. You need to study those well.

9. Register Your Cow Agro Farm Under NBR

You have to register your farm for tax at the Zonal Taxation Department, that's under NBR or National Board of Revenue. You will get a TIN or Tax ID number for your business from there. It won't cost you anything and take around four days.

10. Open Your Farm's Bank Account

It's crucial to get a business bank account in the name of your cattle farm. This is a simple process and consists of these steps:

- Find out and contact your desired bank.
- Collect and submit the needed documents (usually, consisting of your business's Articles of Incorporation, NID or passport, or driving license, and address proof)
- Fill up the application form of the bank and give all required information.
- Consult a banker if you want to discuss the business needs and develop a good relationship with her/him.

11. Arrange the Needed Permits and Business Licenses

You will need some permits and licenses to operate a cow agro farm legally such as zoning permit, a business license, the animals' health certificates, and a slaughterhouse operating license.

12. Lease or Purchase the Exact Cow Agro Farm Equipment

Your required equipment depends on your farm's size, facilities, and cattle types. Some of the basic equipment can be water troughs, feed troughs, cattle prod, and fencing so that your cows wander here and there out of your property.

13. Build The Shed Accordingly

Making a good cow shed is important because your investment will grow in this place. A cow's house is often known as a shed. Before building the shed, you have to decide how many cows and which breed you are going to collect. Because different breeds require different amounts of space.

For example, the local Bangladeshi cow is not very big in size whereas some foreign breeds can be double or triple in size compared to a local one. Even the environment has to be suitable for cows. Otherwise, they won't produce the expected result. If the temperature of your selected place is high or cold than required, you have to ensure that building materials help you to neutralize the environment. If the location is prone to natural disasters or any other kind of calamities, take every precautionary measure like stocking foods, and medicines. In Bangladesh floods and cyclones are quite common. Therefore, a house made with brick and cement sheets will be safe for cows. Especially, the foreign breed will require more care and a healthy environment. Though Bangladeshi breeds are habituated with our weather and do not need special care.

14. Select The Suitable Cattle Breed

Every breed has its own features, food habits, offspring, and, pros and cons. This part is a little bit tricky for you as there are a lot of breeds in Bangladesh.

Bangladesh has a good amount of cross-breed cows but their pedigree is tough to know. Because the farmers don't keep pedigree records. But still, it's possible for you to define their breed by observing cattle's outlook and features.

If you don't have a lot of investment but you have the knowledge, then you are good to go. Otherwise, a huge investment with little knowledge can spoil everything.

There are many local breeds including Pabna Cattle, North Bengal, Red Chittagong, Mirkadim, Sahiwal, Sindhi, Holstein Friesian Local Cross, etc. Basically, they are not that local, most of them are cross breeds

Start learning about local and international cow breeds. Some are good for meat production, while others are for milk. So, decide what your product will be on this cow farm.

If you start an agro-business without having the exact knowledge of the market of the selected product, your business will collapse in a short time.

15. Managing Ranching Fields

Providing the cows with some ranching fields will be quite a good addition to your farm. Pasturing is good for cattle health. Though it is not mandatory. There are many farms where cows are kept inside the farm for lifelong. You can grow some high-quality grasses, hays, and other food grains for the farm which can substantially reduce the food cost. Nowadays, a couple of grains can simultaneously be planted in one land. Try to learn those methods and techniques.

16. Turn Waste Management into Profits

While cows eat a lot, they also produce a good amount of waste. Cleaning is very important because of biosecurity.

In an agro farm, waste can be recycled and it can help to increase your profit. Cow waste is used for making various bio compost. It is quite useful for increasing soil fertility. Bio compost also has a huge demand in the market.

If used properly, it can be a profitable side business for you.

17. Regularly Consult a Veterinary

No matter how small your farm is, it's precious to you because you've made an investment. So the motive will always be profit. Diseases in cattle farms are highly contagious and sometimes fatal too. Animals don't show their symptoms at the beginning. When it's visible, the damage is already done. Therefore a regular check-up by a veterinarian doctor is required. All the vaccines and medicines should be given to the cattle accordingly by discussing with expert veterinary. Take every precautionary measure to prevent diseases and maintain the highest biosecurity. In Bangladeshi villages, there are many people who provide treatment to cattle and poultry. They are not certified veterinary. They just somehow manage a crash course experience and start treating animals. It is very much common that

mistreatment is killing household animals. Try to stay away from those inefficient people. Though they can solve some basic problems, there are always some risks while working with them.

18. Keep Your Income and Expenditure Updated

You have to keep all your income and cost on a daily basis. Those days have gone when we used to write down those account-related things. Things have changed. Some software are available now that you can use to track your accounts.

[HishabPati](#) is an awesome software that helps you keep records of your business expenditures and income.

19. Ask for Local Experts' Advice If Needed

If you search, you will find many local agro farms in your area. All of them may not be large cattle farmers but still, they can help you with some knowledge and experience. If you find a local expert agro businessman, then it will be a blessing. In Bangladesh, most village people have cattle. Though the quantity of cattle is few, you can get a rough idea from them. Talk to a few families about their experience with cow rearing and milk production.

20. Ready to Start

Now, you are ready to start your cow farming. Just follow these mentioned steps and you can achieve your desired success.

21. Work Hard and Stay Hopeful

You don't have huge money and resources. What you have is hard work and hope. Things don't go always according to plan. Don't get upset if things don't go well. Be patient and work hard, success will come eventually.

Final Words

Starting a business can be difficult and overwhelming. When you are trying to start a cow agro farm, things are also the same and you can face many unknown difficulties. Most importantly, when you will start a real one you will find a lot newer pros and cons. After reading this in-depth article, you must be confident about how to start a cow agro farm in Bangladesh at low investment. So, with this confidence go ahead and start your cow agro-business right now. Best of luck!!!

What is Agro/agricultural businesses in Bangladesh

What is Agro/agricultural business means and how to do Agro/agricultural businesses in Bangladesh are the two most significant question that requires a brief discussion and instruction which can be understood from the layman's perspective. In the light of which we can define the term "Agro", which is extremely broad and lacks a proper definition and it is inclusive of a lot of different kinds of businesses. Let's say for example, the regulatory compliance or applicable laws can be different for a seed importer than any other businesses which deals with fertilizers.

Therefore, in the following discussion, the focus shall be mainly on the agriculture side of things. Agro-business/Agribusiness is the business of agricultural production. Bangladesh is an agriculture-based country. Even though the essence of agriculture here has changed quite a bit over the last two decades, the focus remains the same. Whether it's the rice on the paddy fields or growing fruits and vegetables, the knowledge, the techniques and the structure of business have expanded rapidly.

Agriculture was a family business not too long ago. Now a days, automation, scientific advances and better transportation have allowed for industrialization of this ancient occupation. There are lots of factories growing up catering to the agriculture industry. With these advances, the updating of the legal requirements also become of paramount importance. The type of crops that were cultivated have changed significantly and most farmers have different kind of yields at different times of the year to make sure the fertility of the land is not compromised. Department of Agricultural Extension under the Ministry of Agriculture plays a major role in maintaining the agribusiness in Bangladesh.

LICENSES AND REGISTRATION PROCESS FOR AGRO/AGRICULTURAL BUSINESSES IN BANGLADESH

Before addressing the license and registration requirement for businesses involved in agriculture in Bangladesh, one needs to understand the type of agricultural business that they are involved in. For an example a farmer may not need any business license for harvesting in general. However, any businesses that are involved in production, import, sell, marketing, management and storage of fertilizer and/or seeds may require to comply with certain types of laws and regulatory compliances in Bangladesh.

As everything is more digitalized and farmers are being brought more under surveillance by the Government, the requirements for license and registration have increased.

Fertilizer

Fertilizer is an essential product in the agriculture industry. The production and distribution of fertilizer cannot be done without the required registration as mentioned in the Fertilization Management Act (2006) read along with Control of Essential Commodities Act 1956. There are several prescribed forms under the Fertilization Management Rules (2007) for, as follows:

1. Production of fertilizer
2. Import of fertilizer
3. Collection, marketing, transportation and selling of fertilizer; and/or
4. For renewal of registration.

When the forms are submitted along with other required documents regarding the type of fertilizer, the scheme of investment, necessary test results, other documents such as Trade License, Tax Identification Number (TIN), Value Added Tax (VAT) Registration certificate are also required to acquire the license from Department of Agricultural Extension.

Seed

As per the Seed Act (2018), any person willing to be the dealer of seeds, cannot do the business without the requisite registration from the Seed Certification Agency. The application shall be done as per the prescribed rules and registration requirements in the Seed Rules (1998). The registration for seed dealership also requires Trade License, TIN and VAT Registration certificate as pre-requisites.

The concept of plant quarantine has been introduced to make sure that there is no pest infestation or spread of diseases while the international trafficking of plants and such related and scheduled organisms take place. For quarantine of plants, the main requirement is the registration for import and export, but this is not covered

exclusively by the general Import Registration Certificate (IRC) or Export Registration Certificate (ERC) used in Bangladesh. The importer must also apply to the National Plant Quarantine Authority to obtain the necessary license for import of plants or plant products as prescribed by the Plant Quarantine Rules (2018). Similarly, for the export of such plants, the exporter must apply for the Plant Health Certificate from the authority before they can export a plant or plant product.

Pesticide

Pesticides have become a necessity in agriculture, from paddy to fruits and vegetables. All sorts of crops require some sort of pesticides to protect it from insects and pest infestations. For the import, production, re-production, packaging and re-packaging of a pesticide, the brand of the pesticide has to be registered as per the Pesticide Act (2018). Also, a license must be obtained from the Department of Agricultural Extension for the commercial marketing, sale and advertisement of the pesticide along with the import, production, packaging etc. as prescribed by the Pesticide Rules (1985).

General Requirements

With regards to all the above registrations and licenses, to conduct business some operational requirements are common. For any entity to operate as a company doing business in the agriculture industry, for example, selling seeds or fertilizers etc., the entity must be incorporated as a company in the Registrar of Joint Stock of Companies or RJSC. As mentioned above, Trade License, VAT and TIN registration are also necessary to operate the business. Other than that, if a company is establishing a factory for the purpose of manufacturing or processing, they would further require Factory license, Fire License and Environmental Clearance from the respective departments of the Government.

For importing and exporting of the agricultural products, the company would require Import Registration Certificate (IRC) and Export Registration Certificate (ERC). As mentioned above, in addition to the IRC and ERC, there are some additional requirements in some cases such as those levied by the Plant Quarantine Act (2018).

LEGAL ISSUES

Labour issues are quite common in this industry. Labour issues can range from wages & leaves of the workers, unfair dismissal, termination benefits, Trade Union and its activities, health & safety of the workers etc. Accidents can occur at factories and the proper compensation to be paid for such accidents often become the central legal issue. These issues are well addressed in the Bangladesh Labour Act (2006)

and the Bangladesh Labour Rules (2015). The Agricultural Labour (Minimum Wages) Ordinance, 1984 fixes minimum rates of wages for agricultural labourers.

With regards to fertilizer, persisting legal issues arise mainly with fertilizers which can be polluting the environment, misbranding of the fertilizer or adulteration of the fertilizer etc. There are penalties in place if an entity is found responsible for these legal situations under the Fertilization Management Act (2006). Similarly, for seeds, the legal issues mainly start from the certification of the seeds. Seeds cannot be imported or exported if the proper certification with regards to the quality of the seeds cannot be determined under the Seed Act (2018). If anyone stops an inspector from carrying out his service duties as per the laws of Bangladesh, he/she can be punished for the same.

For pesticides, the legal issues arise with mis-labelling the pesticide or use of pesticides which has not been approved by the Government or reduce the quality of the approved product or cause adulteration under the Pesticide Act (2018). Also, another very important matter is warranty of the pesticide which the manufacturer must provide properly to the dealer. If anyone willingly misleads or causes hindrance to the inspector in executing his Government duties, he or she shall be considered of committing a crime under the Pesticide Act (2018).

Taxation

Finally, Bangladesh is a country where 100% foreign direct investment is allowed except for some controlled sectors. In the agricultural sector, such investments are allowed and thereby foreign entities can enter the industry and make investments as they seem fit. They can incorporate companies under RJSC or set up branch offices as necessary through the Bangladesh Investment Development Authority (BIDA) and register with the RJSC as appropriate.

Agro business sector in Bangladesh has always been a prominent sector to invest and deal business with. Foreign investors as well as local companies play equal role in this sector. Generally, businesses need to form a Limited Company in RJSC to operate within Bangladesh as a Limited Company, as well as individual ones. Currently Tax rate for this sector is 32.5% for established businesses. However, having an agriculture based economy enables Bangladesh to enjoy a number of benefits related to tax such as: enhanced depreciation rates enjoyable as defined by Income Tax Act, even if no accounts are maintained, 40% of the revenue can be put as cost of sales, Income upto 2,00,000 BDT is exempted of an individual person if his/her only source of income is agriculture in an income year, exemption from tax in case of any industrial undertakings specifically meant to be used for agricultural purpose, relief from paying quarterly advance tax, Agricultural college enjoys tax free

income generation derived from its agricultural educational activities etc. Nominal requirements for a limited company formed locally includes a number of reporting to be done to NBR, such as: Opening a TIN, Monthly Tax deduction statement, Half Yearly Withholding Tax statement, Yearly statement related to tax return submission of its employees, Yearly statement related to salary disbursed from company to its employees, Quarterly Advance tax deposition, Yearly Tax return submission, attending appeal/hearing session as required on behalf of the company, Monthly VAT return etc. FMA can advise and assist to satisfy all regulatory compliances to enable the company to run smooth and hassle free.

Introduction of FMA and its services

FMA is a full-service legal firm with pristine experience in the agribusiness industry. FMA can provide valuable assistance to any business working in the agriculture industry. FMA can work with setting up the company, starting from the Name Clearance Certificate to drafting the Articles and Memorandum of Association and any additional documents required for company incorporation. FMA can also help in obtaining any licenses such as Trade License, IRC, ERC, VAT registration, TIN registration etc. FMA can provide legal assistance to obtain licenses for the business of seeds, fertilizers & pesticides from relevant government departments.

FMA has an expert team dealing with labour laws of Bangladesh. FMA can draft company's labor guidelines, provide advice on provident funds, worker's profit participation fund etc. Also, FMA is able to provide all advice on labour disputes with regards to payments, unfair dismissal, termination benefit, leaves etc. FMA's legal team consists of experienced lawyers who can efficiently represent any aggrieved in the court system of Bangladesh regarding any labour agreements or relevant issue related to the agriculture industry.

FMA also has a full-fledged financial division dedicated to tax laws, payroll maintenance etc. With import, export and foreign exchange matters, this team can provide absolute guidance. Further, with regards to any breach of contract or agreement FMA can provide full assistance. Also, for any disputes pertaining to land, FMA can help with vetting all the documents and make sure they are in order. At the same time, any drafting related to land issues such as power of attorneys etc. can be easily taken care of by FMA.

FMA has a very capable team for representation in arbitration, mediation and negotiation. All in all, FMA is a total service provider for sorts of legal issues that may stem from an agriculture business.

COVID-19 Impact on Business

Covid-19 has created an unprecedented situation all around the world. Even the World Wars, did not shut down the entire planet to this extent. It has already counted trillions of dollars in losses with businesses shutting down all around. The agriculture industry is one of the few industries which had to be kept open as an essential industry because food is a must and agriculture provides the staple like rice, vegetables etc.

This however does not mean that the agriculture sector has not taken a financial hit. In Bangladesh, locking down most of the country to stop the spread of the Covid-19 has caused the workers to get into a standstill, which is why they are unable to move around easily into their area to support the farmers when it is time to reap the crops from the fields. For the lack of the availability of labour, a lot of crops are lost every day. On an industrial level, the crops, seeds and fertilizers are rotting in the storage as import and export have hampered on a major scale. Pesticides are not available due to the shutdown of the production. A lot of produce are also getting wasted at different ports as it is not possible to release them.

Agriculture being essential to the survival of the world will have to go through this crisis but still be the biggest contributor under these circumstances. Bangladesh Government has taken steps to provide help to the farmers as much as possible by maintaining social distancing to save the crops. At the same time, government is providing financial incentives to help keep the agricultural industry afloat for the foreseeable future.

Poultry Farming In Bangladesh: Business Plan For Beginners

There is a great market for commercial poultry farming in Bangladesh. And it is already an established business opportunity. The economic system of Bangladesh is mostly dependent on agriculture and agricultural related production. Poultry products like meat and eggs are the main source of animal protein for Bangladeshi people.

Chickens are the common and mostly raised poultry birds of Bangladesh. Along with chickens, raising some other poultry birds like quails, turkeys, ducks, pigeons, peacocks etc. are also gaining

popularity day by day. I am describing here the benefits of poultry farming in Bangladesh and the steps for starting this business commercially.

Benefits of Poultry Farming in Bangladesh

Poultry farming is a lucrative business. And there are some advantages of starting this business. The main benefits of starting poultry farming in Bangladesh are listed below.

1. Poultry farming in Bangladesh is a very profitable business for both individuals and Entrepreneurs.
2. Huge demand of poultry products inside the country. So, you don't have to worry about marketing your products.
3. There are no religious taboos for consuming any poultry birds meat and eggs in Bangladesh.
4. Poultry farming in Bangladesh is such a great business that can never dry up.
5. Commercial poultry farming can create an employment opportunities for the job seeking unemployed educated people. Even, the women can also start raising some poultry birds in small scale farming system. This will ensure the availability of necessary nutrition for the family and help them by making some extra income.
6. Nowadays, there are numerous highly productive poultry breeds are available that are very suitable for commercial production.
7. Commercial poultry farming business has a great ROI (returns of investment) ratio. That means you will get good returns of your total investment.
8. You need some capital or initial investment for starting commercial poultry farming in Bangladesh. If you don't have the capital then you can apply for bank loan. There are many banks available in Bangladesh which will give you bank loan happily with a very little interest. You can also get some loan from various non-govt NGO's.
9. In a word, poultry farming in Bangladesh is absolutely a great business. Especially very suitable for educated job

seekers. Because, employment opportunities are decreasing day by day due to rapid population growth. So, commercial poultry farming is a great income and employment source along with being self dependent.

Start Commercial Poultry Farming in Bangladesh

Starting a poultry farming business relatively easy. You need to follow some necessary steps for starting commercial poultry farming business.

Here we are trying to describe the necessary steps for starting commercial poultry farming in Bangladesh.

Step 1. Select A Good Farm Location

The first step for starting poultry farming in Bangladesh is the selection of a suitable location. You can start raising poultry in your home or in a separate place that is in quiet place and far from your home.

Buying land is the most expensive part of commercial poultry farming business. It would be better if you own the land. This will decrease initial investment. While selecting land for starting, keep in mind the followings.

1. Select a calm and quiet place which is free from all types of chaos and noise.
2. The size of land depends on your current number of birds and future plan.
3. Selecting a land far from the cities will be effective for your production.
4. While selecting, try to choose an area with fresh and pollution free environment.
5. Rural area is perfect for setting up commercial poultry farming business in Bangladesh. Because, you can find

- land and labor in rural area easily and cheaply than urban areas.
6. Never try to establish poultry farm in a piece of rented land. It would be better if you have the land of your own.
 7. A great source of sufficient clean and fresh water in the farm area.
 8. The selected area must have to be free from all types of predators and harmful animals.
 9. Proper transportation system will be very effective.
 10. A suitable market near the farm for selling your products and buying necessary commodities.

Step 2. Select Your Farming System

Following three systems are suitable for commercial poultry farming in Bangladesh. According to the climate of Bangladesh the most effective farming systems are

1. Extensive system,
2. Semi-intensive system and
3. Intensive poultry farming system.

Step 3. Select Highly Productive Poultry Breeds

There are numerous highly productive poultry breeds available throughout the globe. Some of those are very suitable for commercial purpose according to the weather and climate of Bangladesh.

You can start raising poultry for meat and egg production. Choose proper breed for your desired production.

You can contact with your nearest poultry producer or any expert in this industry to learn about which breeds are producing more. Mostly raised and common poultry breeds in Bangladesh are listed below.

- **Broilers:** Broilers are highly meat productive commercial poultry breeds. They are raised mainly for their meat production. They grow faster by consuming a certain amount of food. They convert the food into meat and converting ratio is also very good.
- **Cockerels:** Cockerels are another meat productive poultry breeds. They also raised commercially for meat production. But their growing rate is very slow. Generally they grow slowly than any other commercial meat producing poultry breeds. They become very hardy and has a special demand in the market.
- **Layers:** Layers are used for commercial egg production. There are some layer poultry breeds available which can lay more than 280-320 eggs annually. After finishing profitable egg production stage, you can sell them for slaughtering purpose.
-

Choose any of the above breeds according to your desired production and available facilities. Also keep in mind your local market while choosing effective poultry breeds for farming. Visit your nearest market and try to understand which product has huge demand.

Step 4. Provide Good Housing Facilities

Free range poultry farming require large farm area. And it is not suitable for large scale poultry farming in Bangladesh. So, you have to make a suitable house for your poultry birds so that they can be kept inside the house all time. Design of poultry house vary according to the breed and farming system. While making a poultry house consider the followings and learn more about how to build a poultry house.

1. Proper ventilation system is a must for good health of poultry birds. So, make your poultry house well ventilated.

2. Keep essential facilities for entrancing sufficient amount of fresh and clean air and light inside the house.
3. Try to make south faced house. This will ensure flow of sufficient fresh air and help to prevent cold north air.
4. In case of making numerous house in large scale commercial production, try to keep at least 40 feet distance from one house to another house.
5. Clean the house perfectly before bringing the chicks into the farm.
6. Ensure that, your house is free from all types of predators and harmful animals.
7. Keep proper facility for preventing rain water and cold wind in winter season.
8. It would be better, if the house located in a calm and quite place.
9. Make proper drainage system inside the house so that you can easily clean the house.
10. And keep all other facilities which are necessary for good poultry health and better production.

Step 5. Ensure Good Quality Feeding

Good and high quality nutritious feeding ensure maximum production. So, always try to feed your birds fresh and nutritious food. You can feed your birds commercial poultry feeds.

This type of feeds are available in the market. Various types of feeds are available in the market according to the breed and age of poultry birds.

If you want to feed your birds home made food, then you have to buy all necessary nutritious feed ingredients separately and mix it before feeding it to your poultry birds.

- Poultry feed
- Broiler poultry feed
- Layer poultry feed

Step 6. Caring and Management

Diseases are the main threat of poultry farming business. So, special care and managements are must. Always vaccinate the bird timely. Never feed them polluted or contaminated foods. Keep a storage of necessary medicines. And always try to take good care of them.

Step 7. Marketing

Marketing is the easiest steps of poultry farming in Bangladesh. You can easily sell your products in your nearest local market. Nowadays, Bangladesh is earning some foreign money by exporting poultry products.

Poultry farming is really a lucrative business. It can play a great role for eradicating poverty and unemployment problems. If you want to start poultry farming in Bangladesh, then try to learn more about poultry farming and visit some farms to gather some practical experience.

Fish Farming In Bangladesh: Business Plan For Beginners

Fish farming in Bangladesh is playing an important role to the total national income of this country. Bangladesh is a south Asian country and there are hardly any areas in the country where river or any other water source is not available.

In a word, Bangladesh is surrounded by rivers and various types of water sources like pond, stream, lake etc. And a major part of the total population of this country are directly or indirectly involved with fish or fish related business.

Advantages/Benefits of Fish Farming in Bangladesh

The economy of Bangladesh is mostly dependent on agriculture and agriculture related business. And fish farming has a great contribution. The main benefits of starting fish farming in Bangladesh are listed here.

1. The climate and environment of Bangladesh is very suitable for fish farming.
2. Various types of fish species are available which are very effective for profitable fish farming business.
3. Easy source of water and necessary elements.
4. Low cost labor and other management costs are also minimum.
5. Suitable market for selling the products. Fish has a great demand to the people of Bangladesh. So, you don't have to think about marketing the products.
6. You can start fish farming business in both small and large scale production type.
7. Fish farming in Bangladesh is already a major source of employment and many working facilities can be created through high tech commercial fish farming system. Even the unemployed educated people can also contribute this business and create a lucrative business and earning opportunity for them.
8. Bangladesh is exporting fish products from a long time ago and earning good foreign currencies. Developed fish farming methods can produce more and help to earn more foreign currencies.
9. Various govt. and non-govt fish farming training centers are available. So, if you want to start fish farming business, then you can easily train up yourself from those training centers.
10. Fish farming business requires some initial investment. Many local or international banks are available which are ready to sanction loan. Some govt.

banks also providing loan for this type of business with a very low interest rate.

11. In a word, fish farming in Bangladesh has many benefits and opportunities. You can take this earning opportunities for making a good profit from fish farming business.

How to Start Fish Farming in Bangladesh?

Starting profitable fish farming business in Bangladesh is not too difficult. If you go through some easy and simple process, then you will be able to make good profit by fish farming in Bangladesh.

Here I have described the basic steps for starting this business. Follow the process very carefully.

Step 1. Select A Suitable Land/Area

Selecting a suitable land/area for commercial fish farming is the most important part. Although, almost all places of Bangladesh are suitable for fish farming.

But some areas are suitable for specific fish species. For example, southern part of the countries are suitable for saltwater fish farming and the middle or northern parts are famous for freshwater fish farming.

However, while choosing a suitable area or land for your fish farming business, consider the followings.

1. Try to avoid steeply sloped lands and select the land which is relatively level.
2. While selecting the land, keep in mind about your future business plan. Try to select large land that is perfect for performing all types of necessary activities.
3. Try to avoid polluted and flooding areas. Flooding area can seriously damage your business.

4. Selected land must have to be far from the crop fields. Because crop farmers use a lots of pesticides and fertilizers in their field. And this type of fertilizers and pesticides get mixed with air and rain water and pollute the water of fish farm and make a horrible environment. So, always try to avoid this types of lands.
5. If the selected land become slightly lower than the main water source then it will be very cost effective to fill the land with water. You can easily use gravity to fill the land with water rather than by pumping.
6. Good transportation system with the nearest market or city is very effective.

Step 2. Pond Construction and Design

After selecting a suitable farm land, it's time to make a good designed pond with availability of all types of required facilities for fish farming. The design of the pond depends on the fish species and production system.

In southern part of Bangladesh, the farmer used to make large ponds by making a embankment surrounding the flat land. This type of pond is called "Gher".

This gher are generally used for shrimp production by using traditional farming methods. The farmers make a sluice gate for filling the gher with river water, stock some shrimp minnow and depend on the nature for growth.

However, you have to make a proper designed pond according to your location and desired fish species. Ensure good environment in the pond where the fish can grow happily. See pond management.

Step 3. Selecting Fish Species

Select the fish species according to your location and market demand. Tilapia fish farming is very profitable and it is a common

fish species of Bangladesh and suitable for commercial production in every place of this country.

In southern parts of Bangladesh shrimp is the widely cultivated fish species. Shrimp has a great demand and high value in local and international market.

Along with shrimp crab, bhetki, tangra, horina chingri etc. are common fish species which grow naturally in saltwater gher.

Katla, rui, mrigal, common carp, boal, pabda, chital, koi, shol, gozar, various types of catfish etc. are common freshwater fish species. You can choose any of the fish species according to your location.

Step 4. Feeding

Feeding high quality fish feed ensures maximum production. Although most of the farmer depend on natural fish feed and have no interest in supplementary fish feeding.

But, for commercial production and high profit, you must have to feed your fish high quality and nutritious food. Various types of fish feed prepared for commercial production are available in the market.

You can easily buy and feed your fish those commercial food. If you want to prepare the feed at home, then you have to learn about the nutrition requirements of fish and buy all the feeding elements separately.

And then you have to mix it in proper ratio. While making supplementary feed for fish always try to add all types of nutrient elements, vitamins, minerals, salt etc. Feed your fish twice a day. Once early in the morning and another time at evening.

Step 5. Special Care and Management

Always take good care of your fish. Do all tasks timely. If good water source available, change the water after a several period. Try to keep the pond environment suitable for proper growth and production.

Test the water, soil and fish health on a regular basis. Make a stock of necessary medicines and use them timely if something goes wrong. Prevent entrance of all types of harmful animals and predators like frogs, snakes etc.

Step 6. Fish Collection

Collect the fish timely when the fish reach marketing age. Collection time varies depending on the fish species. You can easily collect fish from pond by removing the water or by using net. After collecting, send the fish in the market as soon as possible.

Step 7. Marketing

Marketing fish products in Bangladesh is very easy. All types of fish has a huge demand in the local and international market. You can easily sell the fish in your local market. So, don't think about marketing the fish.

If you want to start fish farming business in Bangladesh just do the other steps perfectly. Fish farming in Bangladesh is absolutely a lucrative business. If facilities available, then you can also do this business along with your current job or profession. Because, in fish farmng business you don't have to work 8 or 12 hours a day. Before starting fish farming in Bangladesh, learn more about this business and try to complete a training. Good luck!

Goat Farming In Bangladesh: Business Plan For Beginners

Discussing about the pros and cons of goat farming (advantages and disadvantages) is very important for starting and operating a successful goat farming business.

Commercial goat farming business has many advantages and disadvantages. It is a very profitable business, and at the same time it also has some disadvantages.

If you are a beginner, and want to start a goat farming business, then you should know about these pros and cons of goat farming business.

Here we are trying to describe about the top pros and cons of goat farming business. Hope this guide will be helpful for you to take proper decision.

Pros and Cons of Goat Farming Business

Goats are wonderful creatures, and they are being raised for long time in India. There are many advantages/pros of goat farming business. Currently, goats are being raised commercially in most of the parts of the world.

And popularity of commercial goat farming business is increasing gradually. Huge market demand and availability of many different goat breeds are the main advantages of goat farming business.

There are already many large goat farming companies available in many parts of the world, and they control a notable portion of the total market demand. As the population increasing, the demand of food is also increasing. Commercial goat farming business can play a very important role to meet up this increasing food demand.

Goat products such as milk and meat, both are very nutritious and good for human health. Goats are among the main meat producing animals in many countries.

Most of the people who consume meat, generally prefer goat meat. So, goat meat has great demand in the international market. The milk is also popular in some areas.

Goats are actually multi-purpose animals. Along with meat and milk production, their skin and fiber are also valuable. Goat manure is also of very good quality and can be used for crop or other green production.

Pros/Advantages of Goat Farming in India

Goats play a very important role in the rural economy of some poor countries. If you are thinking about starting goat farming business, you need to know about the advantages/pros of goat farming business.

Goats are multi-purpose animals, and there are many breeds available to choose from. However, here we are describing more about the main advantages of goat farming business.

1. Require Less Space

Goats are smaller sized animals. So they generally require less space, compared to some other domestic animals. They have less housing demands, and a house with minimum facilities will be good for them. Even the goats can be kept with your other farm animals (in small scale family farm production).

2. Less Feeding Requirements

As the goats are smaller sized animals, so they require less feeds. There are some goat breeds available in India which can survive in low quality feeding also.

3. Easy to Care

Most of the goat breeds generally require less caring and other management. They are very easy to care, even women and children can care for them.

4. Utilities

Goats are multi-purpose animals, and they are raised for many different purposes. Their multipurpose utility is another advantages of goat farming business. Goats are generally raised for meat and milk.

But some goat breeds are also used for fiber or skin production. Some goat breeds are also very good for raising as pets.

5. Availability of Many Breeds

Depending on your area, there are some native goat breeds available, and you can choose any. You can choose any breed depending on your production purpose.

Among the native goat breeds, some are popular for meat production, some breeds are good for milk and some goat breeds are good for both meat and milk production.

Jamunapari, Beetal , Jakharana and Surti goats will be good for you if you want to start commercial dairy goat farming business. Some good meat goat breeds are Sirohi, Sojat, Osmanabadi etc.

If you want to produce both meat and milk, then selecting dual-purpose goat breeds will be good. Beetal, Sirohi, Barbari, Marwari, Mehsana, Kutchi, Gohilwadi and Zalawadi goats are good dual-purpose goat breeds. There are also some exotic goat breeds available (such as Boer, Alpine etc) in some countries.

6. Ready Market

Goat products such as meat and milk have great demand in international market. So you don't have to be worry about marketing your products. Goat products have no religious taboo, and are highly accepted for consumption.

7. Climate Tolerance

Goats are very hardy animals, and they can adapt themselves with almost all climates around the world.

8. Goats are Hardy Animals

Goats are very strong and hardy animals. They are capable of surviving well than other animals. They are capable of resisting many common goat diseases.

9. Grow Faster

The goats are faster growing animals. They become mature quickly and multiply their numbers in the flock within a very short period of time. Goats generally reach slaughtering weight much faster.

10. Great ROI

Goats are easy to care, and they require less spending on their feeding, housing and caring. So, they make good profit for the farmers compared to total costs.

11. Employment Source

Commercial goat farming is a great employment source for the people. Especially for the educated unemployed people.

These are the main advantages of goat farming business. If you are a beginner and willing to start a new goat farming business, then you also need to know about the disadvantages of goat farming business.

Cons/Disadvantages of Goat Farming

Along with many advantages of goat farming in India, there are also some difficulties or disadvantages of this business. Traditional farming system and lack of knowledge are the main disadvantages of goat farming business.

Goat farming business is very easy, and definitely profitable if you can manage everything perfectly according to a plan. Although, there are some disadvantages that you should be aware of. The main disadvantages of goat farming business are listed below.

1. Traditional System

Most of the goat farmers use traditional system for raising goats. And a majority of the farmers used to keep their goats in extensive management system. They are not aware about the modern system.

2. Lack of Knowledge

There are also lack of knowledge about running the goat farming business effectively. There are many agriculture extension offices, Universities and Research centers available. But most of the people are not using these govt. services.

3. Inability to Choose Right Breed

Most of the goat farmers, especially the beginners fail to choose right breed for their business. As a result, they don't get good production. And then they leave this business.

4. Starting Without Experience

Some of the beginners start raising some goats immediately after making the decision. This is not wise, and the beginners without any

practical goat farming knowledge will face high cost and mortality rates. And they generally make less profit or even face loss.

5. Lack of Vet Service

Adequate vet service is not available throughout the country. This is also a great disadvantages of goat farming business.

6. Marketing Difficulties in Some Area

A good market is not always ready in some places. So the producers face problems for selling their products. This is not good for running a profitable goat farming business.

7. Lack of Specially Designed Vehicles

Specially designed vehicles are needed and very useful for transporting live goats from one place to another. And there is lack of such vehicles.

8. Lack of Capital

The poor farmers in some poor countries don't have enough capital to start goat farming business in large scale. Enough capital for running a farm with at least 50-100 goats, will ensure good income from this business.

These are the common pros and cons of goat farming business. Please review wisely both disadvantages and advantages of goat farming before making decisions. Hope this guide has helped you to learn more about the top pros and cons of goat farming business. Good luck!

What To Feed Goats In Stall Feeding System?

Some commercial goat producers used to raise goats in stall feeding system. And stall feeding system is considered as one of the best and most profitable goat farming system (especially for commercial goat producers).

But always remember that, goats do their best if they have facilities to go out in the pasture, grazing on various types of greens, shrub, leaves and forage throughout the day.

But in some areas around the world, people don't have the facility to let their goats spending their days grazing on various types of greens and tasty looking plants or leaves. If you are among those areas, then you have to depend on stall feeding goat farming system.

What to Feed Goats in Stall Feeding System

In stall fed goat farming system, try to feed your goats balanced diet that is enriched with all necessary nutrients and that can absolutely meet all their nutritional demands.

Goat's Regular Diet

Naturally goats become happy and stay healthy by consuming various types of greens, which are available in the nature. This type of natural diet includes weeds, shrub plants, grasses, leaves etc. Adding some extra additives with natural diet, will ensure good health, proper growth and maximum production. Goat producers usually provide their goats grain and hay (in captivity) for maintaining regular growth and a healthy weight. Providing hay and grain with their other feeds, ensure that their goats are getting all required nutritional demands.

[Buy vitamins and supplements](#)

A combination of free choice plants and grasses and less amount of free choice hay and grain is considered as the best and healthy

pasture diet for the productive goats. So, if you have pastures, then let your goats graze on the grasses and plants and limit the scoop of hay and grain for better result.

Stall Feeding

In stall feeding system, goats don't have the facility of grazing to meet up their nutritional demands by themselves. So, you have to provide them balanced diet with all types of necessary nutrient available. You have to replace grazing with various types of forage. You can provide them highly protein enriched grain and high quality hay (for example peanut or alfalfa).

Never feed your goats more than 1.5 to 2 pounds of grain daily. Because feeding more grain can result slow growth. Instead, add more high quality hay in their regular diet, if you notice that your goats are not maintaining an adequate weight. In some areas, it's very difficult to serve the goats sufficient amount of greens. In this case you can provide them specially prepared feed that can meet up the demand of greens. You can feed them hay mixed with urea and molasses. Follow the steps below for preparing hay mixed with urea and molasses.

- Take 1 kg chopped hay or dried grass.
- 220 grams molasses.
- 30 grams urea and
- 600 ml fresh and clean water.
- Mix the urea and molasses with water.
- Then mix that mixer with the chopped hay or grass.
- You are done! Now it's ready for feeding your goats.

This type of processed dry feeds are easily digestible, contain more fiber and very suitable for goat health (especially very suitable for castrated goats). You can try feeding your goats this processed dry feed if you are raising them for meat purpose.

Minerals

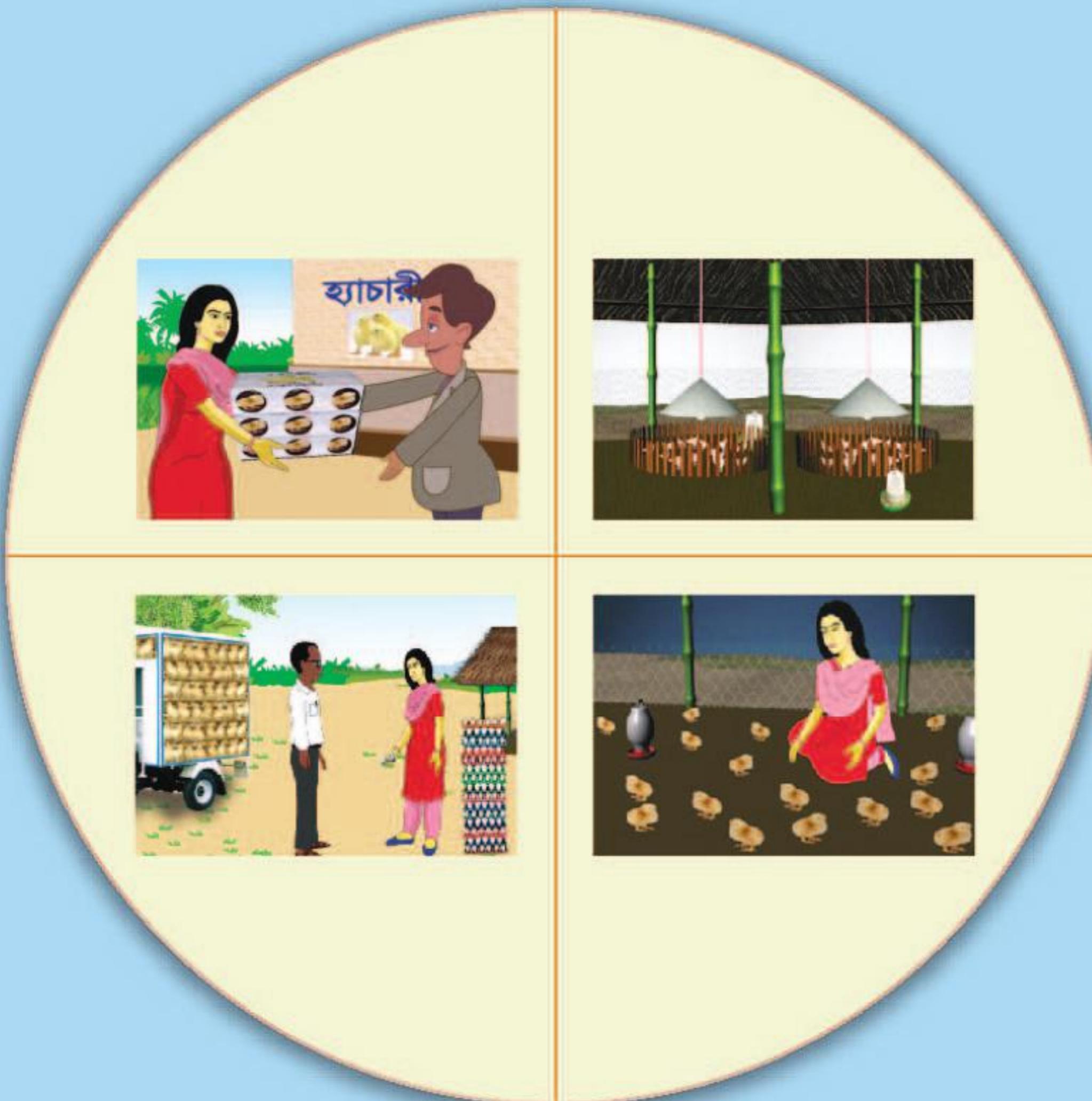
Minerals play a vital role in your goat's health. Adding necessary minerals are must for raising goats in stall feeding system. Because in stall feeding system, feed additives are limited and you have to ensure necessary minerals by adding it with your goat's regular feed. You can add loose mineral mixture or mineral block with your goat's feed.

Water

Sufficient amount of clean and fresh water is very important for raising goats, especially if you raise them in stall feeding system. Provide your goats plenty of fresh and clean water regularly. On an average an adult goat need more than 1 litter of fresh drinking water daily. Although it depends on the breeds. Some plants and pasture greens contain their own moisture and your goats will need less water. But some feeds like grains and hay are often quite dry and provide little amount of water or moisture content. If you feed your goats hay or grain, they will need more water. Goats may become dehydrated or sick if they are deprived of sufficient amount of water. So, always make a clean and fresh water source available.



Poultry Rearing



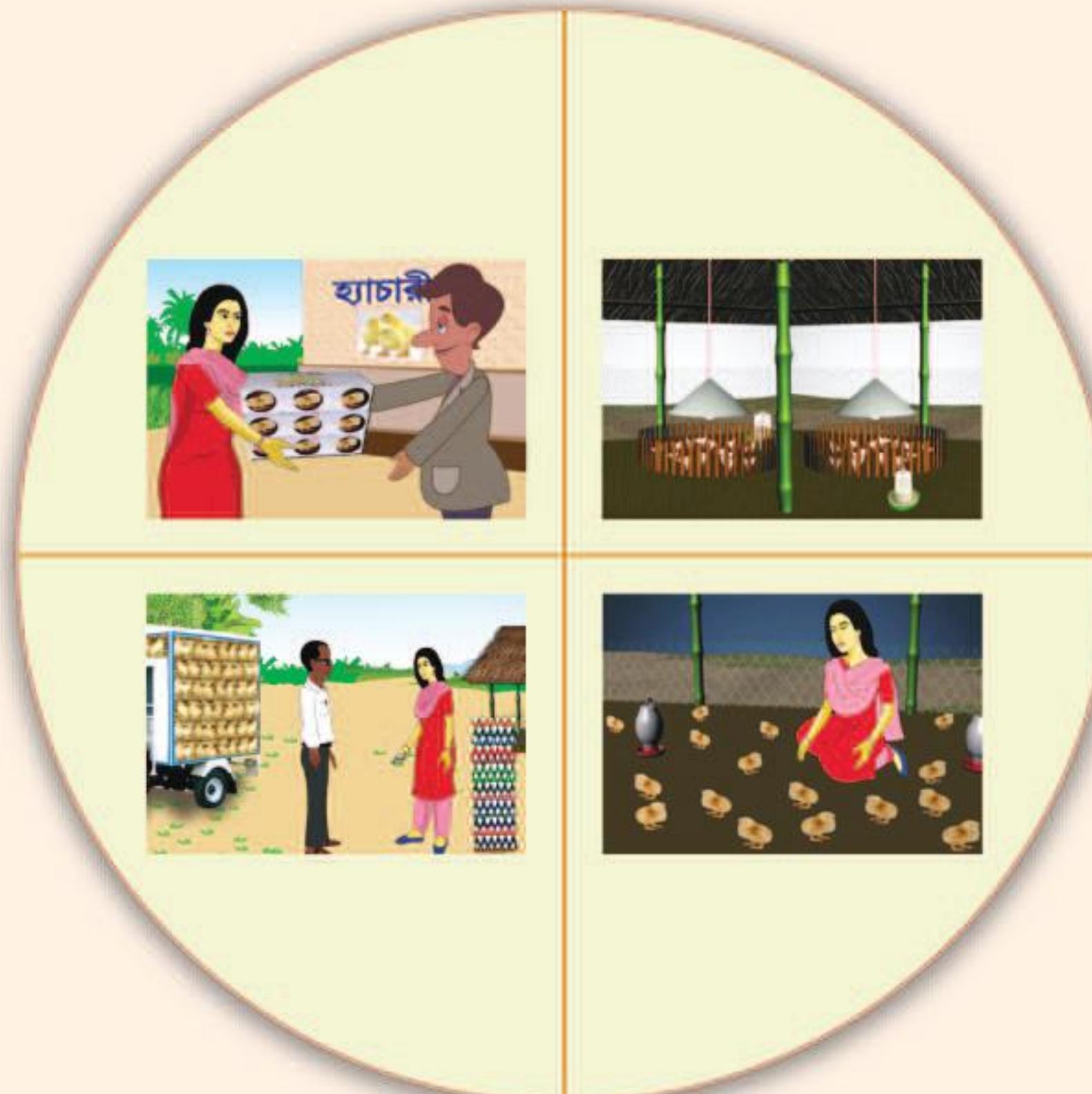
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Learning material for the enhancement of livelihood skills for people with limited reading skills

Poultry Rearing



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for people with limited reading skills

Publisher

Dhaka Ahsania Mission
House 19, Road 12
Dhanmondi Residential Area
Dhaka 1209, Bangladesh

First Edition

December 2012 (5,000 copies)

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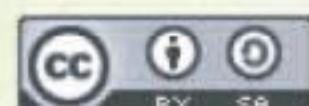
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Murgi Palon (Poultry Rearing): Learning materials for the enhancement of livelihood skills designed for neo-literates and persons having limited reading skills, developed by Center for International Education and Development (CINED) and published by Dhaka Ahsania Mission with support from Commonwealth of Learning. English translation of original Bangla version.

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Preface

Bangladesh is a country of enormous possibility. Yet, the majority of its people live in poverty, suffering from malnutrition, unemployment, superstition and many other forms of deprivation including natural disasters. Development workers, however, think that this situation can be changed by providing people with education and enhanced skills for livelihoods.

With this prospect in mind, Dhaka Ahsania Mission (DAM), since the early onsets of its development drive has focused on education, and has operated various non-formal education programs for different groups of people. DAM has taken up the initiative to impart skills development training to those people and thus create a pool of human resource. Considering the prime tool to execute all these activities, DAM has consistently prepared education materials of various types and merit as per the needs of different groups of people for their basic and continued education. Presently, Dhaka Ahsania Mission has, to its credit, more than 400 basic and continuing education materials of different titles.

In line with the previous publications, during 2003 - 2004, DAM developed a series of 21 books on skills enhancement and income generating activities. Later, in 2009, three more materials were developed for the workers in the Ready Made Garments (RMG) sector. Basing on that experience, DAM's 'Center for International Education and Development' (CINED) has taken an initiative to develop one more series of livelihood skills enhancement education material with the heading '**Let's work and build our lives!**'. In this series, 5 booklets have been developed on 5 different topics. Each book in this series is complemented with an animation video. The users of these booklets will benefit from the videos as they can better understand the learning content after watching the videos alongside reading the booklets.

A list of competences that the learners would achieve after reading this booklet has been given at the end of this book. The organizations that are providing training on skills development will play an effective role in imparting competency-based training to the informal sector using the booklets and animated videos of this series. We hope that these materials will be used extensively in the topic-based training of the post-literacy and continued education activities under the non-formal education programs.

The booklet '**Poultry Rearing**' is one of the five books in this series. The other booklets in this series are: Flower Gardening, Vermi Compost, Batik Print and Nursery. The booklet '**Poultry Rearing**' contains easy to understand language about the methods of rearing poultry, how to market and sell it.

Chief Executive Officer of CINED, Mr. Shahnewaz Khan, has responsible for the overall coordination of the planning and development of the booklets and the animation videos. "I would like to convey my gratitude and thanks to all who were involved in the development of this booklet. We are sincerely grateful to Commonwealth of Learning (COL) for their generous financial assistance in the development of this series."

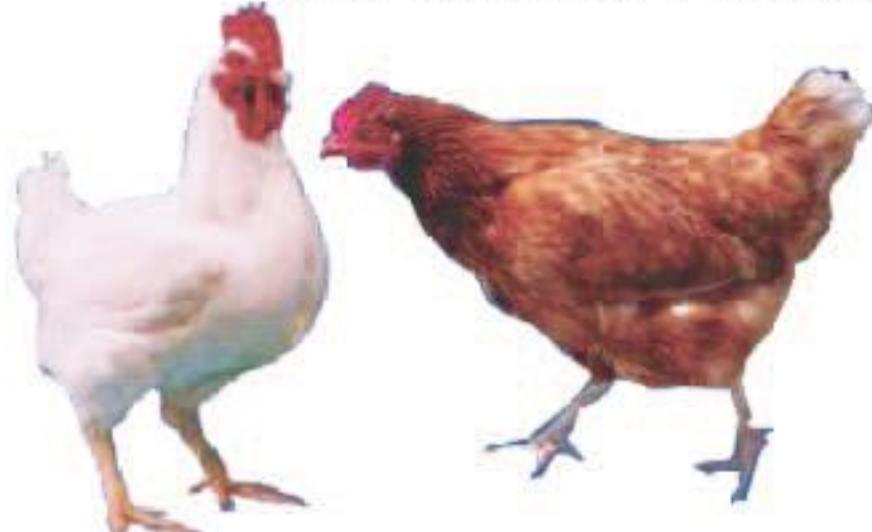
We believe that, after reading these booklets, watching the animated videos and using the information, innumerable number of unemployed women and men would be able to build their home-based small businesses. As a result, their quality of their life will be improved, and they can contribute effectively to the process of national development. We would consider, with due importance, any suggestion from you regarding the booklets and the animation videos of this series while publishing the next edition.

December, 2012

Kazi Rafiqul Alam
President
Dhaka Ahsania Mission

Poultry Rearing

Bangladesh is a country of thousands of villages. In these villages, almost every household rears poultry. Women usually take up this job to make ends meet for their families.



Many women make up for their household expenditures by selling eggs and poultries. Chicken meat satisfies our protein needs. The poultry excreta and bone dust are used as fertilizer in our crop fields. Poultry feathers are used to make dusters to sweep off fine dust. Also, the poultry entrails are used as food for the fish stocks.

Many people in the villages rear poultry in their houses to meet up their family's protein needs. However the need of the entire country cannot be met by small scale production. Many people in the villages and in the towns are now setting up poultry farms as a business. We can build such farms either in our own houses or at a nearby place.

Why build a poultry farm?

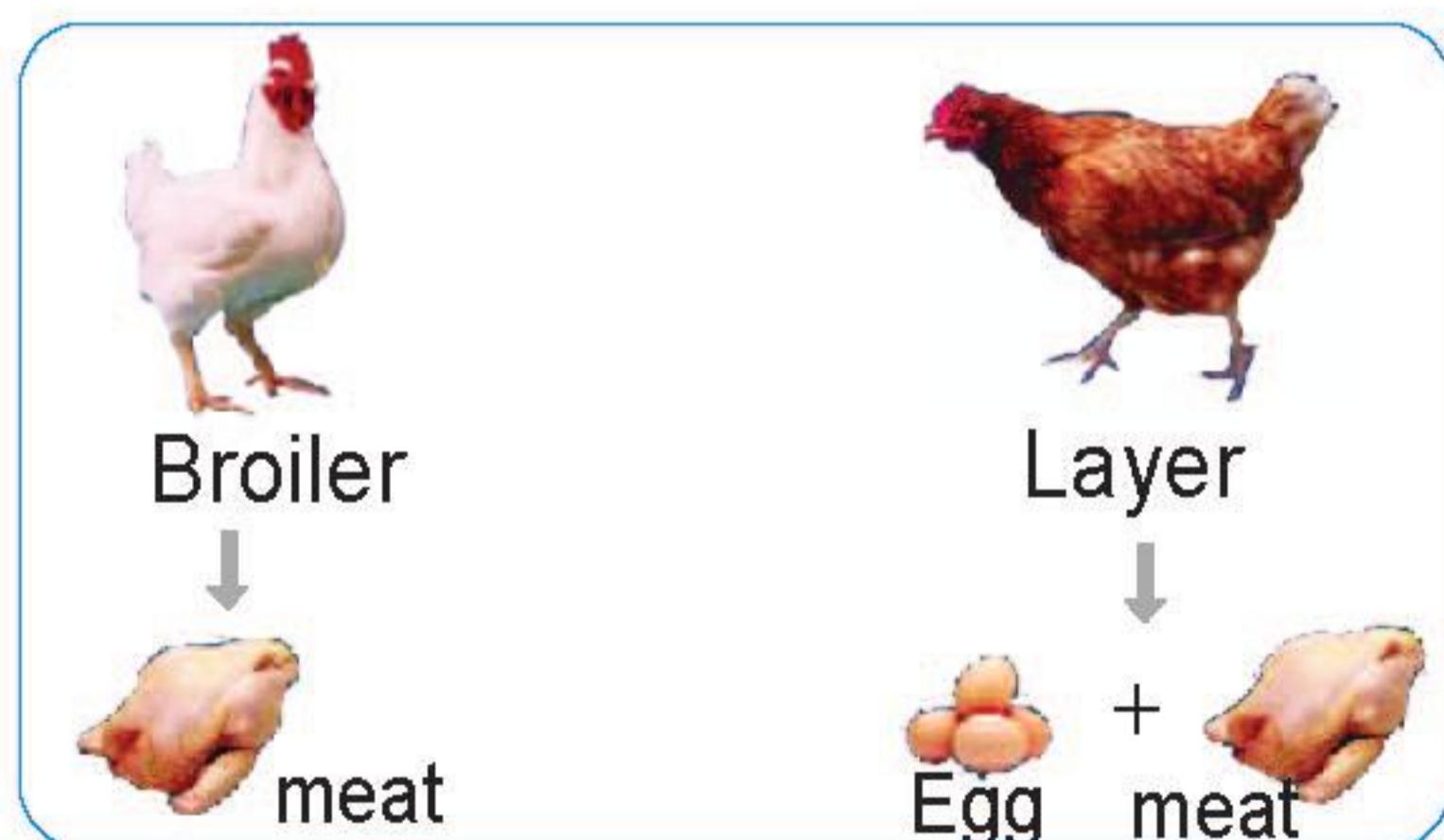
There are many advantages of establishing a poultry farm. For example:

- Poultries can be produced within a few days and with less effort.
- People's demand for protein can be met.
- Return on investment comes back within one and half to three months only.
- A start up capital of only 25 to 30 thousand taka is enough to start this business.
- A tiny piece of land measuring 20 ft x 10 ft is enough to rear 100 - 150 poultry.
- A family can operate a poultry farm.
- Apart from chickens and eggs, poultry excreta can also be sold as fertilizer.

We can consider poultry farming on a commercial basis for all these benefits.

Types of poultry birds

There are two types of poultry birds that are commonly found at poultry farms- Broilers and Layers. Broilers are usually reared for meat and Layers for eggs.



Things to know before starting a poultry farm

We must know a few things before rearing poultry. These are: 1. Materials necessary to rear poultries; 2. Construction of poultry house; 3. Chick collection; 4. Poultry feeds; 5. Poultry diseases; and 6. Care and management of poultry birds. All these have been discussed in details in the following chapters.

Materials those are required before starting poultry rearing

Materials necessary to rear poultries Two categories of materials are required in poultry rearing. They are - Fixed materials and Current or variable materials

1. Fixed materials

Materials that can be used for a few consecutive years once they are obtained or collected are called fixed materials. Let us now learn the names and amounts of fixed materials that we will need.

List of fixed materials



Poultry farm house – 1 No.



Large Chick Tray or
feeder pot – 5 Nos.



Small Chick Tray or
feeder pot – 5 Nos.



Large water
pot – 5 Nos.



Small water pot – 5



Spade – 1 No.



Iron or wire made net – 60 ft.



Polythene – 10 yards

These materials are available at bazaars or makeshift bazaars located at the district or sub-district towns. At current market value, the approximate price of the materials is Tk. 17, 400. Over all the approximate expenditure for building a farm house would be Tk. 12,000.

2. Current or variable materials

Aside from the fixed materials, many other materials are also needed for production. These materials should only be bought or collected when they are needed. Such materials that are needed only during the actual production process are called current or variable materials. We will now learn the names of current or variable materials.

List of current or variable materials



Basket – 2 Nos.



Paddy husk – 2 sacks



Wood dust – 2 sacks



Gloves – 2 pairs



Electric bulb – 100 watts



Electric wire



Rope – 1 kg.

These materials are available at bazaars and makeshift bazaars at district and sub-district towns. Tentative price of these materials would be Tk. 800.

Construction of poultry house

The place where the poultries live should be comfortable. To ensure this you have thatch a hut with two slanting roofs. You can erect this hut either inside your house's courtyard or somewhere beside your house. A hut of 20 ft in length and 10 ft in breadth would suffice. The deck or the floor should be leveled properly to a height of one and half to two feet from the ground.



The hut can be erected using bamboo or wooden planks. Earth or bricks can be used for structure. But it is better to build the hut with thick bamboo woven mats, as it will lower the costs of building the farm. You should bear in mind that the hut should be east - west in direction in length, and south or east faced. This will ensure maximum sunlight and airflow inside the hut. The hut should be seven and half to eight feet in height. Once the structure is completed, the hut needs to be covered with one and half to three feet high barbwire. This will keep dogs, cats, mongooses, civet cats or foxes away. During rain and cold the hut needs to be covered by thick curtains to protect the poultry birds both from cold winters and rainwater. Typically, a broiler birds occupies 1.2 sq ft and layers 1.7 sq ft space. So in 200 sq ft, 150 -170 broilers and 120 -125 layers can be easily reared.

Constructing the deck or floor of the poultry house

Create the base of the floor with 4 to 5 sacks of paddy husk. Spread the paddy husk onto the floor



and level it to 2 - 3 inches thick. This method is called Litter Method. This method will ensure that the poultry excreta do not adhere to the floor. Initially, the floor should be prepared only with paddy husk and kept like that up to 10 - 15 days. After 15 days, apart from paddy husk, you can also use wood dust to prepare the floor. If the Litter gets saturated by poultry excreta, you have to daub 2 kg lime on it, or turn the Litter

upside down. The Litter should be turned upside down twice or thrice a week with the help of a spade or shovel. However, if a part of the Litter begins to reek or hardens as a result of being clogged by poultry excreta, that portion is no longer usable and you have to throw it away. You have to mix new Litter with the old one, if the old one it is still useable. If not, you have to make new Litter. You have to make new Litter every 6 to 7 months.

Collecting Chicks

You cannot make a good profit unless the chicks are of a good kind. Hence you have to make sure to collect the good variety of chicks. Tips on chicks collection are:

- For meat, you have to collect 1 day old chicks of broiler variety.
- For eggs, you have to collect 1 day old chicks of layer variety.
- Buy chicks that are supplied by a good company.
- You should know whether the chicks are vaccinated or not.



Poultry feed

Poultry birds eat different types of feeds. A poultry bird usually takes 100 grams of feed per day. Poultry feeds contain wheat, maize, rice particle, rice bran, wheat husk, sesame oil cake, crushed dried fish, oyster, crushed snail and salt. These are mixed and sold in the bazaar as poultry feed, and can be purchased in kilograms. There are three types of poultry feeds that are available in the market. Those are starter, grower and finisher. But one can prepare poultry feed at home also if she or he has the training to do so. If the feed is prepared at home, the cost of buying poultry feed comes down to a great extent.



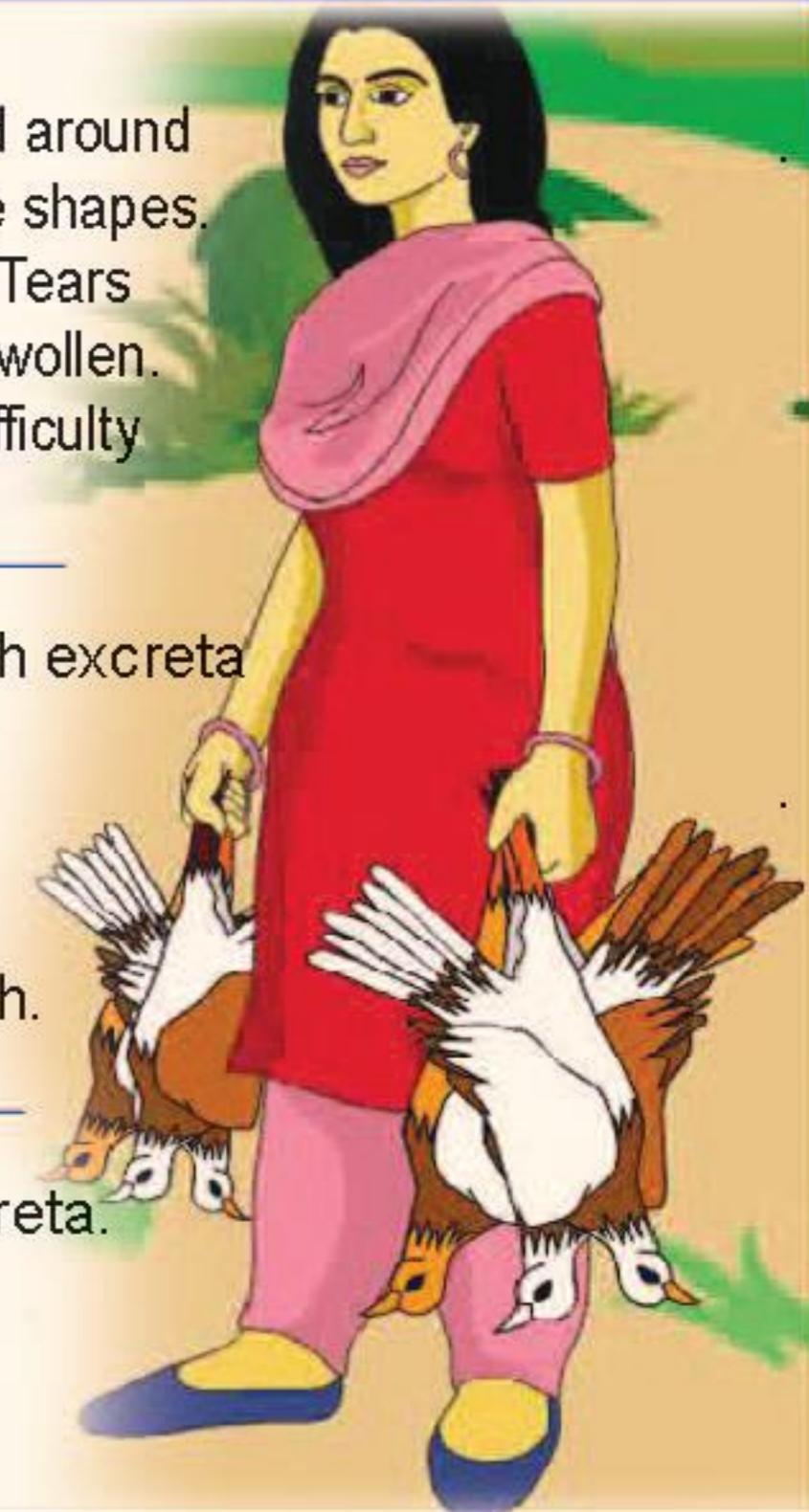
Diseases of poultry birds

Poultries are affected by various types of diseases. Amongst these diseases, Ranikhet, pox, blood dysentery, cholera, bird flu etc are notable. Poultries may die if they are affected by these diseases. Hence you must always be very careful. You have to learn about poultry diseases and their symptoms and take immediate measures when your poultries are affected. Poultry diseases and their symptoms are shown in a table on the next page.



Poultry diseases and their symptoms

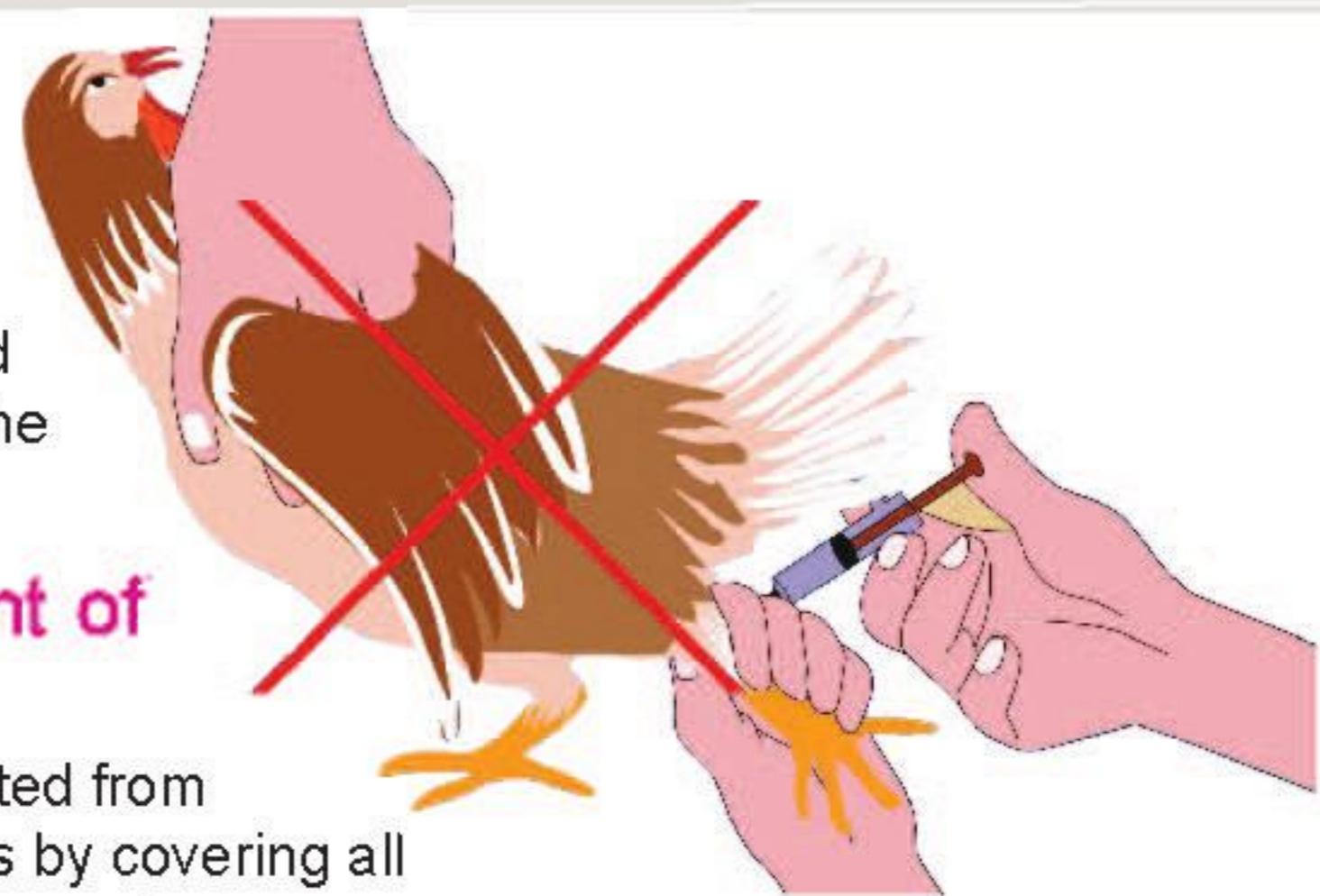
Name of diseases	Symptoms of diseases
Ranikhet	<ul style="list-style-type: none"> - Poultry birds become drowsy; they keep their eyes closed and their necks turned backPoultry birds defecates whitish or greenish loose stools. Sometimes they contain blood stains. - They suffer from respiratory troubles and breathe with their mouths open. They make purring noise and salivate. - Their bodies shiver, and their wings stay bogged down. The birds drowse in sitting position and have runny noses. - They take less food and water.
Pox	<ul style="list-style-type: none"> - Poultry birds have fever. - Poultry birds have red spots under their wings and around their faces. The spots get larger and take lentil-like shapes. - Blisters and cocoons are seen on the birds' eyes. Tears keep rolling from their eyes and their eyelids are swollen. - Cocoons appear in their trachea and they have difficulty breathing.
Cholera	<ul style="list-style-type: none"> - Poultry birds defecates yellowish or greenish excreta - Poultry birds have fever. - Their wings are bogged down. - Saliva comes out of their mouth. - Crest on their head and their ear turns bluish.
Blood dysentery or coccidiosis	<ul style="list-style-type: none"> - Blood can be seen in their loose foamy excreta. - Poultry birds drowse and make sound. - Stops taking food and water.
Bird flu	<ul style="list-style-type: none"> - Poultry birds die suddenly without having any symptoms. Within 2 - 3 days, 90 to 100 percent poultry bird can die. But, sometimes, the symptoms mentioned below can be seen: - Poultry birds sneeze and cough. Cold mucus may come out from their noses. - Liquid greenish excreta. - Food intake decreases. - Eyelids and head can become swollen. - Poultry bird's body can shivers, wings bogged down, and their head and neck can bend.



If any of the symptoms appears in the poultry birds, you have to consult a local veterinary doctor immediately. You have to treat the diseases as per the doctor's advice. Poultry birds have to be vaccinated regularly. You also have to quarantine the affected poultry birds immediately.

Caring methods and management of poultry birds

- Poultry birds and chicks have to be protected from cold weather during winter. You can do this by covering all sides of the hut with curtains made from gunny bags.
- You have to facilitate air passage in the poultry house during summer.
- You should not give the poultry bird stale or rotten food.
- Clean water should always be served in the water pots.
- You should not vaccinate the sick poultry birds.
- You should vaccinate the poultry birds in the morning or in the evening. You have to complete the vaccination within an hour.
- If the poultry birds peck at one another, you have to sever their beaks while their age is between 7 to 8 days. You have to use a sharp knife, blade or special pliers to sever their beaks. This job should only be done only by a skilled person.



Cautionary notes-

- You have to bury the dead poultry birds.
- You should not enter into the poultry farmhouse wearing footwear that is used at home. Separate footwear should be used inside the farmhouse.
- You have to enter into the poultry farm house after washing your hands and feet, tying your hair and changing your clothes.
- You have to wash your hands, feet and face again after leaving the farm house.
- To save the poultries from the disturbances of rats, you have to apply rat poison regularly on all sides of the farm house.



Broiler rearing



Broilers are 6 to 8 weeks old chicken with tender body meat. Broilers are reared to obtain meat. Their bodies are usually fleshy and soft. Their bones are soft and weak, and their skin usually smooth. They weigh one and half kg to three kg at the age of 8 weeks. The broiler chickens can be sold when they are 35 days old. This is one of the reasons why people are taking more and more interest in farming broiler chicken nowadays.

Steps of broiler poultry rearing

Chick collection

Collect 1 day old chicks from different farms located in the district or sub-district towns. A chick produced by a good company can be bought at a price of Tk. 40 to Tk. 45. Bring home the chicks carefully and release them into the poultry house.



Chick brooding

Rearing chicks in a temperature controlled environment and providing them food and water is called brooding. To brood, buy 1 day old chicks from a poultry farm or hatchery. You have to brood the chicks for 3 - 4 weeks after bringing them in. Hang two 100-watt electric bulbs from the ceiling of the farm house to brood 100 chicks.



Suspend the light bulbs at a height of one foot or one and half feet from the floor. Attach a hood around the bulbs. Erect railings to make sure that the chicks cannot go beyond the controlled temperate zone. Keep the food trays and water pots at different places in the hut. But you must have to put them in the controlled zone. Brood the broiler poultry chicks as per the guidelines mentioned below. You have to control the

temperature of the brooder after observing the chick behavior.

Brooding of broiler poultry chicks

Age of the chicks	Temperature of the hut	Feed and water	Litter management
1 - 13 days	33 degrees Celsius	Give 'starter' type broiler poultry feed. Fill one third (1/3) of the small chick tray with food and one third (1/3) of the small water pot with fresh water.	The Litter made by paddy husk has to be scrubbed every day after the first week passes.
14 - 20 days	30 degrees Celsius	Following the proportion instruction above, give 'grower' type broiler poultry feed 4 - 5 times a day in the large chick trays and pour water into the large water pots.	
21 - 45 days	28 degrees Celsius	Similarly, give 'finisher' type broiler poultry feed 4 - 5 times a day in the large chick trays and pour water into the large water pots.	

Usage of light in rearing broiler poultry birds

The use of light in rearing poultry is very important. It is very important to learn how much time you have to keep a chick in light.

Time for keeping broiler poultry birds in light

Age	Daily exposure to light
1 – 3 days	24 hours
4 – 7 days	23 hours
8 – 14 days	20 hours
15 – 21 days	16 hours
More than 21 days	Darkness will prevail at night

Poultry feed

A poultry chick do not require any food up to 36 hours from its birth. You should give them only fresh water for the first 2 days. If necessary, a little glucose can be mixed with the water.

Spread 3 to 4 tin foils or mats at different places inside the hut and put 'starter' type of crushed food in them for the chicks to eat. After the chicks are 4 - 6 days old, replace the tin foils or mats from the floor and give them food in the small chick tray. Accordingly, give them fresh water in small water pots. Five chick trays and 5 water pots should be enough to feed and hydrate 100 chicks. You have to give the poultry birds feed when they are 1 day to 45 days old as mentioned in the list. See the list in the next page.



Amount of poultry feed

Age of the chicks	Amount of feed for a day	Amount of feed for 7 days
1 – 7 days	23 grams	160 grams
8 – 14 days	46 grams	320 grams
15– 21 days	74 grams	520 grams
22 – 28 days	120 grams	840 grams
29 – 35 days	131 grams	920 grams
36 – 45 days	170 grams	1 kg 190 grams

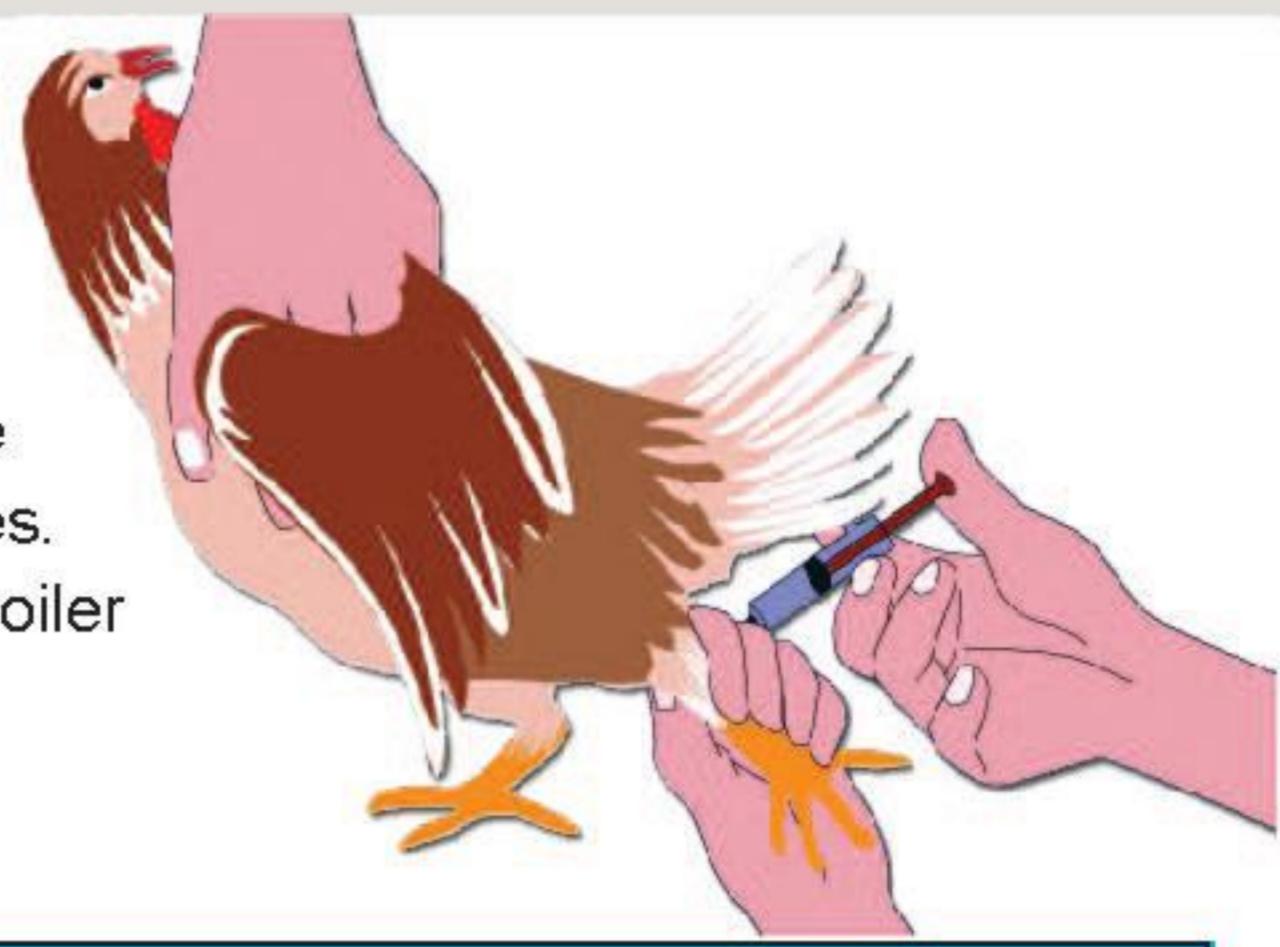
Amount of feed can differ depending on the species of poultry birds or the environment they live in. It would not be a problem if you give more feeds to the broiler chickens than their actual needs. In fact, they grow quicker due to the increased food intake.

Feed preparation for the broiler poultry birds

Feed ingredients	Starter feed (Kg)	Grower feed (Kg)	Finisher feed (Kg)
Crushed maize	35	40	42
Crushed wheat	12	14	10
Rice particles	10	10	10
Soybean	25	20	20
Dried fish	8	8	8
Sesame oil cake	9	7	9
Vitamin Primex	0.30	0.30	0.30
Amino acid	0.35	0.35	0.35
Salt	0.35	0.35	0.35
Total	100 Kg	100 Kg	100 Kg

Vaccination of poultry birds

You have to vaccinate the poultry birds as per scheduled time to keep them healthy. It is important to vaccinate them in time because the poultry birds can die if they are attacked by diseases. The guidelines and schedule for vaccinating the broiler poultry birds are shown below.



Age of the chicks	Name of the vaccines	Vaccination methods
5 days	IB + ND or Ranikhet	1 drop on the right eye after mixing with drinking water
12 days	IBD or Gambura	1 drop on the left eye after mixing with drinking water
17 days	IBD or Gambura	1 drop on the right eye after mixing with drinking water
21 days	IB + ND or Ranikhet	1 drop on the left eye after mixing with drinking water

Each vaccine bottle has a label where the vaccination methods are clearly written. You have to follow those instructions while vaccinating your poultry birds. But make sure to consult your local veterinary doctor before vaccinating your birds.

Selling poultry birds

You have to make arrangements for selling your poultry birds in the bazaars, while they are still at your farm. There is a huge demand for chickens in your own or other localities, hamlets and villages, as well as in the bazaars, either small or big, located at the district or sub-district towns. You can supply your poultry birds in those markets for sales after putting them in baskets. Apart from that, you can sell your poultry birds to the village traders at a wholesale price. This is convenient as you no longer need to carry the poultry birds to the bazaars. This also saves some expense.



Profit from poultry rearing

Profit can be calculated by deducting the costs incurred by the activity from the revenue generated from it. You can make a profit of Tk. 9,720 in 2 months by rearing 100 broilers. A tentative income expenditure account has been provided in the following page.

Fixed cost

As we know from before, the approximated price of the fixed materials needed to rear 100 poultry birds is Tk. 17,400. If we consider 20 percent depreciation of the materials per year, the cost of fixed materials in a year is	Tk. 500
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Current or variable cost

Chick purchase (110 chicks @ Tk. 40 per chick)	Tk. 4,400
Feed purchase (2 month's feed @ Tk. 7,000 per month)	Tk. 14,000
Medicine purchase (2 month's medicine @ Tk. 1,000 per month)	Tk. 2,000
Wood dust, paddy husk etc purchase	Tk. 800
Total current or variable cost	Tk. 21,200

Total cost

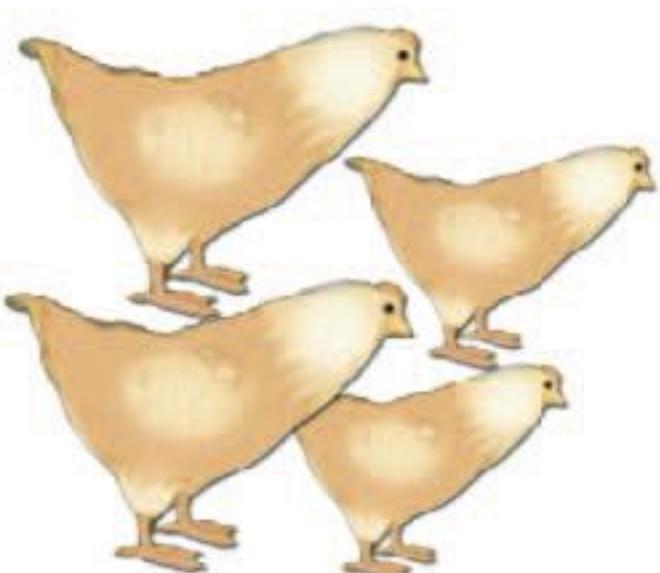
Current or variable cost	Tk. 21,200
Fixed cost	Tk. 580
Total cost	Tk. 21,780

Profit

Sales of poultry birds (225 kg chickens @ Tk. 140 per Kg)	Tk. 31,500
Total cost (fixed and current or variable cost)	Tk. 21,780
Profit from rearing poultry in 2 months	Tk. 9,720

You have to change the Litter once all the poultry birds are sold, within 50 days. If the old Litter seems usable, then mix lime with it and dry it in sunlight. You have to wash the wall mat using a mixture of water and phenyl. All the materials have to be disinfected before they are used again. The poultry house should be kept vacant for 10 - 15 days at least.

Layer rearing



The poultry birds that are reared to produce eggs are called layers. Layer poultries begin laying eggs when they are 20 weeks or 5 months old. This poultry bird lays eggs for a year or more at a stretch. The layer birds have different names at different stages of their age. For e.g. a layer poultry bird is called a chick when they are 1 - 8 weeks old, grower when their age is 9 - 18 weeks old and layers when they cross the 18 - 19 weeks old margin. That is when they begin to lay eggs.

Steps of rearing layer poultry

Chick collection: Collect the chicks from the farms in the same way broilers chicks are collected.

Chick brooding: Brood the chicks for 28 - 35 days in the same way as broilers chicks.

Use of light in rearing layer poultry birds

It is very important to use light to produce poultry eggs. For this, you have to know in details how much exposure to light layers at different ages need.

Age	Daily exposure to light
1 – 3 days	24 hours
4 – 14 days	23 hours
15 – 22 days	22 hours
3 – 4 weeks	18 hours
5 – 6 weeks	15 hours
6 – 7 weeks	12 hours
8 – 19 weeks	Darkness will prevail at night
19 – 23 weeks	13 hours
23 – 27 weeks	14 hours and 30 minutes
More than 27 weeks	16 hours

Poultry feed for layers

Feed a layer poultry chick up to 45 days accordingly to the method applied for broiler chick. First the 'starter', then the 'grower' and finally the 'finisher'. Gradually, you can increase the amount of feed. Mix crushed oyster with the principal poultry feed and feed it to the layers 4 - 5 times a day. Layers begin to lay eggs when they are 20 weeks old. At the onset of laying eggs, i.e. 4- 5 days before they lay eggs, their food consumption decreases. However, once they begin to lay eggs their food consumption increases again.



You must not give excess food to the layer poultry birds than that mentioned in the chart below. If you do so, they will lay fewer eggs. It would be better if you divide the food amount mentioned below in 3 equal parts and give the layers each part 3 times a day.

Age of the chicks (week)	Weight of the layer poultries	Production of eggs (100 layers)	Amount of feed per day (Gram)
21 – 22	1 kg 200 gram – 1 kg 600 gram	35	85 – 95
23 – 27	1 kg 200 gram – 1 kg 800 gram	75	90 – 100
28 – 32	1 kg 400 gram – 1 kg 800 gram	93	93 – 103
33 – 40	1 kg 400 gram – 2 kg	92	96 – 104
41 – 50	1 kg 400 gram – 2 kg 50 gram	90	104 – 116
51 – 60	1 kg 400 gram – 2 kg 200 gram	88	104 – 116
61 or more than 61	1 kg 200 gram – 2 kg 200 gram	75	104 – 116

Feed preparation for layer poultry birds

You can prepare the feed for the layers on your own by following the below mentioned rules. But you should consult your local veterinary doctor if you opt to make feed for your layers.



Feed ingredients	1 – 20 weeks (Kg)	21 – 40 week (Kg)	41 week, or More (Kg)
Crushed maize	40	34	52
Crushed wheat	10	20	-
Rice particles	15	15	15
Soybean meal	13	11	9
Sesame oil cake	5	-	5
Bone meal / Fish meal / Crushed dried fish	8	8	9
Crushed oyster	5	7	8
Fish oil	2.25	3.25	2.25
Salt	0.25	0.25	0.25
Amino acid	0.25	0.25	0.25
Vitamin Primex	0.25	0.25	0.25
Total	100 Kg	100 Kg	100 Kg

Vaccination of poultry birds

You have to vaccinate the poultry birds and chicks at different times, and following different methods. This is essential to increase your poultry birds' immunity and to keep them healthy. Shown below are the names and methods of vaccinating poultry birds. This table is intended for your primary knowledge and understanding of the vaccination of poultry birds. Every vaccine bottles have labels whereon details of the vaccines and their usage are elaborated. You have to follow the instructions strictly.

Age of the chicks	Name of the diseases	Name of the vaccines	Vaccination methods
1 day	Marex	Marex vaccine	Injection beneath the skin on the neck
2 days	Gambura	Gambura vaccine	1 drop in 1 eye
3 – 5 days	Ranikhet	BCRDV	1 drop in 1 eye, one drop in one nostril
7 day	Infectious bronchitis	IB	1 drop on 1 eye
10 – 14 days	Gambura	Gambura vaccine	1 drop on 1 eye
21 – 24 days	Ranikhet	BCRDV	1 drop in 1 eye, one drop in one nostril
24 – 28 days	Gambura	Gambura vaccine	1 drop on 1 eye
35 days	Pox	Foul Pox vaccine	Injection beneath the skin on the neck
60 days	Ranikhet	RDV	Injection in the thigh meat
80 – 85 days	Cholera	Foul Cholera vaccine	Injection in the thigh meat
110 – 115 days	Cholera	Foul Cholera vaccine	Injection in the thigh meat
130 – 135 days	Infectious bronchitis	Integrated vaccine	Injection in the thigh meat

You must consult a veterinary doctor before vaccinating your poultry birds. If needed, you have to feed the layer poultry bird anti-worm medicines.

Egg production

A layer poultry bird lays eggs up to 32 weeks of her age. Amongst 100 layers, 85 of them, in average, lays an egg daily. But, depending on the environment and nutritive value of the feed given to them, they can lay more eggs. When the layers are 18 months old, they no longer lay eggs to the extent they used to before. Hence it is better to sell off the layers that are over 18 months old and bring in new layers to the farm.



Egg collection from the farm house

Layers may lay eggs either during the daytime or at night. During winter, collect the eggs in between 10 to 11 am in the morning and during 4 to half past 4 in the afternoon. You should not wash the eggs in water if it is littered. The eggs can rot quickly if you wash the eggs in water. So, you have to wipe the littered eggs with a thick cloth or with a brush. If you find the egg shells are not hard enough, you have to understand that your layers lack calcium and phosphorus. Therefore, you have to give your layers added calcium and phosphorus with its feeds.



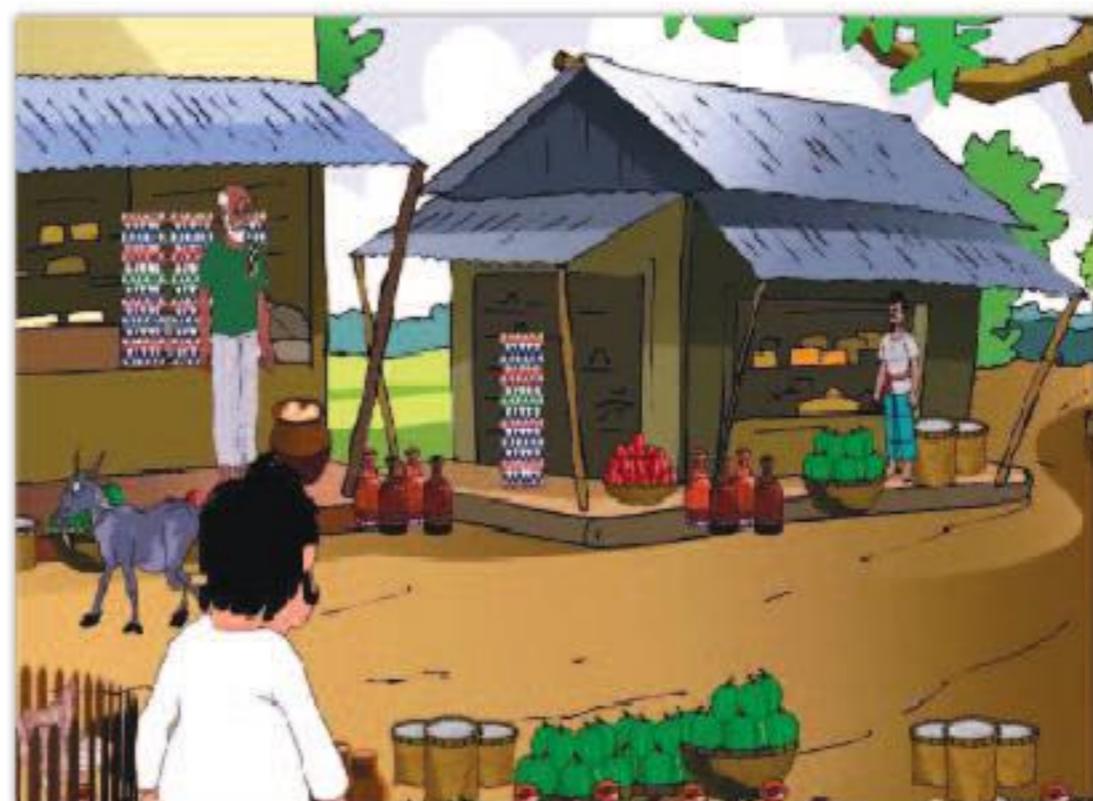
Preservation of eggs

Egg preservation means preserving the quality of the eggs and preventing the eggs from getting rotten. Eggs remain in good health for 3 - 4 days during summer and 7 - 10 days during winter unaided. However, if the eggs are not sold off immediately after being laid, they need to be preserved and stored. You can preserve eggs in many ways, such as:

- Keep some husk or wood dust in an earthen or tin pot, and keep the eggs arranged neatly on it.
- Mix 1 kg of lime with 20 kg water and let the mixture stay for 10 minutes. Pour the water from the top in another pot, and keep the eggs submerged in the solution. Eggs can be kept safe up to 2 months in this way.
- Another method of preserving eggs is to submerge them in coconut, mustard or soybean oil for 1 minute. This will seal the tiny holes on the egg's shell. Store the eggs in another pot. Using this method, you can keep your eggs safe for 1 month.
- You can also preserve your eggs in a refrigerator. Keep the eggs in the lower chamber in a position so that the narrower part of the eggs remains downwards. If you have a regular electricity supply, your eggs will be safe for 2 months.

Sales and marketing of eggs

Egg trays can be easily purchased from the bazaars. You have to keep your eggs in the trays and place them in groups. You can place one tray on top of the other and stack about 5 - 6 trays. You can tie the stacks with a rope and carry your egg trays out for sale. You can sell eggs at your local bazaar, hotels, restaurants, or in your own hamlet and locality. You can also carry your eggs in baskets for sales. Many local traders collect eggs directly from farms. You can sell your eggs to those traders as well.



Profit from poultry rearing

We will now look at how much profit one can make from rearing 100 layer chickens for one and a half year. To make the profit and loss account of rearing layer poultry birds, we have to take into account all the expenditures incurred and the revenue generated from the activity. Layer birds start laying eggs when they are 5 months old, and lay eggs up to 12 - 13 months.

Profit can be found after deducting all relevant costs, incurred in the process of production, from the revenue achieved from selling the produced goods. The surplus amount is the profit. A profit of Tk. 1, 71,680 can be made in one and half year from rearing 100 layers. A tentative income expenditure account has been provided in the following page.

Fixed cost

We know that the tentative price of fixed materials needed to rear 100 layer poultry birds is Tk. 17,400. If we consider 20 percent depreciation of the materials per year, the cost of fixed materials in a year is

Tk. 5,220

Current or variable cost

Chick purchase (120 chicks @ Tk. 40 per chick)	Tk. 4,800
Feed purchase (18 month's feed @ Tk. 4,000 per month)	Tk. 72,000
Medicine purchase (18 month's medicine @ Tk. 1,000 per month)	Tk. 18,000
Wood dust, paddy husk etc purchase	Tk. 800
Total current or variable cost	Tk. 95,600

Total cost

Current or variable cost	Tk. 95,600
Fixed cost	Tk. 5,220
Total cost	Tk. 1,00,820

Total sales

Sales of eggs (31,025 eggs @ Tk. 8 per piece)	Tk. 2,48,200
layer birds sales (180 kg layer @ Tk. 135 per kg)	Tk. 24,300
Total sales	Tk. 2,72,500

Profit

Total sales	Tk. 2,72,500
Total cost (fixed and current or variable cost)	Tk. 1,00,820
Profit from layer poultry birds rearing in one and half year	Tk. 1,71,680

Conclusion

Poultry Rearing is a profitable business. You can make a handsome profit by investing just a little amount of money into this business. If you are rearing broiler poultry birds, the invested money returns after one and half months only. And in case of layer poultry birds, money from sales proceeds of eggs recovers investment in just 21 weeks. Anyone who is thinking of generating a good profit while investing a little money can think of building a poultry farm for rearing either layer or broilers. It is advisable to start with just a hundred poulties and gradually increases the number of birds. As the farm gets larger, the cost per unit starts to fall and profit increases. Many people are taking up this business these days because of its profitability.

Certain specific skills are needed to operate a poultry farm. Hence, you should be trained on poultry rearing before starting this business. You can also receive on the job training from a nearby farm owner, and then start the business. Many disease outbreaks may occur at your poultry farm. So, you have to be careful always. Maintaining regular contact with the local veterinary doctor is essential to save your poultry birds from getting diseased.

Achievable competence

After reading this book, the readers:

1. Would be able to say about the opportunities of the Poultry Rearing as a small business;
2. Would be able to say the names, amount and places of their availability and possible prices of the materials necessary to rear poultries.
3. Would be able to name the species of the poultry birds those are reared on a commercial basis.
4. Would be able to narrate the farm house building techniques for Poultry Rearing.
5. Would be able to narrate the preparation techniques of a Litter to rear poultries.
6. Would be able to explain the techniques of selecting and collecting the chicks.
7. Would be able to say what types of feeds are given to the poultries to eat and how much feed is given to which species at their what ages.
8. Would be able to explain about the types of poultry diseases, their symptoms and their remedies.
9. Would be able to say the names of various types of necessary vaccines and the application techniques of vaccines.
10. Would be able to narrate the techniques of poultry caring.
11. Would be able to say what precautionary measures have to be taken to rear poultries.
12. Would be able to say when and how much light exposure are needed for the broiler and layer chicks at their which age.
13. Would be able to explain the feed preparation procedures for both the broiler and layer poultry birds.
14. Would be able to narrate the sales and marketing procedures of both the broiler and layer poultry birds.
15. Would be able to narrate the possible income and expenditure accounts of both the broiler and layer poultry rearing.

Readers would be able to grasp the above mentioned competence more skillfully after watching the Poultry Rearing related animated video.



Learning material for the enhancement of livelihood
skills for people with limited reading skills

