

Combating Environmental Degradation in Bangladesh: New Urge For Sustainable Agricultural Technologies¹

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Abstract Reducing environmental degradation in attaining sustainable agricultural development is now -a days one of the important focuses of discussion. Environmental degradation is, of course, occurring in almost every countries in different frequencies. The present study focuses on different aspects of environmental degradation in Bangladesh. Empirical data was collected during November 1994 to January 1995. The findings reveal that a lot of environmental changes occurred in Bangladesh during the last ten years; the cultivation of modern rice varieties and vegetables have increased along with the use of chemical fertilizers and pesticides, on the other hand, the forest areas, and the production of pulses and oil seeds have been decreased significantly. The findings also showed that none of the government organizations has so far taken any programs for reducing environmental degradation as well as developing sustainable agriculture. None the less, some of the NGOs were found to have programs for minimizing environmental degradation and sustainability issues in agriculture. On the basis of environmental problems an attempt was made to develop a sustainability criteria for policy implications.

Key words: Agriculture, environment, degradation, technology, sustainability.

1. Introduction

The word *environment* is almost understood by every one. It means the surrounding consisting of air, water, atmosphere, plants, animals, fishes and other animate and inanimate things which can support or influence the growth of life of an individual or a group of in-

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dividuals including all kinds of flora and fauna. It is important to note that the environment is always changing. It is because there are so many changes in the natural phenomena that each one has impact on the other. For example the constant use of chemical fertilizers and pesticides causes natural hazards to soil and water, industrial smoke creates pollution to air and so on. Extreme of such changes pose a great threat to all on the earth. Hence, environment sometimes becomes a threat to development if it is not carefully managed. In Brazil, for example, the environment became so polluted around Sao Paolo city due to discharge of constant smoke from the steel industries that almost all the green grasses in the hills were dead. An special program had to be taken by the Brazilian authorities for transplanting new grasses in the worsely affected hills from other parts of the country. Perhaps this extreme deterioration of environment had led to convene an *Earth Summit* in Sao Paolo, Brazil in 1992. Hence, it is obvious that it becomes necessary to be conscious about the further deterioration of the environment.

Literally the word *degradation or pollution means impurity, changes or damages*. Degradation occurs when a thing does not occur in proper time in proper place. Degradation may occur on any aspect such as *alphabetical degradation, employment degradation, natural degradation* and so on. Alphabetical degradation, in any way, does not harm human mankind. But natural or environmental degradation has direct impact on the quality of human life. Environmental degradation or pollution, however, means contamination or alteration of the physical, chemical or biological properties of any air, water or soil including changes in temperature, taste, color, turbidity, odor, or any other characteristics of air, water, soil or discharge of any liquid, gases, radio active or any other substances which create or render such air, water or soil harmful, injurious, detrimental or disagreeable to public health, and safety, to domestic, commercial, industrial, agricultural, recreational, or other bonafide uses or to livestock, wild animals, birds, fishes, plants or other forms of life (KHANDAKAR *et al.*, 1995).

Sustainability, on the other hand, is a word which has different meaning to different people. Somebody defines it as a mechanism of achieving constant growth and productivity without disturbing the environment, while others define it as a process of attaining higher productivity without using external inputs. These two concepts bring a general consensus that sustainability means – *keep going* in producing satisfactory results without causing threat to environment and the minimum use of external inputs. Of course, no technology can be sustainable for ever. It needs to be changed or modified in order to fit with the changing demands and situations. In this context GARFORTH (1995) says,

..... sustainability is not just a question of technology. There are important social, economic and institutional issues as well. From a social perspective, rural and agricultural development must provide sustainable livelihoods for households in rural areas, particularly for those with few resources and with little opportunity for non-agricultural employment or incomes. An economic perspective points to the need for farming systems to generate sufficient returns to justify the resources used. Institutional issues focus on the ability of the supporting infrastructure to guarantee supplies of necessary inputs to farmers, including land, credit, information and advice.

In the case of agriculture, *sustainability* basically refers to the capacity to remain productive while maintaining the resource base (REIJNTJES *et al.*, 1992:2). The TAC of the CGIAR defined the sustainable agriculture as “the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources” (TAC / CGIAR, 1988). In the case of sustainable agriculture such productive methods are being used which maintain or improve the productive and reproductive resources such as soil, plants, animals, human labor and skills, socio-economic systems, services and infrastructures as well as the non-productive natural and cultural resources. The other concepts which often interchangeably used with ‘sustainable agriculture’ are: low input agriculture, alternative agriculture, biodynamic agriculture, organic farming, biological agriculture, environmentally friendly agriculture, ecological agriculture, and integrated agriculture. Sustainable agriculture encompasses, but is not limited to, farming systems known as biological, ecologically clean, low-input, organic, and alternative. Thus the Iowa Groundwater Protection Act of 1987 says, “Sustainable agriculture is the appropriate use of crop and livestock systems and agricultural inputs supporting those activities which maintain economic and social viability while preserving the high productivity and quality of Iowa’s land” (IGA, 1987). All definitions tend to include the elements the Leopold Center uses as the ‘day-to-day’ definition: *the farming systems that are environmentally sound, profitable, productive, and maintain the social fabric of the rural community* (KEENEY, 1991). However, GARFORTH *et al.* (1997) have opined that a sustainable agricultural system must satisfy the criteria in three categories as follows:

a. *Ecological (physical, or biological)*

- diversity -recycling within system
- capacity -non-pollution

b. *Economic*

- efficiency -income
- security

c. *Social*

- justice -integration

GIPS (1984) expanded the concept into a broad working definition: “A sustainable agriculture is ecologically sound, economically viable, socially just and humane.” The process of development of sustainable agriculture was outlined by RODALE (1983), who later insisted on a system of food production that would improve, rather than continue to degrade or even maintain, the *status quo* of soils. He called this ‘regenerative agriculture’ (RODALE, 1985). According to the American Society of Agronomy (1989): “A sustainable agriculture is one that, over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable; and enhances the quality of life for farmers and society as a whole”. In an international seminar on sustainable agriculture, HARWOOD (1989) described a value-laden workable definition as, “an agriculture that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and balance with the environment that is

favorable both to humans and to most other species”.

2. Consequences of Environmental Degradation in Bangladesh

Climatic changes in the globe has significant role on the environmental degradation. The case of Bangladesh is not an exception to this. Bangladesh has a flat, fertile deltaic land with fringe of hills in the east and south-east, and luxuriant greenery all over. All around the year crops are cultivated in its 119, 624 sq km land area. It has got a very high population indeed compared to land area; the density of population is 755 persons sq km. Hence, Bangladesh cannot grow enough food to feed her own population and every year on an average 15 to 20 thousand metric tons foodgrains have to be imported from other countries at the cost of valuable foreign exchange. In the year of natural calamities this imports even goes higher up to 35 thousand metric tons. It is really painful that very often natural calamities like flood, tidal surge and cyclone, tornado, and drought hit Bangladesh and causes a heavy toll to human lives and other living creatures including other resources and properties. A lot of casualties were recorded due to tornado hit in Bangladesh in 1969 at Demra, in 1989 at Satoria, in 1977 at Madaripur, in 1992 at Gazipur, in 1996 at Tangail, and the latest in October 1997 at Tongi. Thousands of human lives, cattle, and other living creatures were lost as a result of devastating cyclone in Bangladesh in 1970, 1985, 1988, and 1991. Flood is also a very common occurrence in Bangladesh. The people of Bangladesh will never forget the devastating floods occurred in 1987 and 1988 which caused not only endless sufferings to human lives and other creatures, but it damaged severely the country's communication infrastructures. Though on a limited scale, drought also caused a considerable sufferings to Bangladeshi people. The historic drought occurred in 1979 in Bangladesh when the sufferings of the people of north-western part of the country knew no bounds.

It is not that Bangladesh is a territory which is meant for natural calamities only. People themselves of the country are also responsible to a some extent for the occurrence of these calamities. For example, the exclusive forest land is only 5 to 6 percent where at least 25 percent forest areas are thought to be required for a country for its balanced development. In spite of this small forest area, it is ironically decreasing day by day due to the cutting of trees for various purposes (such as making household furniture, using as fire wood in brick fields etc.) at the one hand and shifting the forest lands into crop lands on the other. Further, many farmers indiscriminately use chemical fertilizers and pesticides in their crop fields. Even many band insecticides are largely used in the boarder areas which kill not only the harmful insects but all other small creatures and soil micro-organisms. All these factors are greatly responsible for environmental degradation. Other areas of environmental disasters are the sinking of unplanned deep tube wells and construction of embankments. For example, due to the sinking of too many deep tube wells by the BMDA (Barind Multipurpose Development Authority) in Nachol Thana of Chapai Nowabganj district has been serious problem now on the availability of ground water in the deep tube wells. Most of the deep tube wells are now not in operation because of inadequate ground water. In most cases the command areas of these deep tube wells have not been maintained. Unplanned construction of embankments by the WDB (Water Development Board) also disrupted

the natural habitat. Due to its effect fish population is drastically reduced in Bangladesh at the one hand, and desertification has increased in the surrounding areas on the other. Godagari and Chapai Nowabganj Sadar Thanas are the extreme examples of such calamities.

Environmental degradation has now become the focal point of national politics in different countries of the world. Of course, environmental degradation is a threat to human existence. The UNCED (United Nation Conference on Environment and Development) was held in June 1992 at Rio de Janeiro of Brazil where all these issues were critically discussed. There was debate whether the developed or developing / underdeveloped countries are relatively responsible for environmental degradation. Mass awareness has at least been created after the Rio conference. However, still debate is going on and one is blaming the other. From Rio conference certain bindings were imposed to developed countries on their role in releasing green house trace gas. But no body is obeying the bindings. Already a hole of about the same size of Europe has been noticed in the *ozone* layer. This means that the ozone layer will not be able to soak hot sunlight. The heat of sun will penetrate through the ozone and reach the earth. By this time the earth's temperature has increased to 4° celsius from the average temperature. The increase in earth's temperature will lead to melting of ice in polar regions which will contribute increase sea level at the bottom.

In a report prepared by 2500 scientists submitted to the Secretary General, UNO Dr. Bhutros Bhutros Ghali in September 1995 it was stated that during the period between 1996 to 2100 the sea level may be raised from 20 to 26 inches. Consequently the Bangladesh, Egypt and Maldives would be the worst sufferer. The area having same height of sea level will go under water. The report also indicated that many parts of the world such as sub-saharan Africa, South and South-east Asia, and Tropical Latin America will be unsuitable for crop cultivation and will be converted to deserts. It may be noted that in May 1952 the average temperature in Rajshahi region of Bangladesh rose to 45.10° celsius, in 1966 it was 43.6° celsius, while in 1972 it was again 45.10° celsius. Now the overall temperature in the northern districts of Bangladesh have increased up to 40.0° celsius.

3. Empirical Evidence

3.1 Background

In order to address the above condition a research study was undertaken in Bangladesh as one of the components of a collaborative study entitled "Implications of Environmental and Sustainability Issues for the Organization and Practice of Agricultural Extension" funded by the Overseas Development Administration (ODA) of the U. K. The study was conducted in two phases: the first phase continued from April 1994 to mid January 1995 and the second phase continued from mid January 1995 to June 1996. However, the present findings are the partial outcome of the first phase of the study conducted in Bangladesh. The objectives of the resent study were to:

- i. establish criteria for sustainability which can be applied to technologies promoted by extension agencies,
- ii. identify technologies promoted by GOs, and NGOs in the study areas, identify

the nature of decisions which farmers are being encouraged to take, and apply the sustainability criteria to them,

iii. develop indicators which extension agencies can build into management information systems to allow them to monitor progress towards environmental and sustainability objectives,

iv. identify extension approaches and methods of technology dissemination promoted by GOs and NGOs in relation to environment and sustainable agriculture,

3.2 Collection of Data

Two Research Assistants were appointed to act as data collectors. The Research Assistants were trained on different aspects of data collection. Data were collected from 14 different organizations (six GOs and eight NGOs) during November 1994 to January 1995. In all, data were collected from 53 persons at various levels of different organizations using interview schedules, and 40 individuals through sustainability indicators. Moreover, nine group interviews were held and one case study was made. The detail layout of the organization-wise respondents is shown below in Table 1.

Through interview schedules the respondents at various hierarchical levels were asked on the different aspects of changing in the farming systems during last ten years including environmental problems; sustainable agriculture; technologies for sustainability; and current extension approach, structure, planning and training arrangements of extension organizations. On the other hand sustainability indicators were used mostly among the field level extension workers in order to ascertain their perception about the pre-selected sustainability indicators for farm technologies. Group interviews were conducted from the organized group members of different organizations in suitable time as suggested by the group members.

Table 1. Organization-wise distribution of respondents of different aspects of data collection

Organization	Personal interview schedules used	Sustainability indicators used	Group interviews held	Case studies conducted	Total
1. DAE	19	18	01	—	38
2. BRDB	04	03	02	—	09
3. BAUFSES	04	02	—	—	06
4. BAUEC	01	—	02	—	03
5. GTI	01	—	—	—	01
6. BARD	01	—	—	—	01
7. DANIDA	08	07	—	01	16
8. BRAC	06	04	01	—	11
9. ASA	03	01	01	—	05
10. PROSHIKA	—	01	—	—	01
11. CARE	01	—	—	—	01
12. TAC	02	02	01	—	05
13. Grameen Bank	02	02	01	—	05
14. BS19	01	—	—	—	01
Total	53	38	09	01	103

3.3 Findings

3.3.1 Changing in farming systems

The respondents were asked to indicate the changes in farming systems in their locality during the last ten years. A good number of changes have been reported by them. The major changes are: (i) decrease of forest area, (ii) increase of HYV rice cultivation, (iii) increase of homestead vegetable cultivation, (iv) increase of backyard poultry and livestock production, (v) decrease of pulses and oilseed production. However, the detailed changes, as identified by the respondents (N=53) are presented Box 1.

3.3.2 Environmental problems

Semi-structured questions were asked to the respondents in respect of environmental problems. The problems are shown in Table 2. The table reveals that farmers have been able to detect some of the very important problems in respect of environmental degradation. The respondents' views in respect of environmental problems regarding trees, soil, water and pollution deserve deliberate attention and thinking for the policy makers to do something to protect environment as well the country from the further disaster and extreme

Box 1: Changes of farming systems during last ten years in Bangladesh (N=53)

1. Increased sugarcane cultivation
2. Introduction of Spaced Transplantation (STP) in sugarcane
3. Increased homestead vegetable gardens
4. Increased use of chemical fertilizer
5. Decreased use of jute cultivation
6. Deforestation, especially forest areas
7. Roadside tree plantation
8. Increased area under agro-forestry in fallow lands
9. Increasing plant nurseries
10. Increased cultivation of HYV rice
11. Decrease of the cultivation and production of oilseeds
12. Decrease of the cultivation and production of pulses
13. Increase of interest of the farmers in raising backyard livestock and fishery
14. High demand of quality seeds
15. Increasing the cultivation of banana
16. Increasing cropping intensity
17. Increase of result demonstration in oilseeds (sunflower, soybean, mustard etc.)
18. Increase of mulberry cultivation and production
19. Increase of self-employment opportunities
20. Increase of fish farm through self-initiation
21. Introducing pond side vegetable cultivation
22. Introduction of vegetable cultivation in the school yard
23. Introduction of chicken and duck-cum-fish culture
24. Increasing the use of balanced fertilizers
25. Increasing the importance of crop rotation
26. Increasing women's involvement in homestead vegetable cultivation, and rearing poultry birds
27. Increasing the cultivation of wheat
28. Increasing fruit cultivation
29. Introducing rice-cum-fish culture
30. Increasing shrimp culture

Table 2. Environmental problems identified by the respondents (N=53) in respect of trees, soil, water and pollution

Tree	Soil	Water	Pollution
1. Cutting trees and using them in the brick field	1. Deficiency of Zn and S in rice	1. Decreasing river water level	1. Dying of fish due to use of agrochemicals
2. Reduced bio-mass	2. Deficiency of boron in vegetable	2. Water logging due to defective drainage	2. Killing of beneficial insects by using insecticides
3. Cutting trees for making furniture	3. Declining soil fertility	3. Occurrence of flood almost every year	3. Pollution of pond water due to dual use
4. Dying of plants due to excess use of fertilizer	4. Increased use of nitrogenous fertilizers	4. Drought during dry season	4. Increasing CO and CO ₂ in the atmosphere
5. Shortage of saplings	5. Soil erosion	5. High iron content of water	5. Increasing industrial pollution
6. Non-replacement of trees after cutting	6. Low content of organic matter in soil	6. Reducing natural fishes in the pond, canals and rivers	6. High rate of fish diseases
7. Unauthorized cutting of trees by local people	7. Dryness of soil due to high land and lack of cowdung	7. Shortage of water in the tubewells	7. Use of banned insecticides in the border areas
8. Unplanned cutting of trees	8. Hardening of soil	8. Polluting river water due to slaughtering of animals in the riverside	8. Dropping stomach and debris of animals/dead animals in the river water
9. Cutting of trees through bribing to govt. officials	9. Lack of soil testing facility	9. Minimum distance between Deep Tubewells	9. Bad sanitation leading to pollution
10. Loss of organic matter due to collection of leaves of trees.	10. Phosphate deficiency in soil	10. Shortage of ground water for irrigation	10. Mixing of stools and urine with water
	11. Imbalanced use of fertilizer	11. Lack of rain in time	11. Hampering fish breeding due to the use of agrochemicals
	12. efficiency of K in soil	12. Unplanned embankments/cross dams	12. Polluting pond water due to the retting jute in the pond

deterioration of the quality of human life.

3.3.3 Attempts to overcome environmental problems

The respondents were asked to indicate whether any attempt was being made from their organizations to tackle the environmental problems or not. Most of the respondents indicated positively that attempts were being made, may be on a limited scale, to tackle the environmental problems. The major attempts as indicated were as follows:

1. providing advice and instruction
2. planting more trees
3. introducing IPM
4. demonstrating use of compost
5. advocating organic farming
6. recommending use minimum inorganic fertilizers
7. recommending rice bran and wheat bran as food for fish
8. suggesting farmers use technologies on the basis of their resource base.
9. introduction of new crop rotation

10. teaching farmers in making and using organic manures
11. advising farmers for improved sanitation
12. setting nurseries to plant more trees.

In fact, there are some organizations who are not yet concerned about the environmental degradation. Their main thrusts are to increase the income of their clientele. Hence, they are more concerned about the income generating activities of the concerned people.

3.3.4 Sustainability criteria

The respondents were asked to define the word *sustainability* and set criteria for sustainable agriculture. They were also asked to identify the existing sustainable technologies in their organizations along with their means of achieving sustainability. The results are documented in Table 3.

3.3.5 Potential sustainable agricultural technologies

The respondents were asked to opine on 'what are the technologies they consider as sustainable' and 'for what technologies they are encouraging farmers to adopt'. A considerable

Table 3. Criteria for sustainability, sustainable technologies and used means of achieving sustainability (N=53)

Sustainable criteria	Sustainable technologies that are in use	Means of achieving sustainability
1. Market value of the product	1. Use of IPM	1. Supply of seeds in time
2. Market facility	2. Less use of chemicals	2. Providing training to farmers
3. Controlled market	3. Controlling of weeds by mulching	3. Setting demonstration plots
4. Availability of inputs in easy terms and conditions	4. SSP fertilizer demonstration	4. Mulching
5. Ensuring cultivation next year	5. Rearing of poultry birds in homestead	5. Use of cowdung
6. Possibility of using the technology by the future generation	6. Rice-cum-fish cultivation	6. Cultivation of black gram
7. Easy to get the result	7. Perching branches of trees in rice fields	7. Ensuring inputs
8. Farmer adaptability	8. Supply of rice bran instead oil cake in the ponds	8. Ensuring farmers' participation
9. Need of the farmer	9. Crop rotation	9. Preparation and use of compost and other organic manures
10. Adaptability with environment	10. Integrated poultry-cum-fish culture	10. Advising farmers for planting more trees
11. Demand fulfillment by the farmers		11. Credit disbursement
12. Maintain soil fertility		12. Supervision for producing good quality seeds
13. Gives good yield		13. Economic support
14. Less attack by the insects		14. Motivation
15. Simple and reachable by the farmers		15. Developed cropping pattern
16. Less prevalence of diseases		16. Pond management developed for fish cultivation
17. Usable throughout the year		17. Providing training to women
18. Profitability		18. Emphasizing more on crop diversification
19. Usable by women		
20. Technology must be appropriate		
21. Long lasting effect		

Table 4. Potential sustainable technologies as identified by different respondents from different organizations (N=53)

Potential sustainable technologies	Identifying organization (s)
1. Rice-cum-fish culture	DAE, DoF, CARE, BRDB
2. STP (Spaced Transplantation) in sugarcane	DAE, BSFIC
3. Use of compost in homestead gardening	DAE, ASA, BRDB, CARE
4. Introduction of Crop Diversification Program	DAE, BAUFSES
5. Introduction of Integrated Pest Management	DAE, BAUEC, CARE
6. Rearing of poultry birds and goats	BRDB, BRAC
7. Beef fattening	BRDB
8. Hatching of eggs using husks	BRDB, BRAC
9. Feeding water hyacinth to cows	BRDB
10. Apiculture	BRDB
11. Homestead vegetable production	DAE, BRDB, BAUEC, CARE
12. Cultivating leguminous crops	DAE
13. Planting trees in the institutional premises	DAE, DoF
14. Sericulture	BRAC
15. Roadside tree planting	DAE, DoF
16. Crop rotation	DAE
17. Organic fish culture	BRDB, DANIDA
18. Duckweed production in ponds	DANIDA
19. Cultivating fish in mini ponds	BAUEC, BRDB
20. Production of quality seeds	BSF
21. Vegetable production in pond boarders	DANIDA
22. Group formation of farmers	DAE
23. Rearing heifers/bulls	BRDB
24. Rearing day old chicks	BRDB
25. Carp poly culture	MAEP
26. Use of urea molasses	DANIDA

number of technologies have been identified in this way. The technologies are listed in Table 4.

3.3.6 *Extension approach and methods of technology dissemination*

Extension approaches varied among the different organizations. The organizations which were interviewed have the following range of approaches, and used either individual and/or group methods with their clients. The results are furnished below:

Government Organizations

1. Department of Agricultural Extension (DAE)

I. Approach: Both Individual and Group Approach

- Target group: All households
- Objectives: (a) technology transfer
(b) build up farmers' organization
- Methods of technology dissemination:
(a) advice
(b) training

- (c) demonstration
- (d) farm and home visits

II. *Training*

- Aspects:
- (a) extension methods
 - (b) new crop varieties
 - (c) plant protection
 - (d) rice-cum-fish culture

Clientele:

- (a) all categories of farmers
- (b) among trainees 10% are women
- (c) training arranged specifically for women

Venue for training: Thana Headquarters

Trainer: TAO and SMO

2. **Bangladesh Rural Development Board (BRDB)**

1. *Approach*: Group Approach

- Target group: Resourceless farm families
- Objectives:
- (a) build up local farmers' organization
 - (b) transfer of particular technology
 - (c) Combination of both

Methods of technology dissemination:

- (a) information giving
- (b) giving advice
- (c) education and training
- (d) participatory problem-solving

II. *Training*:

- Aspects:
- (a) income earning activities
 - (b) saving behavior
 - (c) health and sanitation
 - (d) group dynamics

Clientele: Groups members

Venue: Training Center

Trainer: TRDO/Technical Trainer, TRT/TAO/TFO/TLO

Non-Government Organizations

1. **Bangladesh Rural Advancement Committee (BRAC)**

I. *Approach*: Group Approach

- Target group: Group members (below 0.50 acre of land holdings)
- Objectives:
- (a) transfer of particular package of technology
 - (b) social awareness
 - (c) fundamental education
 - (d) provide credit
 - (e) build up farmers' organization

Methods of technology dissemination:

- (a) advice
- (b) education and training
- (c) participatory problem solving

II. *Training*

Aspects:	(a) extension methods (b) income generation
Clientele group:	Group members
Venue:	TARC
Trainer:	Technical Trainer

2. DANIDA

I. *Approach*: Individual

Target group:	All households
Objectives:	Transfer of a particular technology
Methods of technology dissemination:	(a) information (b) advice (c) education and training

II. *Training*:

Aspects:	(a) extension methods (b) in the technologies
Clientele:	Individual farmer
Venue:	In the field or home
Trainer:	Extension Worker / Aquaculture Officer

3. Association for Social Advancement (ASA)

I. *Approach*: Group approach

Target group:	Landless women
Objectives:	Build up local farmers' organization
Methods of technology dissemination:	(a) information (b) advice (c) education and training (d) participatory problem solving

II. *Training*:

Aspects:	Extension methods
Clientele group:	Group members
Venue of training:	Training center
Trainer:	Unit Officer

4. Technical Assistance Center (TAC)

I. *Approach*: Group approach

Target group:	Small families
Objectives:	Technology transfer
Methods:	(a) information (b) discussion (c) motivation

II. *Training:*

Aspects:	(a) extension methods (b) particular technology
Clientele group:	Group members
Venue of training:	In the office
Trainer:	Executive Director

3.3.8 *Conclusion and recommendations*

The findings reveal that although only recently a few NGOs have started to give emphasis on different aspects of environmental degradation and sustainability issues in agriculture, the public sector organizations are still lagging behind on this matter. The government organizations have concentrated their efforts mainly to fulfil the production objectives through different package production programs. However, extension workers were found to a some extent be conscious about the environmental and climatic changes, decreasing water availability, deforestation, decrease in open water fish production, decline in soil fertility and above all environmental pollution (Cf. Table 2). Extension workers had also their own perception about sustainability criteria and accordingly some technologies have been identified as sustainable. The means of sustainability had also been identified by the extension workers. However, the extension approaches and methods of disseminating the technologies have not been identified as congenial for addressing the issues of environmental degradation and sustainable agricultural development.

Therefore, in order to give emphasis on reducing further environmental degradation and attain sustainable agricultural development the concerned authorities and policy makers should give due cognizance and thrust on the following:

1. creating active, interactive, productive and viable homogenous strong villagebased farmers' cooperatives.
2. using different mass media effectively for disseminating clear-cut messages on environmental pollution and degradation. For this the use of radio, local innovative farmers as well as farmer to farmer communication should get top most priority.
3. ensuring farmers' participation in all grassroots level planning.
4. developing appropriate technologies to meet local situations and environmental variations.
5. designing and producing extension materials in a way that farmers can understand and grasp the idea of environmental degradation. In order to reach all categories of clientele different types of materials would be necessary.
6. integrating activities of all GOs, NGOs and commercial organizations at least on the issues of environmental degradation and sustainable agricultural development.
7. creating mass awareness, developing strong will and determination among common people, and above all forcing the feeling of commitment from all sections of people in the

community-the politicians, bureaucrats, academicians, businessmen, farmers and all others.

Abbreviations

ASA	: Association of Social Advancement
BAUEC	: Bangladesh Agricultural University Extension Center
BAUFSES	: Bangladesh Agricultural University Farming Systems and Environmental Studies
BARD	: Bangladesh Academy for Rural Development
BRAC	: Bangladesh Rural Advancement Committee
BRDB	: Bangladesh Rural Development Board
BSF	: Bangladesh Seed Foundation
BSFIC	: Bangladesh Sugar and Food Industries Corporation
BWDB	: Bangladesh Water Development Board
CARE	: Center for American Relief Everywhere
DAE	: Department of Agricultural Extension
DANIDA	: Danish International Development Agency
DoF	: Department of Fisheries
GB	: Grameen Bank
GO	: Government Organization
IPM	: Integrated Pest Management
KSS	: Krishak Samabaya Samittee
MAEP	: Mymensingh Aquaculture Extension Project
MBSS	: Mahila Bittyahen Samabaya Samittee
NGO	: Non-government Organization
SMO	: Subject Matter Officer
SRP	: Systems Rehabilitation Project
TAC	: Technical Assistance Center
TAO	: Thana Agriculture Officer
TARC	: Training and Resource Center
TFO	: Thana Fisheries Officer
TRDO	: Thana Rural Development Officer
TRT	: Technical Resource Team

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バングラデシュにおける環境悪化との闘い ——持続的農業技術のための新しい推進力——

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持続的農業発展の達成において、環境悪化を縮減することは今日では最も重要な議論の焦点のひとつである。もちろん、環境悪化はほとんど各国において異なった頻度で起こっている。この研究では、バングラデシュにおける環境悪化の異なった様相に焦点を当てる。経験に基づく資料は1994年4月から1996年6月の間に集められたものである。調査結果は過去10年間にバングラデシュでは多くの環境悪化が起こっている。近代的な稲の品種や野菜の耕作は化学肥料や農薬の使用に伴い増大しており、反対に、森林面積や豆科作物や油子作物の生産は著しく減少した。調査結果はまた、どの政府機関も今のところ持続的農業発展だけでなく、環境悪化を縮減するためのいかなる計画もちあわせていない。それにもかかわらず、いくつかの NGO が環境悪化の縮小と農業における持続的発展のための計画を持ち始めた。環境問題を基礎にして、政策含意に向けた持続性規準を発展させるための試みが行われる。

キーワード：農業, 環境悪化, 技術, 持続性