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MERITS AND DEMERITS OF ECOLOGICAL AGRICULTURE AND MODE OF ITS ADOPTION IN BANGLADESH*

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ABSTRACT

The main purpose of stusdy was to discuss about the merits and demerits of ecological agriculture and to determine its mode of adoption in Bangladesh. Attempt was made to search internet, available books, journals and printed materials from different sources of home and abroad during the period from June 2004 to October 2008 and it was revealed that there was on going debate in favour of and against ecological agriculture as it has many merits and demerits. For determining the mode of adoption of ecological agriculture in Bangladesh, data were collected from a sample of 144 ecological farmers drawn from a population of 478 ecological farmers of six Area Development Centers (ADCs) of Proshikha with the help of a pre-tested interview schedule during the period from February to August, 2006. Findings revealed that more than half (52.12 per cent) of the total lands of the respondent farmers were cultivated by the mixture of ecological and chemical practices compared to 47.66% of the total land of the farmers were cultivated by absolute use of ecological agricultural practices and only 0.22% of the total land of the farmers were cultivated by absolute chemical inputs.

Keywords: Merits, demerits, scope of adoption, mode of adoption, ecological agriculture

INTRODUCTION

Ecological agriculture means agricultural practices without using any chemical fertilizers and chemical pesticides. Ecological agriculture, also popularly known as organic farming, nowadays has been emerged as a new approach to sustainable agriculture. Many authors consider it to be the farming system which best fulfils the requirements of sustainability (Lampkin, 1990; Gerber and Hoffmann, 1998). The concept of ecological agriculture has been manifested by different terms by different researchers as well as different organizations. All possible non-chemical methods are used for nutrient and pest management for this type of agricultural farming. For example ecological farmers use cowdung, crop residue/weed fertilizer, compost, poultry excreta, farm yard manure, water hyacinth, quick compost/oil cake, green manure, liquid organic fertilizers, biofertilizers etc. to supply plant nutrient in the field. They make proper weeding and eradication of insect/disease attacked plants/plant parts, put tree branches in the field and use quality seed, crop rotation, ash, hand/hand net, botanical pesticides (neem: *Azadirachta indica*, nishinda: *Vitex negundo*, biskatali: *Polygonum orientale*, garlic: *Allium sativum* extract etc.), beneficial insects, light trap, pest resistant varieties etc. in their crop fields to control crop pests.

According to Zhengfang (1995), "Ecological agriculture is a comprehensive agricultural production system intensively engaged in accordance with the principles of ecology". Remmers (1993) defined ecological agriculture as those systems, which have arisen as a reaction to the dominant conventional agriculture of modern times and it is aimed at ensuring sustainable land use.

Narwal *et al.* (2000) of Haryana Agricultural University, India gave the definition of ecological agriculture as those practices which reduce the use of outside inputs on farms. Ye *et al.* (2002) revealed that Chinese ecological agriculture (CEA) is a relatively recent agricultural and rural development approach, which has emerged in the light of continuous efforts in exploring sustainable agriculture and rural development in modern China. Li and Li (2000) stated that Chinese ecological agriculture (CEA) is an agricultural system with ecological rationality and a positive function (recycling), which is created and developed through system

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engineering methods according to ecological and economic principles. According to Jaisingh (2005), "Agriculture without chemicals, chemical fertilizers or sprays is generally understood as organic agriculture". He further stated that a crop cultivated through composts in place of chemical fertilizers without using even a trace of chemical sprays and powders is organic crop because its yield is completely healthful for eaters. In brief it can be stated that microbial compost-agriculture is organic agriculture which is medically beneficial too. It is also known as carbonic agriculture.
USDA Study Team on Organic Farming (1980) defined that organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent of feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes as well as biological pest control for maintaining soil productivity to supply plant nutrients, and to control insects, weeds and other pests.

Murakami (1991) revealed that if we understand the problems with chemical agriculture, we soon realize that there is no option but to find an alternative method of agriculture. This method should have the following criteria:

- Don't disturb the natural environment
- Ensure as much or more productivity as chemical agriculture
- Ensure sustainability
- Depend less on external inputs

As stated by Joshi and Prabhakarasetty (2005) the basic principles of organic farming or ecological agricultural practices can be enumerated as follows:

- A crop should be able to grow and yield successfully utilizing the nutrients from soil of high fertility by enhanced microbial activities.
- Pests and diseases of a crop should be essentially controlled by natural enemies, predators, bio-control agents or by use of natural products/bio-extracts.
- All possible organic sources available in nature should be used in digested/semi-digested/undigested condition to supply the plant nutrients.
- Natural resistance of some crops to pest and diseases should be conveniently exploited for the benefit of crop production. No practice, which would suppress the natural resistance, is encouraged in organic farming.
- The process of biological nitrogen fixation should be encouraged in all possible ways during the process of crop husbandry. Alternation of cropping systems, inoculation of suitable bacterial culture and management for better bacterial activity in the soil may help in better nitrogen fixing activities in the soil.
- The human interference in the crop husbandry activities should never obstruct the natural processes of an eco-system and should never upset the natural balance available between components of an eco-system. On the contrary, such activities should be supportive of natural processes.
- Biomass management in a given situation to encourage self-supportive natural system of providing nutrients in conjunction with enhanced biological activity should be a prioritized consideration in organic farming.
- Nature's friends such as earthworm and spiders should be recognized and their activity should be encouraged for the benefit of soil fertility, crop growth and pest control.

Some scientists thought that ecological agriculture was the best alternative for sustainable agriculture but some were against the use of ecological agricultural practices. There were arguments in favour of both the aspects. Food and Agriculture Organization (FAO) of the United Nations recognized

ecological agriculture as a suitable option for sustainable agriculture (IFOAM, 1996). Many authors raised strong arguments for introduction of ecological agriculture. But, some opponents felt that ecological agriculture was against the process of scientific development (Pretty, 1995).
In many parts of the world, this practice is already in use. As a new farming technology, it is necessary to examine its merits, demerits and mode of adoption. But very few research works had tried out to do the task. Considering these facts, the study was made to discuss the merits and demerits of ecological agriculture and to determine its mode of adoption in Bangladesh.

RESULTS AND DISCUSSION

Merits of ecological agriculture

Ecological agriculture can overcome the problems of chemical agriculture. Therefore, before going to discuss about the merits of ecological agriculture it is better to discuss about the problems of chemical agriculture. From the ecological point of view, chemical agriculture is totally anti-natural and destructive method (Murakami, 1991). This chemical agriculture creates the following problems:

1. **Degradation of the soil**

Degradation of soil due to chemical agriculture and diminishing supply of humus may occur on the following points:

- Soil becomes hard due to breaking down of soil structure
- Decreases water holding capacity of soil
- Decreases nutrient holding capacity of soil
- Creates deficiency of micro-nutrients
- Micro-organisms decrease in number and become inactive
- Soil becomes acidic due to P^H imbalance
- Elimination of humus becomes accelerated

2. **Increase of pest problem**

Degraded soil is unhealthy soil. Unhealthy soil grows unhealthy plants that are easily attacked by pests (insects and diseases). Chemical pesticides used by the farmers to control pests are poisonous and harmful to all living things. There is no consideration of the root cause of pest attack. Consequently pest problems remain unsolved and gradually become worse. A quick generation cycle and the production of huge number of eggs quickly become the characteristics of insects. These characteristics enable the insects to develop resistance to the chemical insecticides quickly. So, farmers are forced to use more pesticides or stronger pesticides to control the insects. But again, the insect generations become resistant to the pesticides. A second factor is the disappearance of natural enemies of pests (e.g. spiders, frogs, birds, etc.) which eat the insects. The natural enemies of pests become fewer in number and have a slower generation cycle and therefore are less productive than the insects. They can not develop the same resistance against chemical pesticides and consequently are killed and disappeared. The result creates imbalanced ecosystem in which only the insects can break out.

3. Degradation of food quality

The products grown with chemical fertilizers and chemical pesticides are low in quality and create health hazards. The farmers who use these chemicals are affected first, and those who eat the poisoned products become affected consequently.

In this regard Murakami (1991) established a vicious cycle of chemical agriculture (Fig. 1.)

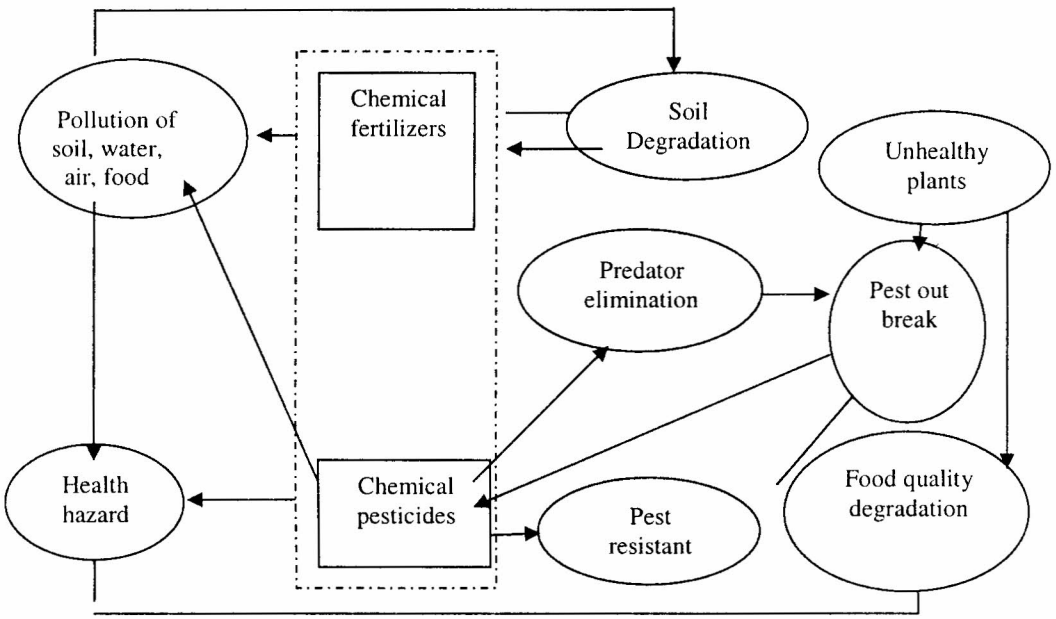

Fig. 1. Vicious cycle of chemical agriculture

After understanding the above problems of chemical agriculture one can easily understand the merits of ecological agriculture, because ecological agriculture was introduced to solve the problems of chemical agriculture. According to Joshi and Prabhakarasetty (2005) major merits of ecological agriculture or organic farming are:

- As both nutrient needs and pest control are met by non-chemical methods, the entire eco-system, for which a package of organic farming is developed, remains free from all sorts of hazards by chemicals. The soil fertility, soil fauna, soil micro flora and crop growth remain in perfect harmony leading to sustainable system.
- Pollution by agro-chemicals at various levels of manufacturing, handling, packing, application by various inhalation, ingestion, and dermal routes is fully avoided. Non-point contamination of water and agricultural produces as well as the health complications due to such contamination are also avoided.
- The soil regenerates its original status of a dynamic living system with harmonious interactions of its biological, physical and chemical components. As the soil organic matter is improved, the porosity, infiltration and structure of soil are drastically improved. This helps in better moisture conservation and would reduce the erosion losses substantially.
- In long term analysis, organic farming practices are more cost effective, as sustainable yield levels could be achieved at no extra cost of chemical brought from outside. As the system can retain their self-supportive nature in the long run, assured returns are possible in most crops without any cost of fertilizer and other agro-chemicals.
- Organic farming can result into a fairly pollution free products from agriculture and in turn, helps the society to be pollution free. Human and animal populations are not posed to the short term and long term ill-effects of consuming agro-chemicals through organic food.

- Large subsidies on fertilizers and other agro-chemicals now draining the national exchequer and foreign exchange reserves are curtailed.

Demerits of ecological agriculture

Though ecological agriculture has many advantages or merits, it has some demerits also. In some cases, by using ecological agriculture, the yield might fall due to lower nutrient content of ecological plant nutrient management practices. Again at the time of severe pest attack, it is not easy to make pest control by ecological pest management practices. Joshi and Prabhakarasetty (2005) mentioned some demerits of ecological agriculture as follows:

- Uniform practices of organic farming can not be developed for all situations and for all crops. Organic materials used in organic farming also differ vastly in various places.
- Dramatic and large benefits in terms of yield and returns cannot be expected in short time from organic farming practices.
- Many organic manures are bulky in nature with low concentration of nutrients. Their carrying to distant places may pose problems of increased cost and labour.
- Most high yielding varieties/hybrids of cultivated crops, developed in the past 3-4 decades are turned to their high responsiveness to application of fertilizers. Their nutrient demands are so high that, meeting their requirement by organic sources alone is economically non-feasible in all the situations. Some of them may not respond positively to organic farming practices immediately.

Modes of Adoption of Ecological Agriculture

Most of the farmers of the study area were using selected ecological agricultural practices for cultivating some specific types of crops in some particular land. Some were using the mixture of chemical and ecological agricultural practices for their crop production. Some were using absolute ecological agricultural practices in some portion of land and mixing types of practices in other portion of their land for the same crop. From these viewpoints, four modes of application of ecological agricultural practices were considered for this study. These were:

Mode-I	:	No use of ecological agricultural practices i.e. absolute use of chemical fertilizers and chemical pesticides without ecological agricultural practices
Mode-II	:	Less use of ecological agricultural practices with large use of chemical fertilizers and chemical pesticides (large use of chemical fertilizers means use of $\geq$50% of the recommended doses of chemical fertilizers as suggested by BARC 2005 and large use of chemical pesticides means use of chemical pesticides for pest control at normal attack.)
Mode-III	:	Large use of ecological agricultural practices with less use of chemical fertilizers and chemical pesticides (less use of chemical fertilizers means use of <50% of the recommended doses of chemical fertilizers as suggested by BARC 2005 and less use of chemical pesticides means use of chemical pesticides for pest control only at the time of severe attack.)
Mode-IV	:	Use of absolute ecological agricultural practices i.e. use of ecological agricultural practices without any chemical fertilizers and chemical pesticides

On the basis of the adoption of the above modes of ecological agriculture individually or in combination, the percentage distribution of the respondent farmers are shown in Table 1.

Table 1. Percentage distribution of the respondent farmers on the basis of the adoption of the modes of ecological agriculture individually or in combination

Sl. No.	Combination of mode(s)	Respondents' Percentage
01	Mode-I, II, III & IV	01
02	Mode-II, III & IV	20
03	Mode-II & IV	08
04	Mode-III	01
05	Mode-III & IV	69
06	Mode-IV	01
	Total	**100**

Table 1. revealed that most (69%) of the respondent farmers used Mode-III & IV combinedly followed by 20 percent of the respondent farmers using Mode-II, III & IV combinedly. The third most important was Mode-II & IV combinedly which was used by eight percent respondents. One percent farmers used Mode-I, II, III & IV combinedly. Another one percent respondent used Mode-III and last one percent respondent used Mode-IV or absolutely ecological agricultural practices.

The respondents had a total of 147.95 hectares of total cropped area on which they cultivated different types of crops under the above four modes round the year. Types of crops cultivated and modes of application of selected ecological agricultural practices with area coverage are presented in Table 2. and described below:

Mode-I : In 0.32 hectares of land, the respondents cultivated amon and boro rice (*Oryza sativa*) only by using chemical fertilizers and chemical pesticides. They never used any ecological agricultural practices in these fields (0.22% of the total land of the farmers).

Mode-II: The respondents cultivated amon and boro rice (*Oryza sativa*), wheat (*Triticum aestivum*), chilli (*Capsicum spp.*), onion (*Allium cepa*), tomato (*Lycopersicon esculentum*), Brinjal (*Solanum melongena*), and banana (*Musa spp.*) with less use of ecological agricultural practices and large use of chemical fertilizers and chemical pesticides in 15.7 hectares of land (10.61% of the total land of the farmers).

Mode-III: The respondents cultivated aus, aman and boro rice (*Oryza sativa*), wheat (*Triticum aestivum*), jute (*Corchorus spp.*), sweet potato (*Ipomea batatus*), oilseeds, chilli (*Capsicum spp.*), onion (*Allium cepa*) along with 30 other crops with large use of ecological agricultural practices and less use of chemical fertilizers and chemical pesticides in 61.41 hectares of land (41.51% of the total land of the farmers).

Mode-IV: The respondents cultivated amon rice (*Oryza sativa*), wheat (*Triticum aestivum*), jute (*Corchorus spp.*), sweet potato (*Ipomea batatus*), pulses, oilseeds, chilli (*Capsicum spp.*), onion (*Allium cepa*), garlic (*Allium sativum*) along with 32 other crops with the use of absolute ecological agricultural practices in 70.52 hectares of land (47.66% of the total land of the farmers). In case of cultivation of pulses, spinach (*Beta vulgaris*), carrot (*Daucus carota*) they used absolute ecological agricultural practices in their 100 percent land for those crops. In case of bamboo garden they never used any external inputs like organic or inorganic fertilizers and pesticides, that type of bamboo cultivation was also treated as ecological agricultural practice.

Table 2. Crop wise modes of application of selected ecological agricultural practices with area coverage

Sl. No.	Name of Crops	Mode-I		Mode-II		Mode-III		Mode-IV		Total area of the crop (ha) (3+5+7+9)
		Area (ha)	% of Total (3÷11)× 100	Area (ha)	% of Total (5÷11)× 100	Area (ha)	% of Total (7÷11)× 100	Area (ha)	% of Total (9÷11)× 100	
1	2	3	4	5	6	7	8	9	10	11
1	Aus*	0.00	0.00	0.00	0.00	0.39	100.00	0.00	0.00	0.39
2	Amon**	0.16	0.76	3.66	17.27	13.84	65.26	3.54	16.70	21.21
3	Boro***	0.16	0.57	10.43	36.95	17.63	62.48	0.00	0.00	28.22
4	Wheat	0.00	0.00	0.51	20.49	1.76	71.32	0.20	8.18	2.47
5	Jute	0.00	0.00	0.00	0.00	8.96	90.11	0.98	9.89	9.95
6	Sweet potato	0.00	0.00	0.00	0.00	0.06	12.56	0.40	87.44	0.45
7	Pulses	0.00	0.00	0.00	0.00	0.00	0.00	0.63	100.00	0.63
8	Oilseeds	0.00	0.00	0.00	0.00	0.61	66.92	0.30	33.08	0.91
9	Chilli	0.00	0.00	0.22	6.60	0.12	3.64	2.98	89.76	3.32
10	Onion	0.00	0.00	0.07	2.19	0.13	3.90	3.13	93.91	3.33
11	Garlic	0.00	0.00	0.00	0.00	0.05	4.38	1.16	95.62	1.21
12	Turmeric	0.00	0.00	0.00	0.00	0.08	2.53	3.12	97.47	3.20
13	Ginger	0.00	0.00	0.00	0.00	0.08	15.64	0.44	84.36	0.52
14	Coriander	0.00	0.00	0.00	0.00	0.01	1.28	0.62	98.72	0.63
15	Potato	0.00	0.00	0.00	0.00	2.39	61.44	1.50	38.56	3.90
16	Papaya	0.00	0.00	0.00	0.00	0.01	1.79	0.66	98.21	0.67
17	Tomato	0.00	0.00	0.11	2.32	3.40	75.12	1.02	22.56	4.52
18	Brinjal	0.00	0.00	0.50	6.36	4.07	51.51	3.32	42.12	7.89
19	Bottle gourd	0.00	0.00	0.00	0.00	0.28	5.91	4.38	94.09	4.66
20	Sweet gourd	0.00	0.00	0.00	0.00	0.13	3.16	4.10	96.84	4.24
21	Wax gourd	0.00	0.00	0.00	0.00	0.24	6.42	3.54	93.58	3.79
22	Bean	0.00	0.00	0.00	0.00	0.23	5.51	3.96	94.49	4.20
23	Indian spinach	0.00	0.00	0.00	0.00	0.03	3.31	0.94	96.69	0.97
24	Lal shak	0.00	0.00	0.00	0.00	0.34	9.03	3.47	90.97	3.81
25	Amaranth	0.00	0.00	0.00	0.00	0.33	8.44	3.56	91.56	3.89
26	Spinach	0.00	0.00	0.00	0.00	0.00	0.00	0.26	100.00	0.26
27	Radish	0.00	0.00	0.00	0.00	0.33	19.71	1.35	80.29	1.68
28	Pointed gourd	0.00	0.00	0.00	0.00	0.45	52.60	0.40	47.40	0.85
29	Cabbage	0.00	0.00	0.00	0.00	0.67	32.54	1.39	67.46	2.05
30	Cauliflower	0.00	0.00	0.00	0.00	0.79	33.10	1.60	66.90	2.38
31	Snake gourd	0.00	0.00	0.00	0.00	0.27	9.70	2.52	90.30	2.79
32	Teasle gourd	0.00	0.00	0.00	0.00	0.08	3.02	2.60	96.98	2.68
33	Okra	0.00	0.00	0.00	0.00	0.40	24.83	1.20	75.17	1.60
34	Bitter gourd	0.00	0.00	0.00	0.00	0.05	2.18	2.20	97.82	2.25
35	Ridged gourd	0.00	0.00	0.00	0.00	0.04	3.95	0.97	96.05	1.01
36	Sponge gourd	0.00	0.00	0.00	0.00	0.11	24.51	0.35	75.49	0.46
37	Carrot	0.00	0.00	0.00	0.00	0.00	0.00	0.32	100.00	0.32
38	Cucumber	0.00	0.00	0.00	0.00	0.66	20.01	2.62	79.99	3.28
39	Pineapple	0.00	0.00	0.00	0.00	0.93	95.88	0.04	4.12	0.97
40	Banana	0.00	0.00	0.20	10.80	1.38	73.85	0.29	15.35	1.87
41	Fruit	0.00	0.00	0.00	0.00	0.03	1.25	2.52	98.75	2.55
42	Timber	0.00	0.00	0.00	0.00	0.05	3.17	1.62	96.83	1.67
43	Bamboo	0.00	0.00	0.00	0.00	0.00	0.00	0.32	100.00	0.32
Grand Total		**0.32**	**0.22**	**15.70**	**10.61**	**61.41**	**41.51**	**70.52**	**47.66**	**147.95**

Note: Column 4 = (Column 3 / Column11)×100 Column 6 = (Column 5 / Column11) ×100
Column 8 = (Column 7 / Column11) ×100 Column 10 = (Column 9 / Column11) ×100
Column 11 = Column 3 + Column 5 + Column 7 + Column 9

*Varieties of rice cultivated during March to August, **Varieties of rice cultivated during usually June to December and ***Varieties of rice cultivated during November to May in each year

Findings again revealed that more than half (52.12 per cent) of the lands of the respondent farmers were cultivated by the mixture of ecological and chemical practices. It was due to the fact that the farmers were not dependent on fully ecological practices or on fully chemical practices. The respondent farmers were the ecological farmers of Proshikha. The general farmers of Bangladesh are more dependent on chemical inputs in agricultural practices

Though there are many merits of ecological agriculture, lower nutrient content of ecological plant nutrient management practices and lower capacity of crop pest control of ecological pest management practices at the time of severe attack are the main problems of ecological agriculture. For these reasons, it was found that more than half (52.12 per cent) of the lands of the respondent farmers were cultivated by the mixture of ecological and chemical practices. Research efforts combined with strong commitment by farmers can be helpful in overcoming the problems. By minimizing these problems through introducing high capacity ecological plant nutrient management and ecological pest management practices, there is scope of adoption of ecological agricultural practices in farming situation with varying degree. Joshi and Prabhakarasetty (2005) reported that the scope of organic farming or ecological agriculture cannot be assessed on a uniform scale at global level. The criteria of assessment and in turn the extent of scope of organic farming vary according to soil, climate, cropping system, vegetation, irrigation, allied activities (animal husbandry, sheep rearing, poultry, piggery, fisheries etc.) as well as harmony achieved between different components of each eco-system.

According to Rahman (2001), a widespread introduction of ecological agriculture in Bangladesh could be justified through the following arguments:

- Ecological farming offers the possibility of long term sustainability;
- Ecological agriculture is affordable for resource poor farmers;
- Problem of rural unemployment could be mininimized through ecological farming; and
- Bangladesh has a long heritage of farming with traditional wisdom, which acts as bases for ecological knowledge.

Whatever might be the result of on-going debate on introduction of ecological agriculture in a country like Bangladesh, this approach of farming should get an opportunity to prove its feasibility (Islam, 2002). Within the meaning of broad concepts and varying principles of ecological agriculture, it can be adopted for different crops and in different situations logically and gradually.

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