

Agriculture in Bangladesh — Recent Trend and Agroenvironment toward Sustainability

Mahbub ROBBANI*, Salah Uddin SIDDIQUEE**, Sourovi ZAMAN**
and Hiroshi NAKAMURA**

*Department of Horticulture, Patuakhali Science and Technology University, Dumki, Patuakhali, Bangladesh

**Education and Research Center of Alpine Field Science, Faculty of Agriculture, Shinshu University, Japan

Summary. Bangladesh is an agriculture-based country whose 85% people depends on agriculture for their daily livelihood. Soil fertility and agro ecological condition is favorable for growing a large number crops. Recently the land productivity is declining due to HYV (High Yielding Variety) production, intensive cropping, and indiscriminate use of fertilizers, pesticides and water irrigation. Dependence on agrochemicals leads the negative effect on environment and causes natural-health hazards. Practicing IPM (Integrated pest management) helps to grow healthy crops and improve environment and community health. This is a reviewed paper based on secondary data (year 1994 to 2000) published in different literatures focusing recent agricultural trends and agrochemicals use profile of Bangladesh in context of sustainable agriculture.

Key word: Bangladesh; sustainable agriculture; agrochemicals; integrated pest management

Introduction

Bangladesh is predominantly an agricultural country where agriculture has been viewed as a fundamental contributor to the economy. The climate of Bangladesh is subtropical with a distinct but mild winter season. Most Bangladeshis earn their living from agriculture. About 85 percent of the total population live in rural areas and are directly or indirectly engaged in a wide range of agricultural activities. The agriculture sector plays a very important role accounting for 31.6 percent of total GDP in 1997–98. The government has therefore accorded the highest priority to make this sector commercially profitable, technically feasible and environmentally sound one. Labor intensive farming, supplemented with organic fertilizer and green manure comprise traditional farming practices of Bangladesh. However, the use of chemical fertilizers and pesticides has been included with the introduction of high yielding varieties of different crops. Until

recently, many reports have been published regarding the environmental impacts of using agrochemicals in the crop fields. In this paper an attempt has been made to summarize the recent agricultural trends and agrochemicals use profile of Bangladesh in context of sustainable agriculture. This report was presented at the 1st AFC International Symposium (–Technologies for Sustainable Agriculture in Asia–) held at April 26 of 2003 in Faculty of Agriculture, Shinshu University.

Methodology

This paper is written based on secondary data of different published literatures. Journal papers, books, booklets, bulletins and other reports from government and non-government organizations are the main sources of data.

Results and Discussion

Present state and prospects of Bangladesh agriculture

Some basic facts on agriculture are presented in

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Table 1. Basic facts of Bangladesh agriculture.

Items	Data
Area of Bangladesh	147570 sq.km
Total population (1999)	128.1 million
GDP (1998-99)	755.73 billion Tk.
GDP growth rate (1998-99)	5.2%
Agril. growth rate (1998-99)	5.0%
No. of rural household	17.83 million
No. of non farm household	6.03 million
No. of farm household	11.80 million
Small household	80% (9.42 million)
Medium household	17.50% (2.08 million)
Large household	2.50% (0.3 million)
No. of Agril. labor household	6.40 million
Cultivated area	17.77 million acres
Cropping Intensity (1996-97)	174%
Cultivated area per household	1.5 acres
Irrigation area	8.59 million acres

Source : Statistical Year Book of Bangladesh, 98, BBS³⁾

Table 2. Utilization of land in Bangladesh for the production of different crops and groups of crops in 1997-98.

Crops	Area (ha)	Percent of total cropped area
Rice	10263192	72.85
Wheat	804543	5.71
Other cereals	89438	0.63
Pulses	683943	4.85
Oil seeds	458120	3.25
Fibre crops	614334	4.36
Sugar crops	190613	1.35
Fruits	184543	1.30
Vegetables	200731	1.42
Potato	136383	0.96
Sweet potato	41684	0.29
Spices and condiments	143668	0.22
Coconut	31971	0.25
Betel leaf	14974	0.34
Tea	48564	0.23
Tobacco	32780	0.79
Others	112108	0.01
Total	14087607	100

Source : Statistical Year Book of Bangladesh, 98, BBS³⁾

Table 1. For developing country like Bangladesh, self sufficiency has been and will remain as key focus in food production strategy in order to meet food deficiency. The country is blessed with natural soil fertility and the agroecological condition is suitable for growing a large number of crops of both tropical and mild temperature origin. Princi-

pally, rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.) are the main crops, occupying most of the cultivated land. Sugarcane (*Saccharum officinarum* L.), jute (*Corchorus* sp.), pulses, fruits, roots and tubers, and vegetables are also grown. The areas under different groups of crops as reported by the Statistical year book of Bang-

ladesh (BBS) 1997-98 are shown in Table 2. The production of cereal crops has increased at least by double as a result of using HYV than local variety, application of balance fertilizer, adequate supply of irrigation water and management of insects and pests. Consequently, other farming practices like vegetable cultivation, livestock and poultry production, fish production etc. are underway to fulfill the target³⁾.

Bangladesh agriculture is now in the process of transformation from subsistence farming into commercial farming. Meanwhile, Bangladesh has entered into the European market for export of vegetables and other high value crops. This process opens a vista to private sector investment in the areas of production of high value crops, seeds (especially hybrid seeds), agro-processing enterprises etc. An investigation by the Food and Agriculture Organization (FAO) of the United Nations on the current status of land productivity in Bangladesh revealed that there is a general trend towards declining or stagnating crop yields. These adverse trends are considered to be due to the intensive cropping through indiscriminate use of fertilizer and pesticides, use of water irrigation, total removal of biomass from the agricultural fields¹³⁾.

Opportunities in the agricultural sector

i) Agriculture sector is the single largest contributor to GDP, ii) crop production system is highly labor intensive and there is an abundance of labor in the country, iii) agriculture is the largest source of employment for skilled and unskilled labor, iv) favorable natural environment generally exists throughout the year for crop production, v) wide range of bio-diversity exists for different crops, vi) agricultural commodities are the main sources of nutrition including protein, minerals and vitamins, vii) agricultural commodities have comparatively higher value addition than non-agricultural commodities.

Constraints in the agricultural sector

i) Agriculture is dependent on the vagaries of nature and is risky, ii) availability of cultivable land is decreasing, iii) widespread poverty among

the population engaged in agriculture, iv) lack of required capital for agricultural activities, v) inadequacy of appropriate technology considering farmers socio-economic conditions, vi) uncertainty of fair price of agricultural commodities due to underdeveloped marketing system, vii) agricultural commodities are rapidly perishable and post harvest losses are too high, viii) limited knowledge of common people about the nutritional value of agricultural commodities including vegetables and fruits.

Natural disaster, affecting agriculture

Bangladesh witnessed almost thirty major floods during the last fifty years. However, the flood of 1998 has surpassed all past records of natural disasters of the century in terms of its duration, coverage and the enormity of damages caused. As per preliminary estimates on crop losses, crops over 1.45 million hectares of land have been damaged. About 21,957 livestock is estimated to have been lost. Due to the geographical location, floods are almost recurrent every year. Though battered by bad weather, farmers have always demonstrated their spirit to overcome and to turn a crisis into an opportunity, as agriculture in most cases is the sole life-support mechanism.

Agricultural development strategy

The government commitments toward the agricultural development includes: i) timely supply of agricultural inputs at affordable prices, ii) appropriate action plan for agricultural credit and marketing of agricultural products, iii) government support to agriculture, iv) priority for the development of agro-based small and medium industries, v) enhanced rate of private sector-participation in different sectors of agriculture i.e. seeds, fertilizer, agro-machinery and also in establishing agribusiness, vi) agricultural mechanization, vii) pest management, viii) greater coordination between the government, NGOs and private sectors, ix) food based nutrition, x) environmental protection in agriculture and finally involvement of women in agriculture.

Agrochemicals use profile

Large scale use of different agro-chemicals has

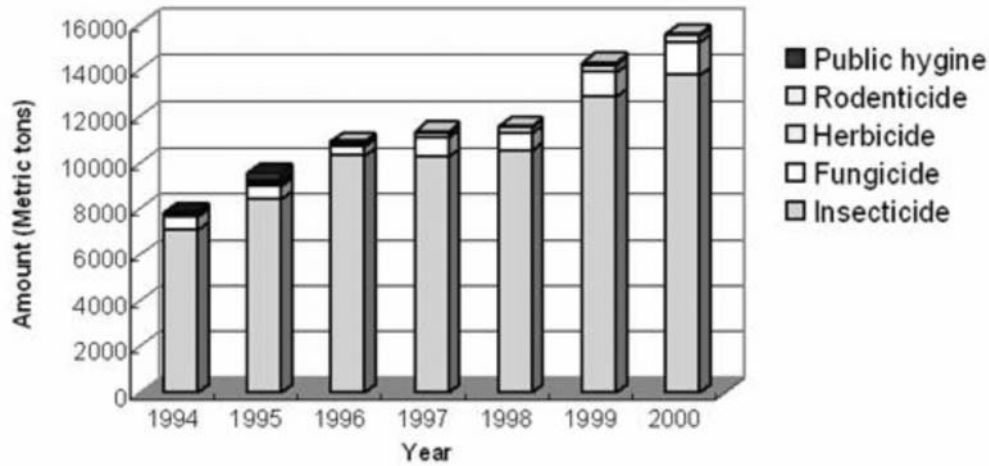


Fig. 1. Use of pesticides in Bangladesh during 1994 to 2000 (BBS, 2001)²⁾

been a characteristic feature of modern agriculture. Agrochemicals use was introduced to Bangladesh in 1957. Since 1980, the amount of acreage covered by ground plant protection measures has actually decreased, though the trends have been erratic. The year 1981 was a peak year for agrochemicals coverage, during which over two million acres of paddy received some form of chemical protection. In 1988, coverage amounted to slightly more than one-half the earlier amount. Total consumption of the spectrum of pesticide types was 4200 metric tons in 1988, an increase of about 7% over the previous year. These include granular pesticides (79% of the total), conventional types (12%), soil insecticides (3%), acaricides (1%), fungicides, rodenticides and weedicides (4%).

Rice is the single most important crop in terms of using pesticides and rice insecticides accounted for nearly 15% of the global crop insecticide market value in 1988¹⁴⁾. In 1988, Japan was the largest consumer of rice pesticides using 45.27% of the total world market followed by Korea (10.04%). Bangladesh has a small share of the total pesticide market, 2.3% and smaller share of the rice pesticide market, 2.04%. Most of the pesticides used in Bangladesh are insecticides (Fig. 1). Over the last decade, about 90% of the insecticides sold have been used for rice. In 1993, the amount of insecticides used was 6906 metric tons (88.63% of pesticides) which is ever increasing following the introduction of modern rice vari-

eties⁸⁾.

Nearly half of all potential food crops of Bangladesh suffer pre and post harvest losses due to pest attack which emphasizes the need for pest management. In Bangladesh, insects cause more serious damage to agricultural crops than diseases. It is estimated that approximately 4000 metric tons of insecticides are being used in the crop sector annually⁴⁾. These include some banned items like DDT, endrin, BHC, aldrin, dieldrin, heptachlore and also some over-toxic Indian items like thiodin. Moreover, there are numerous pesticide products used by the farmers which are formulated by local unauthorized companies⁹⁾. These toxic poisons have been reported to pollute soils and water (both surface and underground), destroy aquatic lives worsen human as well as animal health and adversely affect the natural food chains¹²⁾. Until the last decade, almost all pesticides used in Bangladesh were imported. There are no effective constraints on the types of pesticides imported and used within the country.

Another group of agrochemicals- the synthetic fertilizers are also causing degradation of soil properties that can particularly diminish organic matter content of soil, threaten soil flora and faunal population at an alarming rate⁵⁾. The use of chemical fertilizers started in Bangladesh agriculture in 1951. Fertilizer demand sharply increased with the introduction of high yielding rice varieties. A recent trend of using chemical fertilizers in Bangladesh is shown in Fig. 2. Improper

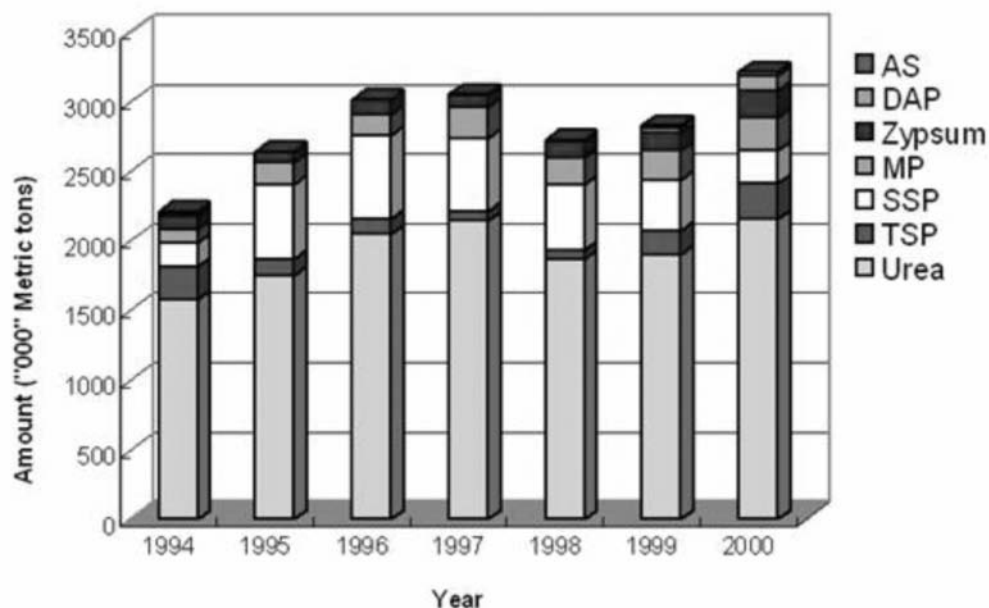


Fig. 2. Use of chemical fertilizers in Bangladesh during 1994 to 2000 (BBS, 2001)²⁾. AS, Ammonium sulphate ; DAP, Di-Ammonium phosphate ; MP, Murate of potash ; SSP, Simple super phosphate ; TSP, Triple super phosphate

soil fertility management causes change in the soil fertility status due to organic matter depletion, nutrient deficiency/toxicity, drainage impedance/water logging followed by degradation of soil chemical and physical properties and soil salinity/acidity. Conceptualizing with sustainable agriculture, it was strongly felt for the development of Integrated Plant Nutrient System (IPNS). The major objectives of IPNS are i) to provide an ideal plant nutrition system, ii) to build up an optimum combination of nutrient resources, iii) to avoid over-exploitation of nutrient resources and iv) to maintain long-term soil fertility and to prevent soil degradation. However, until recently, the impacts from agrochemicals use are not well documented.

Environmental degradation and farmer's attitude

Currently environmental issue has drawn the attention of every nation and is becoming an increasingly important factor, because the global environment is changing rapidly. The environmental crisis happens from air, water, soil, noise, pollution and unforeseen natural hazards. Besides, agricultural practices such as land cleaning, burning, ploughing, leveling, fertilization, irrigation and pesticides spraying are causing the irregular-

ities and deficiencies of the physical environment when these operations are done in the farmer's field. The farmers have been using fertilizers, pesticides and water irrigation to the crop field for a long period. Conversely, vast majority of the countries farmers are still in darkness about the environmental degradation which has been creating problem for maintaining environmental balance.

In studies with pesticide use profile in modern variety rice fields, it was observed that farmers in the study area had little knowledge about insects and pests⁷⁾. Some insects and pests were commonly observed in three rice seasons. The highest insect pests infestation occurred in Aus* season followed by Aman*. About 58 percent farmers applied pesticides considering the degree of pest infestation and presence of pests. Most of the farmers followed the pesticide dealers' suggestions to select the pesticide band and also the dosages of pesticides.

* There are three different seasons available for rice production in Bangladesh. Aus: The rice varieties that are sown in March-April and harvest in June-July. Aman: Sown in July-August and harvest in November-December. Boro: Sown in December-January and harvest in May-June.

Table 3. Method of pest control measures applied by the farmers in the study area during 1995-96.

Methods	Respondent	
	Number	Percentage
Chemical	125	100
Cultural	12	10
Others*	6	5

* = Kerosene and Botanical, Source: Islam *et al.*⁷⁾

All the respondent farmers in the study area followed chemical control measures to control the insect pests' infestation, though a few farmers (10%) practiced cultural control (Table 3). Among the cultural control, they mainly followed two methods i) they ploughed down and dried up the land 15 to 20 days before final preparation, and ii) burnt stables after harvesting. Regarding pesticide storage and disposal practices, it was observed that majority of the farmers followed extremely unsafe pesticide storage and disposal practices. A majority (70%) of the respondents sold their empty pesticide containers that used as water or kerosene storage equipment etc. About 27 percent of the farmers threw them in the paddy field. This indicates possibilities of accidental exposure for the farm family and animals and of chemical seepage to the ground water table⁷⁾.

From agricultural sustainability point of view only a small proportion (18.18%) of the respondents' attitude towards the use of agrochemicals was favorable while the highest proportion (54.55%) possessed moderately favorable, 7.2% neutral and one-fifth (20.00%) unfavorable attitude. Education, rationality, cosmopolitaness and mass media exposure of the farmers were positively correlated with their attitude towards the use of agrochemicals.

Insecticides are sprayed on vegetables several times a week and as a result, resistance to pesticides is well established among several vegetables and their consumption patterns also create a very significant potential for pesticides residues on vegetables and groundwater, affecting the health of consumers¹¹⁾. So it is urgently needed to minimize the use of pesticides, fertilizers and irrigation water for economic benefit of the country

because many unwanted problems are already in view due to their abuse. Due to indiscriminate use of insecticides the population of pollinators, predators and other friendly insects are decreasing day by day. Moreover, growing resistance of insects against insecticides and outbreak of secondary pests has also been noticed in Bangladesh in the recent years.

Sustainability concept

Much has been written about sustainability over the past two decades. At the global scale, the Brundtland Report entitled 'our common future' from 1987 has been widely accepted as a milestone in conceptualizing what sustainability means¹³⁾. Sustainability is an emerging concept for all types of human endeavor, including food production, and refers to a dynamic balance of three aspects: ecology, economics, and social values (norms and values from society and technology). Modern society demands products that are produced by sustainable management. The concept of sustainable agriculture refers to the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources¹³⁾. According to this concept, therefore there is a greater emphasis for use of naturally operating regulatory mechanisms in order to safeguard the environment, protect the predators and parasitoids and thereby ensure sustainable agricultural growth. Considering the negative impacts of agro-chemical based agriculture in Bangladesh, the idea of sustainable agriculture starts taking shape in the country during the recent past⁶⁾.

Integrated Pest Management (IPM) for better environment

Intensive farming and the warm and humid climate are favorable for the rapid development of pests and diseases of crops. To overcome this unfriendly situation, the Government in its New Agricultural Extension Policy (NAEP) has adopted the strategy to promote environmentally sound agricultural practices. For example, Integrated Pest Management (IPM) has been recommended instead of widespread use of the hazardous practices like agro-chemicals¹⁰. IPM is a broad ecological approach to pest control using various management tactics in a compatible manner. It advocates pest management by a combination of several control tactics without relying heavily on pesticides. IPM provides a long-term strategy for minimizing crop losses caused by pests with least possible cost to the farmers and without adverse environmental impact. Since IPM has a holistic approach to crop production based on ecological understanding it is often referred to as Integrated Crop Management (ICM).

Indeed, IPM advocates the following: i) growing a healthy crop (this includes all aspects of crop production such as management of soil, water, fertilizer, weeds, pests etc.), ii) conservation and augmentation of natural enemies (biological control agents) of crop pests, iii) use of pest tolerant or resistant varieties, iv) use of cultivation practices that can minimize the incidence of insect pests and diseases, v) mechanical means of controlling pests, vi) monitoring fields by the farmers on a regular basis, vii) income generation activities such as 'ail' cropping in rice fields and rice cum fish and prawn culture, viii) pesticide can be used as a last resort in managing pests and diseases. In that case priority should be given to botanical and bio-pesticides.

In Bangladesh, not only the GOs but some NGOs have also undertaken programmes to popularize environmentally friendly agricultural practices. These include organic farming, ecological agriculture, biocontrol, botanical extracts, cultural management and improve cropping patterns etc.

Bio-control tactics compatible with IPM are underway

Hispa is a major pest of rice in Bangladesh. It attacks the Aus, Aman and Boro season's crops. Scientists of the Strengthening Plant Protection Services (SPPS) project have isolated a parasitoid (*Trichogramma* sp.) from rice hispa eggs. This parasitoid in some locations causes about 80% mortality of hispa eggs under natural conditions. Therefore, the project is investigating its potential as a bio-control agent for rice hispa. Recently it has been successful in rearing hispa-parasitoid *Trichogramma* on alternate hosts, such as *Corcyra* and potato tuber moth. Probably this is the first report of successfully multiplying hispa-parasitoid *Trichogramma* on alternate hosts. The ultimate objective is to mass release the hispa-parasitoid *Trichogramma* in the rice field to control the hispa in an eco-friendly manner¹¹.

Brinjal Shoot and Fruit Borer (BSFB), *Leucinodes orbonalis* is the major pest of eggplant in Bangladesh. At present, farmers solely rely on insecticides for controlling this pest. One species of *Trichogramma* (*T. chilonis*) and another unidentified *Trichogramma* have been found to successfully parasitize BSFB eggs under laboratory conditions. Trials on mass release of these parasitoids in the field for controlling BSFB are in progress.¹¹

A wasp (*Trathala flavoorbitalis*) has been isolated from BSFB and it is a larval-pupal parasitoid of the BSFB. Under field conditions it parasitizes about 5 % pupae. Its potential could be greatly increased if prophylactic use of insecticides in eggplant fields is stopped or reduced.¹¹

Concluding Remarks

In spite of some unfavorable factors, a wide range of bio-diversity exists in Bangladesh for growing different crops. Production of main cereals, rice and wheat has expanded at a faster rate while minor crops are being pushed out of cultivation to make room for the major ones. The risk factors for Bangladesh agriculture include floods, droughts, cyclones, hail storms, excessive and untimely rainfall. Using agrochemicals has become essential inputs for the cultivation of

HYV rice and other crops. Over dependence on agrochemicals leads to negative environmental consequences in addition to health hazard. In true sense, it is difficult to replace or eliminate the use of agrochemicals at this stage. Because, the natural resistance mechanism of HYVs against pests and diseases is significantly low and these crops require huge amount of fertilizer nutrients for higher yields. Consequently, they need to be protected by chemical pesticides. Therefore, elimination of the use of agrochemicals may give rise to a total collapse of HYV cultivation of the country. On the other hand, due to economic, demographic and modern market situations, the farmers need higher production. Cultivation of HYVs is therefore, unavoidable for them. Alternative management practices are sought to minimize this dilemma situation. However, since IPM has a holistic approach to crop production based on ecological understanding so that farmers would be able to grow healthy crop, increase the farm output and income on a sustainable basis while improving the environment and community health.

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バングラディッシュの農業 — 持続的農業に向けた最近の傾向と環境 —

Mahbub ROBBANI* · Salah Uddin SIDDIQUEE** · Sourovi ZAMAN** · 中村寛志**

*パツアカリ理工大学 園芸学科, Dumki, Patuakhali, Bangladesh

**信州大学農学部 アルプス圏フィールド科学教育研究センター

要 約

バングラディッシュは国民の85%が農業に従事している農業国である。土壌や農生態系の条件は豊かな作物を生育するのに適している。最近、高収性品種の栽培、過度の作付け、肥料や農薬および灌漑水の無分別な使用のため、土地の生産性が減少してきている。農業における化学合成製品の依存は、環境に負の影響を与え健康に悪影響を及ぼしている。総合的害虫管理 (IPM) の実践は、健全な作物を育成し、環境と人々の健康を改善するのに役立っている。本研究は1994年から2000年の間に出版された文献をもとにして、持続的農業に関連したバングラディッシュにおける最近の農業の傾向と、化学農薬などの化学合成製品の使用に焦点を当てて報告したものである。

キーワード：バングラディッシュ；持続的農業；化学合成製品；総合的害虫管理