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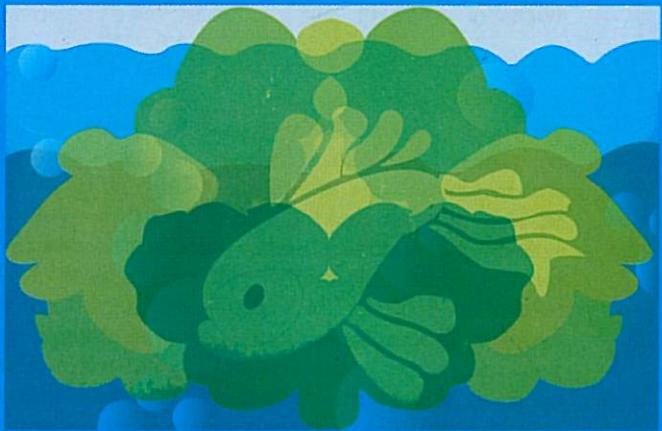


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STATUS OF GREENHOUSE CULTIVATION IN BANGLADESH: FOCUSING ON VEGETABLE AND FLORICULTURE PRODUCTION

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ABSTRACT

Greenhouse technology has been in use for crop production in varying degrees all over the world. Limited numbers of greenhouses are being used in Bangladesh. However, no qualitative study has been done to assess the present state of greenhouse production system in Bangladesh. In this study an attempt has been made to assess the present status of greenhouse production system in Bangladesh along with its prospects and problems. The study area and sample units were selected based on the availability of greenhouses. Data were collected through interview of respondents by pre-tested questionnaire. However, secondary data were also used in this piece of research. The greenhouses are used by the farmers and researchers of Mymensingh, Gazipur, Panchagarh and Feni districts in Bangladesh. The area coverage under greenhouse cultivation (1.98 ha) is very insignificant in compare to open field cultivation (0.69 million ha) of vegetables and flowers in Bangladesh. Potato seed, flowers, orchid and vegetables are cultivated in the greenhouses commercially. The net and plastic covered arch, Quonset and standard peak type greenhouses are used in researchers' and farmers' level. There is a great potential for structural improvement and addition of controlling devices in greenhouses at farmers and researchers level that can improve the quality and volume of production of high valued crops in Bangladesh.

Keywords: Greenhouse technology, Present status, Production practices, structure selection, intensive agriculture

INTRODUCTION

Greenhouses provide an enclosed growing environment for crop cultivation that can be controlled, year round. This allows intensive culture with annual yields many times higher than that of field production (Kacira *et. al.*, 2004). Greenhouse production enables overcoming weather variability and the use of free energy from sun. However, the selection of structure and the production practices not only depend upon the location and the climate but also economics, politics and social structures of that location in a particular country. In Bangladesh, the situation for production of food grains is relatively comfortable, whereas it is not that commendable with reference to some other sectors like horticulture. Agricultural planners have been emphasizing the use of advance biotechnological practices to get breakthrough in production of high valued crops. At the same time, an emphasis has to be paid to improve the efficiency of agricultural input in farming system. This underlines the need for searching improved and new alternative technologies (such as greenhouse cultivation, application of optimize machinery management practices etc.) for intensive agriculture within the socio-economic constraints of Bangladesh. Many studies on greenhouse cultivation for arid, tropics and sub-tropics regions have been conducted by Al-Abdulkader (2006), Hemming *et. al.* (2006), Mat-Sharif (2006), McIntyre *et. al.* (2005), Soni *et. al.* (2005) and Xu-Beilei (1998) for Saudi-Arabia, Indonesia, Malaysia, Maldives, Thailand and China, respectively. Main focuses in these researches were to study present status and development of greenhouse systems for high value crops (HVC) considering climate and socio-economic condition of the respective countries. The aim behind these studies was to enhance off-season production of vegetables and fruits; to produce earlier than open field crops and to improve yield and quality of the agricultural products for export and local market. However, no such study has been done in Bangladesh. Greenhouse technology has been in use for crop production for more than fifty countries all over the world. China is believed to have adopted plastic greenhouse concept to a great extent. Japan, has about 42,000 ha under plastic and glass cover greenhouses top the list (Ann., 1995). The occurrence of smaller and marginal land holdings with shorter growing season in Holland and Japan have been the reason behind adopting greenhouse for intensive crop production. In developed countries, farmers are producing tomatoes

65-120 ton/ha in greenhouse systems (Tiwari, 2003) whereas, farmers are producing only 6-7 ton/ha in open field of Bangladesh. The production is 10-20 folds higher in greenhouse systems than in open field condition. Therefore, there is a great potential for greenhouse production of high value crops like tomatoes for increasing crop production in Bangladesh.

There are very few numbers of greenhouses in Bangladesh. These are mainly for research purposes, which are installed by the foreign researchers without considering Bangladesh climate and socio-economic conditions and yet to be introduced at farmers' level. However, there is no reported study on present status and possibilities of commercial greenhouse production systems in Bangladesh. In this piece of study an attempt has been made to take account of the present status of greenhouse cultivation in the country along with its prospects and problems. The major objectives of the study were:

1. To assess the present status of greenhouse cultivation systems in Bangladesh
2. To identify the problems and prospects of greenhouse cultivation systems in Bangladesh

MATERIAL AND METHODS

The study areas and sample units were selected based on the availability of greenhouses. The selected districts were Feni, Mymensingh, Gazipur and Panchagarh. The study was carried out in Gaotomkhali, Daganbhuiyan of Feni district; Phulpur, Bangladesh Agricultural University (BAU) Germplasm centre and Horticulture centre of Mymensingh district; Bangladesh Agricultural Research Institute (BARI) Breeder Seed Production Centre of Debiganj, Panchagarh district and Bangladesh Agricultureal Research Institute (BARI) and BRAC of Gazipur district.

Preparation of Interview Schedule

A draft interview schedule was prepared according to the objectives of the study with active consultation with key informants, experts from the relevant fields and secondary information. The draft schedule was pre-tested and necessary corrections, modifications and alterations were made accordingly and printed for the field data collection.

Data Collection

Primary data were collected through personal interview and several visits in greenhouse sites. During the interview of greenhouse growers and stakeholders each question was explained to them clearly and tried to find out facts as much as possible. Before taking interview, the whole purpose of the study was clearly explained to the respondents. Initially many of the respondents were doubtful to answer the questions. When they were assured that the study was purely on academic one and was not likely to have an adverse effect on them, they tried to make a good cooperation. Secondary data were collected from raw materials traders and also from different scientific publications like journals, books etc. The answers, which obtained from different stakeholders and journals were carefully checked and presented in the report.

Identification of Problems and Prospects of Greenhouse Cultivation

Same questionnaire was used to identify the problems of present greenhouse cultivation systems and prospects of greenhouse cultivation in Bangladesh. For this purpose SWOT (Strength, Weakness, Opportunities and Threat) analysis was done with the active participation of the stakeholders.

RESULTS AND DISCUSSION

Status of Greenhouse Cultivation in Bangladesh

Greenhouse cultivation evolves to create favorable micro-climates in which crop production would be possible throughout the year or part of the year as intended. Greenhouse crop production offers a means for moving forward greater degree of environmental control. The extent of control varies from mere protection from the rain to full environmental control. However, protection from insect, pest and diseases of vegetables and flowers are possible in greenhouse production system than open field cultivation.

Growing area

The status of main greenhouse production countries is shown in Table 1. In most countries, greenhouses are covered with plastic sheets or glass. Even though the majority of the greenhouses are covered with glass in the

Netherlands, plastic coverings are the wave of the future in the Netherlands because of the workers safety issues. Glasshouses and rigid plastic houses are longer-life structures, and therefore are mostly located in cold regions where these structures can be used throughout the year. In Japan, year-round use of greenhouses is becoming predominant, but in moderate and warm climate regions they are still casual and are not used in summer. There is no such steep expansion of protected cultivation area in Europe and America as in Asia, but the total area is not small, and a stable situation exists.

Bangladesh is divided into six divisions namely Dhaka, Rajshahi, Chittagong, Khulna, Sylhet and Barisal. The most important division for protected cultivation is the Chittagong division, which covers almost 1.214 ha i.e. 61.3% of total greenhouse growing area in the country. The high valued crops like vegetables and flowers are cultivated in the open field and the production area is about 0.69 million ha (Table 2). Greenhouse production systems are recently introduced to different research stations and very few to the farmers' level for commercial purposes. Total greenhouse production area in Bangladesh is about 1.98 ha, which is very insignificant in comparison to other countries (Table 1 & 2).

Table 1. Greenhouse area in the main greenhouse production countries

Country	Greenhouse area		Reference
	(ha)	(year)	
China	1,000,000	(1999)	Wang, 2002
Japan	53,518	(1999)	Sase <i>et al.</i> , 2000
Korea	52,189	(2000)	Son, 2002
Spain	33,750	(2001)	Martinez-Paz <i>et al.</i> , 2001
Bangladesh	1.980	(2007)	estimated
Italy	26,000	(1999)	Pardossi and Tognoni, 1999
Turkey	22,064	(2001)	DPT, 2001
Netherlands	10,416	(2001)	Hayashi, 2003
USA	7,016	(1998)	USDA, 1998
France	8,108	(1999)	Hayashi, 2003
Israel	3,510	(2001)	SAI, 2003
India	2500	(2006)	Ray, 2004

The majority of the greenhouses in the Chittagong division are located in Feni district. These greenhouses are usually used for reducing temperature to some extent; protect plants from rain, insects and fog. About 0.236 ha are covered with plastic and the rest is Poly Vinyl Chloride nylon mesh (Table 2). Greenhouse production in Bangladesh is mainly practicing by the researchers and limited farmers of Feni, Mymensingh, Gazipur and Panchagarh districts.

Table 2. Vegetables, flowers, orchid growing area in open field production system and greenhouse production system

Division	Greenhouse production area (ha)	Percent covered by GH production	Open field production area (million ha)*
Dhaka	0.316	16.0	0.11
Rajshahi	0.450	22.7	0.34
Chittagong	1.214	61.3	0.07
Khulna	-		0.05
Barisal	-		0.08
Sylhet	-		0.04
Total	1.980	100	0.69

Source: *Vegetables and flowers production area, Reconnaissance soil survey, Department of soil survey, 1973-77, Bangladesh Bureau of Statistics (BBS) 2004.

*Products grown in greenhouses***Vegetable production**

Vegetable production in greenhouses is a new experience to the farmers of Bangladesh. Bangla-Dutch agro farm produce lettuce, red cabbage, French bin, radish, Chinese pepper, sweet pepper and broccoli etc. Seeds of these vegetables are being imported from the Netherlands. The products are being sold to five star hotels and Chinese restaurants. Bangla-Dutch agro farm of Feni districts of Chittagong division covers 1.214 ha i.e. 61.3% of total greenhouse production area. BARI Breeder Seed Production Centre, Debiganj, Panchagarh cultivated potato seed in greenhouse for the purpose of supplying good quality seed for the farmers of Bangladesh. The production of potato seeds in greenhouse is free from diseases. On the other hand, potato seed production in open field may be contaminated by many diseases like late blight. BARI Breeder Seed Production Centre, Debiganj, covers about 0.45 ha i.e. 22.72 % of total greenhouse area used for potato seed production (Table 3.) in the country.

Floriculture production

Flower production practices in greenhouse are recently introduced to the farmers. In Phulpur, Mymensingh, the farmers are cultivating orchid, anthurium, gladiolus, and Netherlands fern in greenhouses. These flowers are generally transported and sold through the cooperatives, which has branch office in capital Dhaka. Demand of these flowers is very high in Dhaka market and also secure high price. Horticulture Centre, Keyoatkhal, Mymensingh, is producing anthurium and gladiolus. These experimental flowers are generally sold to the local people. The greenhouses attached to the tissue culture center of BRAC, Gazipur also widely cultivating Cactus. Flower cultivation covers about 10.71% (0.198 ha) of total greenhouse production (Table 3).

Table 3. Products grown in greenhouse cultivation

Greenhouse place	Cultivated crop	Greenhouse area (ha)	Percentage of total greenhouse covered area
BARI Breeder Seed Production Centre, Debiganj, Panchagarh	Potato seed	0.449	22.72
Germplasm Centre, BAU, Mymensingh	Cleft grafting of BAUkul & BAUjambura	0.010	0.53
Guptargaon, Phulpur, Mymensingh	Orchid flower, Gladiolus, Anthurium, Nederland fern	0.188	9.50
Horticulture centre, Keyoatkhal, Mymensingh	Anthurium, Gladiolus	0.024	1.21
Genetic Department, BARI, Gazipur	Strawberry, Brinjal	0.022	1.14
BRAC, Gazipur	Cactus, Tissue culture	0.071	3.59
Bangla-Dutch Agro Farm, Gaotamkhali, Daganbhuiyan, Feni	Lettuce, Red cabbage, French bin, Radish, Red bit, Cherry tomato, Chinese cabbage, sweet pepper, broccoli, Cucumber etc	1.215	61.32
Total		1.980	100

Structural status of greenhouse cultivation

The greenhouses are broadly classified into following two categories based on the extent of environmental control.

Low cost or low tech greenhouse

The low-tech greenhouse is a simple chamber made of polythene sheet of 150-200 micron thickness. It is constructed with locally available materials such as bamboo, timber etc. Unlike conventional or high tech greenhouses, no specific control devices for regulating environmental parameters inside the greenhouse are provided. Low cost greenhouse specifications are shown in Table 4.

A low cost greenhouse structure has constructed in Germplasm centre, Bangladesh Agricultural University, Mymensingh. This is a Quonset type greenhouse structure which is shown in the Fig 1. This is made by plastic material. The width, length and height of this greenhouse are 14ft, 40 ft and 6 ft respectively. The greenhouse structure is made up by bamboo. The greenhouse consists of only one door. The dimension of the door is 6 ft \times 5 ft. BAUkul & BAUjambura are grafted in polybeg during winter. Drip irrigation is applied in the greenhouse. Total construction cost of this type greenhouse is near about 8000 taka.

In Guptagaon, Phulpur, Mymensingh, BRAC constructed experimentally 15 greenhouses for the production of flowers. After finishing their experiment, they have sold these greenhouses to the contact farmers of Phulpur. Now the framers are commercially cultivating flowers plant in these greenhouses. These greenhouses are Quonset type structure. These greenhouses are plastic covered and the frame is made up of bamboo (Fig 2). The width, length and height of the greenhouse are 9 ft, 150 ft and 9 ft respectively. It has only one door of dimension 6ft \times 3ft Black shade net is used as shading material for reducing temperature and day light. The shading effect may reduce the inside temperature by 6°C in comparison to a greenhouse without shading at an ambient temperature of 33°C (Bailey, 1981). Flowers such as orchid, anthurium, gladiolus and Nederland ferns are grown in these greenhouses. Orchid needs 21°-32°C temperature and 80-85% humidity (Kobryn, 1989) and anthurium needs 30°C temperature and 70-80% humidity for better growing. Therefore, year round flowers production by the farmers of Guptergaon is being possible because of greenhouse production using plastic cover and shade net. Sprinkler irrigation is being applied in these greenhouses. Construction cost of the greenhouse is near about 15,000 taka.

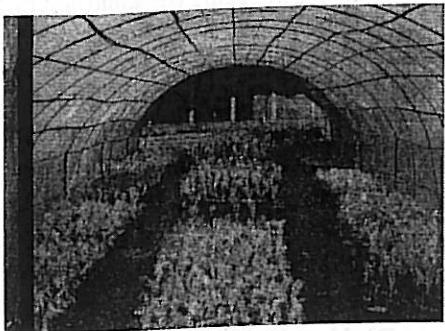


Fig. 1. Cleft grafting of BAUkul And BAUgambura in Quonset type greenhouse(Germplasm Centre, BAU, Mymensingh)



Fig. 2. Orchid cultivation in greenhouse
(Guptargaon, Phulpur, Mymensingh)

Medium cost and High cost greenhouse

These types of greenhouses are constructed by using galvanized iron (G.I) pipes for permanent framed structure. The greenhouse has single layer covering with UV- stabilized polythene sheet of 200 micron thickness and the cover is attached to the framed structure with the help of screws (specifications are shown in Table 5). Whole structure is firmly grouted to withstand the disturbances against wind. However, high-tech greenhouses are equipped with automatic control system. i.e., temperature, humidity, pressure, light control systems (Fig 3).



Fig. 3. High tech greenhouse for tomato production

Table 5 shows the specifications of four types of medium and high tech greenhouses. Quality potato seeds are produced in BARI Seed Breeder Production Centre, Debijang, Panchagarh. This greenhouse is made of plastic net. The greenhouse is Quonset type greenhouse. The structure is made of G.I pipe. The length, width and height of this greenhouse are 147.6 ft, 16.4ft and 7ft respectively. It has only one door. The dimension of the door is 4.92ft×4.92ft. In north Bengal 35,000 ha potato land area are being contaminated by late blight during winter. For this reason, BARI Seed Breeder Production Centre is using net cover greenhouses in winter for the purpose of protecting the potato seed from late blight and fog. Construction cost of this type of greenhouse is near about one lack taka.

In Horticulture Centre, Kaotkhali, Mymensingh, Extension Department installed a high tech greenhouse. The construction cost of this high- tech greenhouse structure is fifty lacks taka. The greenhouse is made of double poly carbonate and the structure is made by G.I pipe. The length, width and height of the greenhouse are 49.2ft, 52.5ft and 12.8ft. It consists of two doors and ten windows.30-35 mesh insect proof stainless steel wire net is used as covering material for window. This greenhouse facilities temperature and humidity control system. Flowers such as anthurium, gladiolus is grown in this greenhouse. Three medium tech greenhouses have been constructed in Bangladesh by BRAC, Gazipur for the purpose of tissue culture and flower production. This is arched type greenhouse structure. Double poly carbonate is used as covering material. The length, width and height of greenhouse are 85 ft, 30ft and 15 ft. It has two doors and two windows and one fan. Flowers like cactus flowers are mainly grown in tray in greenhouse. In Bangladesh Agriculture Research Institute, Gazipur, Genetic department installed a medium cost or medium tech greenhouse structure. This greenhouse is mainly used for tissue culture. It has 18 chambers for the purpose of doing distinct experiment. It is arched type greenhouse. Poly Vinyl Chloride Nylon mesh is used as covering material of greenhouse. It has two doors and two windows. The length, width and height of greenhouse are 98.425ft, 24.6ft and 12.8 ft. Construction cost of this greenhouse is eight lacks taka.

Table 4. Specification of low cost or low tech greenhouses used in Bangladesh

Address of greenhouse	Germplasm centre, BAU	Guptargaon, Phulpur, Mymensingh
Farmer/owner name	Department of Horticulture, BAU	Farmers
Greenhouse type	Quonset type (polytunnel)	Quonset type (Polytunnel)
Dimension of greenhouse:		
1. Width	14 ft	9 ft
2. Length	40 ft	150 ft
3. Height of greenhouse	6 ft	9 ft
Floor type	Soil	Soil
Structure:		
1. Roof type	Bamboo	Bamboo
2. Covering material	Plastic	Plastic and black shade net
3. Side wall	Same	Same
Door :		
1. Number of door	One	One
2. Dimension of door	6 ft × 5 ft	6 ft × 3 ft
3. Covering material of door	plastic net	plastic net
Ventilation type :	Natural convection	Natural convection
Irrigation system	Drip irrigation	Sprinkler irrigation
Crop production system		
1.Crop type	Cleft grafting of BAU kul, BAU gambura	Flower: Orchid, Gladiolus, Anthurium, Netherland fern • Coconut husk (orchid) • Soil(others flowers)
2.Production system in	Poly beg	
3.Production season	Winter	Year round

Table 5. Specification of medium and high cost greenhouses used in Bangladesh

Address of greenhouse	Horticulture centre, Keyoathkhali, Mymensingh	Genetic Department, BARI, Gazipur	BRAC, Gazipur	BARI Breeder Seed Production Centre Debiganj, Panchagarh
Farmer/owner name	Department of Agriculture Extension	Department of Genetic	BRAC	Farmer
Greenhouse type:	Quonset type (plastic house)	Arched type (net house)	Arched type	Quonset type (net house)
Dimension of greenhouse:				
1.Width	52.5 ft	24.6 ft	30 ft	16.4 ft
2. Length	49.2 ft	98.4 ft	85 ft	147.6 ft
Height of greenhouse:				
1. Total height	10.66 ft	12.8 ft	15 ft	7 ft
2. Gutter Height	7 ft	9ft		
Floor type	Soil	Soil	Soil	Soil
Structure:	G.I pipe 6 mm thick	G. I pipe(20mm)	G.I pipe	G.I pipe

1. Roof type	double polycarbonate	dia) double polycarbonate	double poly carbonate	Plastic net
2. Covering material	Same	Same	Same	Same
3. Side wall	Same	Same	Same	Same
Door :				
1. Number of door	two	two (18 chamber)	One	One
2. Dimension of door	3 ft × 6 ft	5 ft × 9 ft	5ft × 9 ft	4.92ft×4.92ft
3. Covering material of door	same	same	same	Same
Window :				
1. Number of window	ten		two	
2. Dimension of window	3.93 ft × 3.28 ft		4ft×3 ft	
3. Covering material of window	30-35 mesh insect proof stainless steel wire net	same	same	
Ventilation type :				
1. Natural convection	Nil	Natural convection	Nil	Natural convection
2. Force feed convection	6fans		One fan	
(a) Number of fan	1.9628ft			
(b) Fan diameter				
(c) Capacity				
Cooling system:	Pad- fan cooling system (pad dimension:52.48×4.92ft)		Pad-fan cooling system	
1.Cooling type	Nil	Nil	Nil	Nil
2.Cooling capacity				
Irrigation system	Drip Irrigation	Drip irrigation	Drip irrigation	Furrow irrigation
Temperature measuring instrument	Digital Temperature controller	Nil	Nil	Nil
Humidity measuring instrument	Digital humidity controller	Nil	Nil	Nil
Crop production system				
1.Crop type	Flower • Gladiolus • Anthorium	Different crop (strawberry, brinjal)	Flower: Cactus	Potato seed
2.Production system in	Soil	Soil	Tray	Soil
3.Production season	Year round	Year round	Year round	November to March

Strength, weakness, opportunities and threats of different greenhouses used in Bangladesh

Different types of low tech, medium tech and high tech greenhouses are being used in Bangladesh. The SWOT analyses of these greenhouses have been carried out. The result is given in Table 6.

Table 6. SWOT analysis of greenhouses used in Bangladesh

Greenhouse type	Strength	Weakness	Opportunity	Threats
Low cost or low tech greenhouse	<ul style="list-style-type: none"> • Low cost technology • Protect from rain, fog, insect, and pest • High water use efficiency • Vegetable and flower production rate in closed system is higher than production in open field • Year round cultivation is possible 	<ul style="list-style-type: none"> • Low longevity of the structure • Repair and maintenance cost is high • Distance location of business market • Proper temperature and humidity cannot be maintained • Lack of technical know how 	<ul style="list-style-type: none"> • Greenhouse structure can be improved • Farmers can get better price for quality production • Greenhouse production practices can be improved • Knowledge of stakeholders can be improved on greenhouse production system • Export quality flowers and vegetables production is possible • Generate self employment for the educated rural youth in the farm sector 	<ul style="list-style-type: none"> • Dominance and competition by the open field vegetable & flower farmers who are controlling the present market • Greenhouse production is not possible, if sunshine hour are less • Susceptible to damage by heavy storms
Medium cost and high cost greenhouse	<ul style="list-style-type: none"> • High water use efficiency • Protect from rain, fog, insect, pest • Vegetable and flower production rate in closed system is higher than production in open field • High longevity of the structure • Year round cultivation is possible 	<ul style="list-style-type: none"> • Production cost is high • Lack of technical know how • Distance location of business market 	<ul style="list-style-type: none"> • Knowledge of stakeholders can be improved on greenhouse production system • Farmers can get better price from the market • Greenhouse production can be improved • Export quality flowers and vegetables production is possible • generate self employment for the educated rural youth in the farm sector 	<ul style="list-style-type: none"> • Dominance and competition by the open field vegetable & flower farmers who are controlling the present market • Lack of proper use of environmental control devices may hamper greenhouse environment for production

Common strength of the greenhouses

Vegetables and flowers production rate in closed system is higher than production in open field

Vegetables and flower production rate in closed system is higher than production in open field because optimum temperature can be maintained in greenhouses. However, vegetables and flowers can be protected from rain, fog, high temperature, insects, weeds and other water related problems. In developed countries,

farmers are producing tomatoes 65-120 ton/ha in greenhouse systems (Tiwari, 2003) whereas in open field of Bangladesh, farmers are producing only 6-7 ton/ha, thus the production is 10-20 folds higher in greenhouse systems. The other important advantage in closed system is proper application of irrigation and fertilizer to the crop.

Possibility of year round cultivation

Temperature and humidity can be controlled in greenhouse, thus allows year round cultivation of high valued crops. Temperature can be controlled by using different shading material such as black shade net, woven materials with aluminum and white band. Bailey (1981) studied the shading effect and reported that an aluminum plated mesh reduced the inside temperature by 6°C in comparison to a greenhouse without shading at an ambient temperature of 33°C. Mechanical cooling device can also be used for temperature control though production cost will be increased. However, this provides opportunity for year round cultivation of high valued crops for the farmers in Bangladesh.

Common problem of these greenhouses

Location of business market

One of the most important factors is the location of business market. Posh markets in the capital city have high demand of quality greenhouse products, which also ensure high returns. Sometimes farmers can not supply their products to these markets because of poor transportation system. The road linked to highway and business market is not good, vehicle facilitates are not available to the farmers. The products are generally transported and sold through the cooperatives, which has branch office in capital Dhaka. The Dhaka market is generally far from the greenhouse cultivation area. As a result, the farmers could not supply better quality product and ultimately get lower price.

Lack of technical know how

There is a big gap in technical know how about the greenhouse cultivation systems among the researchers and farmers of Bangladesh. They also lack proper operational and management knowledge as the technology is very new to them. Horticulture centre, Keoathkhali, Mymensingh, is running Quonset type plastic greenhouse which are installed by the foreign experts but there is no local expert to run this greenhouse smoothly. Because of lack of technical know how, temperature and humidity cannot be controlled and as a result year round cultivation is not possible yet.

Common opportunities

Export quality flowers and vegetables production is possible

Introduction of greenhouse cultivation systems can be the way of producing export quality vegetables and flowers. Because this cultivation system requires less insecticides and pesticides, and optimum temperature and humidity can also be maintained.

Generate self employment for the educated rural youth in the farm sector

Greenhouse cultivation system is a smart production system where educated rural youth can come forward to produce export quality products. This can be good business expedition for educated rural youth as the demand of quality products is growing in super markets and export markets.

Common threats

Dominance and competition by the open field vegetable & flower farmers and intermediaries

The main obstacle to get proper price of greenhouse vegetables and flowers is the dominance and competition from the open field grown vegetable and flowers. Farmers of open field production of flower and vegetables can offer lower price than greenhouse growers. Thus, quality greenhouse products face stiff challenges from low price open field products in the open market.

CONCLUSIONS

Based on the findings of this study the following conclusions are made:

- The area coverage under greenhouse cultivation (1.98 ha) is insignificant in compare to open field cultivation (0.69 million ha) of vegetables and flowers in Bangladesh. However, there is a good potential for greenhouse cultivation of high valued crops like flowers and vegetables as market demand of quality perishable products are increasing in city and super markets.

- At present flowers, lettuce, sweet pepper, red cabbage, radish, French bin orchids, potato seed, brinjal, strawberry are being produced and cleft grafting of BAUkul and BAUjambura are being done in very limited scale in greenhouses. There is a great potential for production of above mentioned high valued crops in greenhouses extensively for export and city posh markets.
- Chittagong division is a potential area for protected greenhouse cultivation. At present about 61.3 % (i.e. 1.214 ha) of the total greenhouse area of the country is covered by this division which is very insignificant.
- Low cost plastic or net covered, Quonset type tunnel, arch and standard peak type greenhouses are common in researchers' and farmers' level in Bangladesh. Farmers using black shade net as a shading material as well as means of reduction of temperature to some extent in some areas, whereas, pad and fan cooling devices are being used by the researchers on experimental basis. There is a great potential for structural improvement and addition of controlling devices in greenhouses at farmers and researchers level that can virtually improve the quality and volume of production of high valued crops in Bangladesh.
- Improvement of technical know-how and knowledge for cultivation and management practices related to greenhouse production among the farmers', block supervisor and scientists are necessary for increasing production and quality of greenhouse products.
- The greenhouse technology has great potential for creating self employment for the unemployed educated rural youth. They may find this production technology as innovative and prestigious for their livelihoods.
- The market forces are not aware of the good qualities of the greenhouse products. Therefore, an awareness campaign is necessary for popularizing the greenhouse products through advertisement in the electronic media.

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