Vegetable Crops Agribusiness

Proceedings of a workshop held at BARC, Farmgate, Dhaka, Bangladesh 2-4 May 1995

Compiled by
M.L. Chadha, Kamal U. Ahmad, S. Shanmugasundaram, and Abul Quasem

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P.O. Box 42, Shanhua, Tainan, Taiwan 741, ROC

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Editor: *Maria Melba B. Wee*

Technical Editor: *S. Shanmugasundaram*

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Acronyms

ADB	—	Asian Development Bank
ADE	—	Agricultural Development Estates
AIS	—	Agriculture Information Services
ASC	—	Agro-Service Center
AVRDC	—	Asian Vegetable Research and Development Center
BADC	—	Bangladesh Agricultural Development Corporation
BAU	—	Bangladesh Agricultural University
BARI	—	Bangladesh Agricultural Research Institute
BARC	—	Bangladesh Agricultural Research Council
BBS	—	Bangladesh Bureau of Statistics
BAEC	—	Bangladesh Atomic Energy Commission
BGB	—	Bangladesh Grameen Bank
BKB	—	Bangladesh Krishi Bank
BRAC	—	Bangladesh Rural Advancement Committee
BRDB	—	Bangladesh Rural Development Board
DAM	—	Department of Agricultural Marketing
DAE	—	Department of Agricultural Extension
EPB	—	Export Promotion Bureau
FAO	—	Food and Agriculture Organization
GKF	—	Grameen Krishi Foundation
HKI	—	Helen Keller International
HRC	—	Horticulture Research Center
IPM	—	Integrated Pest Management
IPSA	—	Institute of Postgraduate Studies in Agriculture
MCC	—	Mennonite Central Committee
MOA	—	Ministry of Agriculture
MSC	—	Mollika Seed Company
NARS	—	National Agriculture Research Station
NGO	—	Nongovernment Organization
OFRD	—	On-Farm Research Division (of BARI)
Pl. Com	—	Planning Commission
SCA	—	Seed Certification Agency
UNDP	—	United Nations Development Program
USAID	—	United States Agency for International Development

Foreword

Bangladesh, with 120 million people, and still growing has an actual per capita vegetable consumption of 40 g/head per day. This is far below the daily requirement of 200 g/head per day. Over 1 million tons of vegetables produced from 152,000 ha land area is not enough to meet the required consumption.

Considering the country's limited arable areas for vegetables, production should be maximized through improved farming systems to achieve a tenfold increase in production in order to keep pace with increasing population in the country.

Enhanced vegetable production shall answer the country's nutrition deficiencies; promote more business; generate wider employment opportunities; and women empowerment. This could be attained if proper farm inputs such as good quality seeds, fertilizers, integrated pest management, irrigation, and post harvest facilities are put in place. Proper training, availability of credit facilities, and networking with other countries are essential to bolster the country's marketing setup. Vegetable-based agribusiness is a step to raise the level of managerial skills among the producers. This could also pave the way towards a balanced distribution of both fresh and processed vegetables in the country.

Promoting vegetable research that makes nutritious vegetables physically and economically available to the consumers and profitable to the producers in fact, builds the foundation for national development. This scenario has spurred AVRDC, BARC, and BARI to organize a workshop on vegetable crops agribusiness funded by the USAID held on 2-4 May 1995 at BARC, Farmgate, Dhaka, Bangladesh. The workshop convened researchers, extension workers, farmers, seed producers, businessmen, government and nongovernment organizations to examine different areas in vegetable production; identify and analyze problems; and formulate goals, solutions and action plans thereof to help vitalize and boost both production and consumption of vegetables and augment financial benefits.

AVRDC, having several years of collaboration with Bangladesh, shall continue to play a catalytic role in strengthening the country's agricultural system.

We hope that this publication would serve as an important tool for a speedy transportation towards more and profitable vegetable production in Bangladesh.

Dr. Samson C.S. Tsou
Director General, AVRDC

Welcome Address, Workshop Rationale, and Objectives

Mr. Chairman, the chief guest, special guest, all other guests participants, ladies and gentlemen. Thank you very much for attending the inaugural session of the workshop on Vegetable Crops Agribusiness. Since time immemorial, vegetables are being cultivated for home consumption and for sale. The larger share of the produce always go to the consumers who are not involved in the production process. Vegetables are treated as a merchandise in a business as any other commodity sold in the market. Again, for most farmers, vegetables are part of an economic process for which they invest on land, capital and use labor. The significance of vegetable production from sowing up to the consumption of the produce is the totality of vegetable crops agribusiness.

But there has not been much efforts made to review the entire gamut of the production and utilization process of vegetables under one forum. Agricultural scientists focus their research efforts to improve the productivity and quality of vegetables. They have little mandate to study how the produce is being sold, how businessmen are handling this merchandise, how the farmers could take a share of the postharvest handling as part of the business, and how the end-users could be given a better chunk of the commodity for a lesser price, retaining its best quality.

If the vegetables are commodities dealt within the marketing channel, the seed, too, from which they are produced is a business item. Short to long-duration storage, processing and preservation of vegetables have given the foundation for agro-based industries.

These have motivated AVRDC-BARC/BARI collaborative project funded by USAID to hold a workshop on Vegetable Crops Agribusiness involving participation from researchers, extension agents, farmers, seed producers, businessmen, and other government and nongovernment organizations. We have planned to examine different areas of activity, sort out problems and solutions thereof and formulate goals and action plans that could help vitalize this sector, boosting both production and consumption of vegetables, and augmenting financial benefits to all concerned with vegetable crops agribusiness.

Besides this inaugural session designated as Session I, the three-day program has been subdivided into another six technical sessions, covering under Session II: Production and Handling of Vegetable Propagation Material, Session III: Production of Vegetables with Agribusiness Approach, Session IV: Marketing of Vegetables, Session V: Storage, Preservation and Processing of Vegetables, Session VI: Socioeconomic Aspects of Vegetable Agribusiness and, Session VII, which is the Plenary/Concluding Session.

Each of the sessions will be more or less self-contained, where, besides presentation of papers by resource persons conversant with the specific topics, there will be ample room for questions and answers, discussion and formulation of appropriate recommendations vis-a-vis work plans.

Aided by the rapporteurs, each session chairman will do the presentation of the summary of his session-proceedings at the concluding session. The final draft recommendations and some work plans will be formulated in the concluding session.

May we hope that, with the cooperation of the participants, the resource persons, the rapporteurs and the session chairmen, we shall be able to go into the depth of every matter relating to different aspects of vegetable crops agribusiness in the country, and arrive at some appropriate conclusions for adoption by all concerned agencies.

With these few words of introduction to the workshop objective, I warmly welcome you all.

Thank you.

A. Quasem
Director, Horticulture Research Center
Bangladesh Agricultural Research Institute

Keynote Address

Mr. Ali, our chief guest; Dr. Elias, Director General of BARI; Dr. Brown, Dr. Quasem and Dr. Chowdhury, the chairman of the workshop, distinguished guests, ladies and gentleman. I am honored to have the opportunity to attend this important meeting. As the collaboration between Bangladesh and AVRDC is concluding its first phase and starting its second, I feel it is appropriate to reiterate the rationale and proposed strategy behind the collaboration. I think the organization of this workshop addressing agribusiness is an important component of the overall strategy.

As you all know, AVRDC chose the improvement of nutritional well-being and increase in farmers' income as our institutional goal. However, we also believe that the ultimate impact of our work may even be beyond our goal. Experience in other countries demonstrated that vegetables, in fact, contribute to industrialization and promoting vegetable-based agribusiness is an essential step towards this objective.

Per capita income is generally used as a major indicator of differences between developed countries and developing countries. A country with a per capita income of US$ 10,000 or $15,000 is classified as developed. This type of indicator, however, is descriptive. It does not tell us what makes the difference.

At AVRDC, we feel that another definition proposed by a medical doctor in Chile back in the 70s may better describe the real situation. He pointed out that this century is a century of science and technology. Any nation which can use S and T knowledge in improving the well-being of the people is a developed country. If the nation cannot fully utilize this knowledge for improving the lives of its people, then the country remains underdeveloped. If the definition is adopted, then the question is what essential factors can be utilized for knowledge power. The answer is obvious: effective education. What factors make education effective? Our answer is healthy people and the right type of educational policy and program. The experience of Taiwan in economic development demonstrated that this hypothesis could be true.

From the health side, there are four major nutritional problems in developing countries that may limit overall development and that deserves special attention. These are: protein-calorie malnutrition, vitamin A deficiency, iron deficiency, and iodine deficiency. A child with inadequate intake of vitamin A for instance, may very likely become blind before he reaches 12, if he manages to survive. But his disability will become a burden to society for the rest of his life rather than contribute to the development process.

Through vegetable research, we try to address three of these four problems I mentioned earlier. We try to promote legumes, such as mungbean and soybean, to make the protein from cereal crops more nutritionally efficient. We try to promote vegetable consumption to enhance vitamin A and we try to increase the vitamin C intake in the diet to make dietary iron more available for our body. In other words, we believe that promoting vegetable research that makes nutritious vegetables physically and economically available to consumers in fact builds the foundation for national development.

The second component is a good educational policy and program so that people are able to utilize the ever increasing fund of knowledge. We feel that an environment where people are able to make their own choices and more importantly, they have the skill to make choices in a complex situation with multiple factors involved in the decision-making process could be the key. Thus, availability of information and managerial skills could be the most important factors included in the educational program. But education is not exclusively carried out in schools.

Vegetable production and marketing is more complex than production and marketing of major food crops. Farmers need to make decisions on commodities, seasonality, input levels, marketing target, and selection of services needed. This process enhances the farmers managerial skills especially those in the rural areas.

Moreover, job opportunities for vegetable production and marketing are not only limited to land-based opportunities. There are a wide range of vegetable-related service industries that can be developed, such as seed distribution; pesticide retail; fertilizer supply; handling, packaging and marketing; grading and transportation, etc. The younger generation, who often have better education, are not forced to leave the rural sector due to lack of opportunities. As a result, they may further improve the whole system and bring in new ideas and opportunities. The development process then becomes self-sustaining.

It is expected that once the rural economy reaches this level, the agribusiness sector, such as the processing industry will start to boom. New concepts, such as honoring a contract, quality control, team efforts, rural organization, etc. which are essential for successful agribusiness operation will be adopted. Farmers as well as other partners will have the vision for safer short-term profit for longer term interest. This type of development option was demonstrated in Taiwan and is happening in Thailand and some other Southeast Asian countries. Agribusiness then becomes a stepping stone to industrialization.

The above mentioned process sounds like a slow process, but the required time may become shorter and shorter. The countries adopting this approach in recent years are able to avoid many unnecessary mistakes based on the experience of other countries. The duration needed for Taiwan was much less than in Japan and the progress made in Thailand is much more rapid than what happened in Taiwan.

Let us review some statistics. Taiwan and Bangladesh have many things in common. Both countries have high population density (1,283 persons/km^2 for Bangladesh and 2,192 for Taiwan). As a result, both have small farm sizes (2.2 ha/family in Bangladesh and 1.2 ha/family in Taiwan). The geographic location is very similar (21-26° N vs. 20-24° N). The annual rainfall is about 1,000-3,000 for both countries. On the other hand, the development in Taiwan has produced some difference in opportunities: people are able to choose their own interests. The literacy level for Bangladesh is 51% against over 90% for Taiwan. Roads are 0.0002 km/ha of cultivated land for Bangladesh and 0.02 for Taiwan. One hundred percent of the rural population in Taiwan has access to electricity, but only 2% of the rural areas in Bangladesh has electricity. Over 70% of the agricultural land in Taiwan is irrigated as against 28% in Bangladesh. The mortality level in Taiwan is about half (5.0%) that of Bangladesh (11.3). It is important to note here that agriculture played a major role in Taiwan's reaching these stages of development.

Let us look at some more statistics from 1952, where Taiwan started its economic development plan. The per capita income then was only US$ 186 which was lower than that of most other developing countries. Agriculture was the major economic activity which represented over 30% of the GNP. Ten years later, labor-intensive manufacturing industries took the lead. Most of these industries were and still are located in the rural areas. Vegetable-related agribusiness such as canning of mushroom, asparagus, and tomato played a very significant role.

These further evolved into more advanced processing industries such as frozen foods and ready-to-consume products. In the meantime, other agribusiness industries such as seed, pesticide, slaughter, flavor, and agricultural machinery, etc. developed as the market evolved.

The points I tried to address are :

1. It is appropriate to consider vegetable-based agribusiness while we are developing vegetable research strategies.
2. In this direction, we may consider the socioeconomic role of vegetables as an integral part of the overall economic development process.
3. The role and impact of vegetables in this direction has been demonstrated in countries such as Taiwan.
4. This approach can be adopted even in a country like Bangladesh which has very little natural resources and high population density.
5. Finally, per capita income is not a limiting factor in undertaking this approach. On the contrary, it could be an advantage to develop labor-intensive agribusiness.

Moreover, development of agribusiness will not prohibit the development of other industries. After all, we believe the level of managerial skill in fact is the basis of development. Vegetable production and marketing and vegetable-based agribusiness are steps to raise the level of management skill in the rural sector. Once it is installed, it becomes self-sustaining.

With this, I wish the workshop success and I am pleased that AVRDC is part of this development effort. We will try to contribute whatever we can to the process.

Dr. Samson C.S. Tsou
Director General
Asian Vegetable Research and Development Center

Inaugural Address

Mr. Chairman, Dr. Samson C.S Tsou, Dr. Richard Brown, Dr. S.M. Elias, scientists from various organizations, honorable guests, participants, ladies and gentlemen.

I am thankful to Dr. M.S.U. Chowdhury and other members of the organizing committee for honoring me as the chief guest in the workshop on vegetable crops agribusiness. This is indeed a very special subject which deserves to be given its due in the context of the nutritional deficiency of what the people of the country in general have been suffering from. The interventions of the AVRDC vegetable project which has contributed to a great extent in uplifting the vegetable research and development programs in Bangladesh, have been already well recognized. This workshop as organized by the AVRDC/BARC/BARI vegetable project is another example of our collaborative venture.

It is undeniable that increased production and consumption of vegetables in the country would contribute to prevention of many kinds of ailments to people of all ages, children, young people, and the aged without exception. In the past, we paid most of our attention to the attainment of self-sufficiency in food, and this process has still been going on. Now it is time that we consider nutritional aspects too, over and above the question of food. The moment we consider nutrition of the people, we bring in vegetables side-by-side with other nutrition givers. Vegetables can give maximum productivity and profitability.

The general objectives of the current Fourth Five-year Plan include, among others, attainment of self-sufficiency in food along with increased production of other nutritional crops, diversification of agricultural production especially along nutritional lines, and containing areas under cereals (especially rice) within limits of soil and ecological balance, in order to progressively release land for other crops, and achieve cereal-production targets through increase in per hectare output. To achieve these objectives, strategies should focus on maximization of yields, improvement of farm practices considering the country's agroecological situation and proper diversification with less dependence on cereal crops.

Emphasis on vegetable production fits into both the objectives and strategies of the plan. Vegetable production has been planned to increase from the bench mark level of 975,000 t (1989-90) to 1.3 million (1994-95). Recognizing the fact that increased production and intake of vegetables would help compensate for the debilitating nutritional deficiencies, it was rightly planned to make determined efforts to increase production and consumption of vegetables.

Recognizing the fact that the major part of the homestead crop and horticultural production is contributed by women, and exposure of modern cultivation technology to rural women as well as institutional support plays an important role in vegetable production, it has been planned to intensify extension work, assure supply of seeds and package of production inputs.

The plan provided for strengthening BADC's seed multiplication program for vegetable seeds, propagation and sale of vegetable seedlings at DAE's base nurseries and Thana nurseries, and giving necessary research backup by BARI's Horticultural Research Center.

The research and production programs of vegetables are expected to make concerted efforts to develop those vegetables which have the best potential in improving the basic nutrition of low-

income families and means of expanded self-help cultivation activities. I have observed that AVRDC, the only international institute mandated to carry out research and training on vegetable crops to promote production, marketing and consumption is closely working in this country. We should take full advantage of this institute. Vegetables, being short duration crops, are suitable for intercropping to help generate cash for small and marginal farming communities. It was also planned to take up vigorous efforts to identify and develop high-value export products and explore markets for them. Exploring and encouraging the processing of vegetables, spices and fruits in the private sector, with technical and other associated backup by the public sector, have also been envisaged.

The recent initiatives taken by different projects in the area of horticulture involving research and extension as well as support service organizations, such as BARI, Department of Agricultural Extension and BADC respectively, have already been a good step in the right direction. Besides these government and private agencies, many nongovernment organizations and individuals have involved themselves in the production and agribusiness of vegetables.

Farmers have been cultivating vegetables since time immemorial. But total production is meager. Our food-habit has not been vegetable oriented. Every other sector of vegetable agribusiness including transportation and marketing has not also been adequate.

There is a great need to raise public awareness about the need for consuming more vegetables. If we begin to feel like eating more vegetables, using them in many more ways than now and in greater quantity, the demand will be raised. In this way, we would embark on a situation calling for more vegetable agribusiness activities from all concerned.

Our backwardness for vegetable production has been due to unavailability of improved varieties and seeds of desirable quality and other inputs needed by the vegetable growers. I am glad to come and know that all of these aspects will be dealt with in this workshop. If the seeds will be discussed, in terms of research and extension , the production process with emphasis on its the commercial aspect should be focused. The storage and marketing, as well as enhancement of exportation of vegetables are in the agenda, too. It is good that socioeconomic aspects which often go by default will also be discussed extensively. Often, this aspect is the main, and sometimes the only critical point, going for or against a venture otherwise looking very sound in technical terms.

I am glad that for organizing this workshop, the AVRDC/BARC/BARI vegetable project, financially assisted by USAID, has taken the lead role. We are thankful to these organizations for taking up this workshop. As I have learned from the list, participants came from various sectors of the government, the NGOs as well as private entrepreneurs, including women. I have reasons to believe that the outcome of the workshop will bring about the real problems behind our backwardness and their possible solutions.

I hope that the various papers to be presented by different resource persons will give us directions and its deliberations and discussions will be fruitful and recommendations thereon shall be realistic enough for the planners and policymakers to pave the way towards tangible improvement of vegetable crops agribusiness.

With this observation and wishing it a grand success, I am having the pleasure of declaring the workshop open.

Thank you ladies and gentlemen.

M. Akhtar Ali
Secretary, Ministry of Agriculture, Bangladesh

Chairman's Remarks

Chief guest, Mr. Aktar Ali, Dr. Tsou, Dr. Brown, Dr. Elias, scientists from the NARS institutions, learned workshop participants, ladies and gentlemen.

I am thankful to you all for sparing your valuable time for this workshop on Vegetable Crops Agribusiness. This has been organized at a time when the need was already felt rather keenly to take stock of the situation in the vital field of agriculture and economic activity. The organizers of this workshop, especially Dr. A. Quasem, Dr. M.L. Chadha, and Dr. Kamal U. Ahmad, deserve commendation for this timely venture. The eminent speakers, who have just addressed the inaugural session, brought into focus many important issues that we should take note in formulating our future plans and programs. The technical sessions to follow will cover almost all aspects of vegetable crops agribusiness cutting across every area of activity that concerns it, both directly and indirectly. Obviously, it can be expected that the outcome of the proceedings of the three-day long deliberation participated in by so many learned personalities coming from all concerned fields including many representatives from the private sector will lead to valuable recommendations.

Meanwhile, some initiatives have been taken by the government of Bangladesh, as our chief guest has already indicated at BARI, Extension Department, and BADC, covering vegetable research, extension and support services. The USAID-assisted vegetable research and development program involving AVRDC in Taiwan and BARC and BARI in Bangladesh has produced some results ready for field adaptation. I must thank the concerned organizations for getting involved in this effective collaborative venture. May I take this opportunity to thank once again the chief guest representing the government of Bangladesh, the USAID Mission Director, and the AVRDC Director General for their presence here today which is definitely a sincere expression of each of the organization's interest in the joint Bangladesh/USAID/AVRDC program which is in progress in the country. May I thank all of you present here for your genuine interest in the subject.

Dr. M.S.U. Chowdhury
Executive Chairman, BARC

Remarks

Mr. Chairman, Secretary of the Ministry of Agriculture, AVRDC Director General, USAID Mission Director, other guests, scientists, participants, ladies and gentlemen.

This is a good opportunity for us to participate in a workshop which is very important for this country. Generally, the plight of agribusiness in Bangladesh as a whole, has been going by default and was not taken earlier as a matter of much concern. Vegetable Crops Agribusiness is an extensive process beginning from field production up to the final disposal of the finished products. A deficiency at any stage may totally spoil the whole system.

One of the needs of agribusiness system is institutional credit to farmers which should be linked to the marketing process and made easily available. Storage facilities for perishables such as fresh vegetables must be ensured at various stages of the marketing channel. Credit facilities should be provided wherever it is deemed necessary and expected to be properly utilized.

Agribusiness development in processing and utilization areas is also essential. In this regard, two major issues are to be addressed. These are technology dissemination for handling, processing, and utilization; and providing soft loans for the establishment of plants and industries that would be undertaken to fill the existing gap.

One of the objectives of vegetable agribusiness should be the export of fresh and processed products. Bangladesh has a great potential for embarking in this area in a big way. In order to achieve successful private ventures, transportation of the products within the country with freezing facilities and air transport to foreign countries must be ensured.

Vegetable production for export should be localized, and, in the production zone, quality must be ensured by providing an efficient extension services, input delivery and output marketing system. In such zones, vegetable growers must be organized in groups, aimed at improving and ensuring quality products and giving them at least a minimum of the bargaining capability. I hope that the workshop will cover all these matters. My best wishes for a successful workshop.

Dr. S.M. Elias
Acting Director General, BARI

Remarks

I am thankful to the organizers of this workshop for enabling me and my colleagues at the USAID Mission to participate in its inauguration, and later on, some of the concerned mission personnel to join in the technical sessions as well. It is surely a gesture of recognition, too, of the part being played by the United States toward greater collaboration with Bangladesh in its various development programs.

As you may be aware, in the area of agriculture, The United States Agency for International Development (USAID) has a general policy to assist in developing higher levels of agricultural production, diversification and value-added processing toward increasing farmers' income, employment generation, nutrition enhancement, and environment preservation. Its main focus is being directed to develop the nations of the world especially in food and nutrition, the two most vital aspects of human life so closely related to one another.

The concerns of agricultural inputs, production, processing, and marketing are among the major components of agribusiness that equally apply to the realms of vegetable crops. Vegetable-based agribusiness is a potential ground for developing realistic food and nutrition policies in different regions of the world including Bangladesh where poverty alleviation, women involvement in a larger scale, and improvement of people's nutritional status is necessary.

As I understand, the recently completed USAID-funded Agricultural Research Project (ARP) was implemented in collaboration with BARC and the NARS during its two main phases and a supplement, equipped the researchers with the necessary tools to generate technology toward improving the nutrition and economic setup of Bangladesh agricultural research. The farming systems research, a major component of ARP attained high marks and global reputation according to the ARP final evaluation report.

Meanwhile, a USAID grant that had begun in 1991, assisted AVRDC/Bangladesh program for vegetable research and development activities in this country. I am glad to know that this workshop constitutes a part of the AVRDC project aimed at bringing together the available expertise in the field through deliberation of many learned participants.

I hope that the outcome of the workshop will contribute to the vegetable sector's overall involvement. The government's main role, as expected, would be to create a congenial environment and provide a general policy package for vegetable agribusiness.

The ultimate task which lies with the private sector should receive adequate support. In all matters of vegetable production, consumption, and agribusiness, a substantial part can be played by the nongovernment organizations, which have attained credence in development activities in various sectors including credit, poverty alleviation, women involvement, and nutrition.

Finally, may I wish a successful workshop. Thank you.

Dr. Richard Brown
USAID Mission Director

Vote of Thanks

Mr. Chairman, the honorable chief guest, distinguished special guests, other guests, all participants of the workshop, ladies and gentlemen.

On behalf of the organizing committee, may I thank the chief guest Mr. Akhtar Ali, Secretary, Ministry of Agriculture for gracing the occasion. His deliberation and counselling will guide us to undertake our task more zealously.

I am privileged to thank one of our special guests Dr. Richard Brown, USAID Mission Director in Dhaka, whose presence here is indicative of the importance of the United States government to agricultural development and nutritional upliftment of the people of Bangladesh. It is worth mentioning that the AVRDC vegetable project, which has been running in this country for a number of years, is financed by USAID.

It is my privilege, too, on behalf of the organizing committee, to extend our heartfelt gratitude to Dr. Samson C.S Tsou, Director General, AVRDC, who has come all the way from Taiwan to participate in our workshop. We have been benefited by his deliberations covering the existing cooperative efforts between BARI and AVRDC. We hope to derive a lot more from his participation during the course of the technical sessions of the workshop.

We wish to thank Dr. M.L. Chadha , Resident Senior Horticulturist, AVRDC and Dr. Kamal U. Ahmad, vegetable crops agribusiness consultant, who have worked day and night to develop the details of this workshop from the inaugural program up to the concluding session. They have contributed immensely to our efforts in organizing the workshop, and without their support and commitment this workshop would not have been made possible.

Your participation has given us the opportunity to discuss vegetable agribusiness from seed to the production process; storage, preservation and processing; marketing, including import and export procedures as well as the consumption and socioeconomic aspects; within a period of three days.

While all the guests participating in the inaugural session deserve to be mentioned with gratitude, I am glad to offer our thanks to all government and nongovernment organizations as well as private agencies and individuals who have facilitated the conduct of the workshop. Let me also thank in advance all the participants of the technical sessions in general and the rapporteurs and chairmen of the individual sessions in particular.

The members of the media deserve our thanks and gratitude.

May we look forward to the successful conclusion of this three-day workshop.

Thank you.

A. E. Hossian
Head, Vegetable Division, BARI

Chapter 1

Seed Production and Handling

Session II : Seed Production and Handling

Part A

Chairman : Mr. M. Shahidul Islam

Rapporteurs : Dr. M. M. Hossain

Dr. A. K. M. Anwar Habib

Part B

Chairman : Dr. A. Quasem

Rapporteurs : Mr. Ali Mohammad

Mr. Shahabuddin Ahmed

Vegetable Research and Development in Bangladesh: New Varieties

A. E. Hossain, A. K. M. A. Habib and S. Ahmad

Olericulture Division, HRC, BARI, Joydebpur, Gazipur, Bangladesh

Abstract

Bangladesh produces over 1 million t of vegetables from 152,000 ha area (excluding potato and sweet potato). Over the years, there is a gradual increase of vegetable production and acreage. Statistics on vegetable production and area indicates that Rangpur, Rajshahi, Dinajpur, Jessore, Khulna, Dhaka, Faridpur, Comilla and Chittagong are the major vegetable growing areas in the country. Bangladesh Agricultural Research Institute (BARI) is the pioneer organization for vegetable research and development in the country. Its Vegetable Section, Horticulture Division was upgraded to Olericulture Division under Horticulture Research Center in 1994. This division is mandated to undertake different vegetable-research projects, such as, germplasm collection and evaluation, nursery technology, variety improvement (which includes introduction, selection, hybridization), cultural management, pest and disease management, homestead garden, improved vegetable cultivation, seed production, etc. On the basis of extent of cultivation, nature of production, market potential, nutritional value and cultural acceptability; 20 vegetable varieties have been prioritized for intensive research under various projects. Vegetable germplasm (collected locally and abroad) comprising cucurbits (992), crucifers (657), solanaceous (2,157), leguminous (1,549) and leafy vegetables (118) were evaluated at different agroecological zones in the country. Out of which, 12 varieties (including hybrids) were released from 1976 to 1992; and another 12 promising lines are awaiting for registration and release.

The released varieties with their package of technologies have been playing a vital role in vegetable industry. Development of heat tolerant varieties as well as adaptation of special techniques, such as, grafting, hormone application, cultural management, cultivation under protection during off-season widened the availability of year-round vegetables. The development and design of home garden model (Kalikapur) has helped the farmers rid of malnutrition with the availability of fresh vegetables throughout the year. Breeder seed production and maintenance of released and pre-released vegetable varieties has initiated a viable seed industry, thus reducing importation of seeds and drainage of foreign exchange. The division has been providing training, technical support and expertise service to public institutions, NGOs, private seed companies, elite farmers etc. for transfer of technologies. Variety demonstration, field days, on-farm trial, workshops, distribution of literature; using communication media like radio, television etc. created awareness among the people about the vegetable varieties with package of technologies leading to increased national production and consumption for better health, nutrition and financial security.

Introduction

Bangladesh with an area of 144,000 km^2 and 120 million people is one of the most densely populated countries in the world. More than 1 million tons of vegetables are produced from 152,000 ha area (excluding potato and sweet potato). The climate and soil of the country are favorable for growing different kinds of vegetables (particularly in winter season). The present

consumption of vegetables in Bangladesh is only 40 g/head per day which is lower compared with SAARC countries like Nepal (42 g), Pakistan (69 g), Sri Lanka (120 g) and India (135 g) (Ramphal and Gill 1990). Vegetable consumption in Bangladesh is only one-fifth of the minimum per capita requirement of 200 g/head per day.

Vegetables are very important as they supply vitamins and minerals which ameliorate the quality of the diet. So, the enhanced production of vegetables can play an effective role in elevating the nutritional status of the people in Bangladesh. Therefore, to supply the daily requirement of vegetable consumption, production should increase to 10 million tons, and in order to attain that, massive efforts are required towards bridging the wide gap between the availability and the requirement of the vegetables. Moreover, intensive vegetable production is needed for nutritional security, employment generation, higher farm income, better export and less dependence on cereal consumption. All these call for placing much emphasis on vegetable research aiming at bringing both quantitative and qualitative improvement of vegetables.

Introduction and Development of Varieties

Bangladesh has different types of vegetables of which winter vegetables cover more than 62% of both acreage and production (cool temp. 12-28° c, and little or no precipitation).

The popular summer vegetables are teasle gourd, pointed gourd, bitter gourd, string bean, stem amaranth, okra, pumpkin, ash gourd, ribbed gourd, Indian spinach, plantain, papaya, and brinjal (eggplant) which are mostly of indigenous origin. The winter vegetables, mostly of European origin include tomato, cabbage, cauliflower, radish, lettuce, broccoli, spinach, bottle gourd, hyacinth bean, carrot, turnip and beet. Some vegetables like okra, eggplant, amaranth, pumpkin, pointed gourd etc. are grown year-round. Now, it has been proven by research that tomato, cabbage, and cauliflower can also be grown throughout the year. The present production and increment (%) of vegetable production and acreage for the last six years are shown in tables 1 and 2.

Recently, some asiatic types of radish, cabbage and cauliflower have been introduced to Bangladesh from Japan, Taiwan and Thailand. Some varieties of these vegetables are of annual type and produce seeds whereas the temperate type do not flower under Bangladesh climate. Moreover, the seasonal fluctuation on the availability of vegetables (excess in winter and deficit in summer) and the acute shortage of vegetables during two slack seasons (mid March–April and October–mid-November) further aggravates the deplorable situation of the vegetables in the country. The location wise distribution of area and production of vegetables indicates the major production pockets to exist in the districts of Rangpur, Rajshahi, Dinajpur, Jessore, Khulna, Dhaka, Faridpur, Comilla and Chittagong. Fig. 1 shows the major vegetable growing areas in Bangladesh.

Research and development infrastructure

The production of vegetables in Bangladesh is primarily based on indigenous and with limited access to modern technology. Today, the government has given thrust on research and development program of vegetables. The Olericulture Division under HRC, BARI, is directly responsible for vegetable research and development. Other institutions such as Institute of Post Graduate Studies in Agriculture (IPSA), Bangladesh Institute of Nuclear Agriculture (BINA), Bangladesh Agriculture University (BAU) are also involved to some extent in vegetable research. BAU and IPSA generally conduct research on vegetables mainly as a part of post graduate degree program. BINA carries out research on vegetables through radiation. Bangladesh Agricultural Research Council (BARC) encourages vegetable research through contract research program,

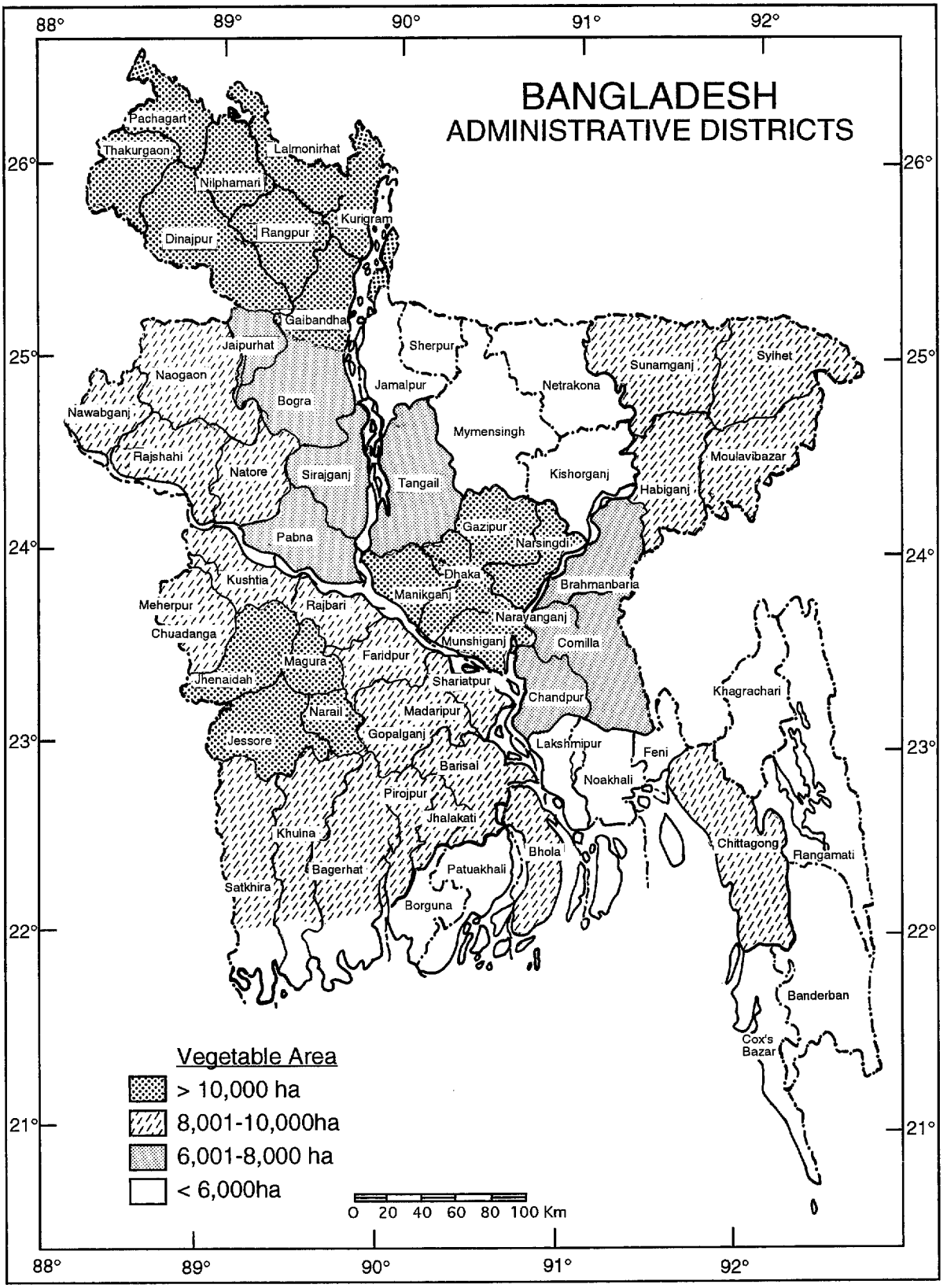

Fig. 1. Major vegetable- growing areas in Bangladesh

manpower development, logistic and financial support to the research institutes. Department of Agriculture Extension (DAE), Bangladesh Agricultural Development Corporation (BADC) and Nongovernment Organizations (NGOs) are involved in transfer of vegetable technologies in Bangladesh.

Table 1. Area, production, and yield of vegetables in Bangladesh, 1992-93

Vegetables	Area (ha)	Production (M. t)	Yield (M. t/ha)
Winter vegetables			
Brinjal (eggplant)	19,433	132,000	6.8
Pumpkin	7,287	56,000	7.7
Cauliflower	8,907	68,000	7.6
Cabbage	8,907	76,000	8.5
Bottle gourd	8,502	69,000	8.1
Tomato	11,741	86,000	7.7
Radish	20,243	179,000	8.8
Hyacinth beans	8,502	38,000	4.5
Spinach	4,453	21,000	4.7
Other vegetables	10,121	53,000	5.2
Potato	126,670	1,384,000	10.9
Summer vegetables			
Pumpkin	5,263	32,000	6.1
Brinjal (eggplant)	9,717	57,000	5.9
Pointed gourd	4,049	21,000	5.2
Lady's finger	4,453	14,000	3.1
Ribbed gourd	5,263	22,000	4.2
Bitter gourd	5,263	20,000	3.8
Arum	12,955	92,000	7.1
Ash gourd	4,858	29,000	6.0
Cucumber	3,644	15,000	4.1
String bean	2,834	7,000	2.5
Indian spinach	3,239	15,000	4.6
Snake gourd	2,429	9,000	3.7
Stem amaranth	4,049	1,900	4.7
Other vegetables	2,834	11,000	3.9

Source : Bangladesh Bureau of Statistics 1993.

Table 2. Increment (%) of area and production, 1986-87 to 1991-92

Season	1986-87		1991-92		% increase over 6 years	
	Area (ha)	Production (M t)	Area (ha)	Production (M t)	Area (ha)	Production
Summer	56,243	0.3	70,850	0.35	26.0	20.7
Winter	90,463	0.6	108,096	0.78	19.5	23.8
Total	146,706	0.9	178,946	1.13	45.5	44.5

Source : BBS 1993.

Vegetable research and development

BARI is the leading institute to evolve improved varieties as well as production of different vegetable technologies . Research is being executed under different projects (table 3) on 22 priority vegetables (table 4). These vegetables have been prioritized considering their area of cultivation, nature of production problems, nutritional value, market potential and cultural acceptability.

Table 3. BARI-vegetable research projects

1. Germplasm collection and evaluation of vegetables of economic importance
2. Nursery technology development of different vegetables
3. Varietal improvement and cultural management of solanaceous, crucifers, vegetable legumes, cucurbits, leafy vegetables and okra
4. Protected vegetable production technology
5. Home garden development
6. Vegetable seed production technology
7. Tissue culture for vegetable crops
8. Breeder's seed production and maintenance

Table 4. Priority vegetables for research

Vegetable	Priority	Season
Tomato	I	Winter
Radish	I	Winter
Cauliflower	I	Winter
Hyacinth bean	I	Winter
Bitter gourd	I	All season
Eggplant	I	All season
Pumpkin	I	Summer
Teasle gourd	I	Summer
Pointed gourd	I	Summer
Watermelon	I	Summer
Onion	I	Winter
Chili	I	All season
Musk melon	II	Winter
Cabbage	II	Winter
Broccoli	II	Winter
Spinach	II	Winter
Bottle gourd	II	All season
Cucumber	II	Summer
Summer tomato	II	Summer
Yard-long bean	II	Summer
Carrot	II	Winter
Stem amaranth	II	Summer

Germplasm collection and evaluation

Collection, evaluation, documentation and maintenance of vegetable germplasm are the continuous process required for the genetic improvement of any crop. Germplasm of different vegetables of economic importance are collected locally and abroad. Local germplasm of the indigenous vegetables are collected from different locations. Likewise, exotic germplasm like tomato, cauliflower, cabbage, pea, carrot etc. are collected from different countries through FAO, AVRDC, BARC, etc. and through the South Asia Vegetable Research Network (SAVERNET) program. The list of collected germplasm is shown in table 5.

Table 5. Collected germplasm of different vegetables in Bangladesh

Vegetable	Scientific name	Total number of collection
Cucurbits		
Pumpkin	*Cucurbita moschata*	80
Bottle gourd	*Lagenaria siceraria*	86
Snake gourd	*Trichosanthes cucumerina*	198
Teasle gourd	*Momordica dioica*	106
Pointed gourd	*Trichosanthes dioica*	33
Bitter gourd	*Momordica charantia*	174
Watermelon	*Citrullus lanatus*	112
Ash gourd	*Benincasa hispida*	30
Cucumber	*Cucumis sativus*	76
Khira	*Cucumis* sp.	11
Muskmelon	*Cucumis melo*	60
Ribbed gourd	*Luffa acutangula*	11
Squash	*Cucurbita maxima*	15
Crucifers		
Cabbage	*Brassica oleracea* var. *capitata*	139
Cauliflower	*Brassica oleracea* var. *botrytis*	201
Radish	*Raphanus sativus*	94
Chinese cabbage	*Brassica pekinensis*	136
Broccoli	*B. oleracea* var. *italica*	77
Turnip	*B. rapa*	10
Leafy vegetables		
Batisak	*B. chinensis*	1
Chinasak	*B. parachinensis*	1
Red amaranth	*Amaranthus gangeticus*	20
Stem amaranth	*A. lividus*	57
Indian spinach	*Basella rubra*	24
Spinach	*Beta vulgaris* var. *bengalensis*	7
Kangkong	*Ipomoea aquatica*	8
Legumes		
Hyacinth bean	*Dolichos purpurcus*	1,138
Garden pea	*Pisum sativum*	95
Yard-long bean	*Vigna sesquipedalis*	65
Bush bean	*Phaseolus vulgaris*	159
Vegetable soybean	*Glycine max*	92
Solanaceous		
Tomato	*Lycopersicon esculentum*	1,996
Brinjal	*Solanum melongena*	161
Malvaceous		
Okra	*Abelmoschus esculentus*	317

Variety development

Varieties available in Bangladesh can be grouped into three categories: (a) local varieties, (b) recommended varieties, and (c) released varieties.

The following are some popular local land races under cultivation at different agroecological zones bearing different local names:

Brinjal— Khatkhatia, Islampuri, Singnath, Jhumka

Cauliflower— Kartica, Agrahayani, Boiltoli, Poushali

Hyacinth bean— Noldog, Grithokanchan, Aswina

Bottle gourd— Khet lau, Hazari lau

Teasle gourd— Monipuri, Mukundupuri

Stem amaranth— Katoa, Bashpata

Moreover, BADC selected different vegetable varieties of local importance and popularity (table 6). BADC has been maintaining and multiplying these varieties through their seed program. The description of recommended varieties is presented in table 7.

Table 6. BADC-selected varieties

Winter crops		Summer crops	
Crop	Variety	Crop	Variety
Radish	Red Bombay	Stem amaranth	Katoa, Baspata
Lalsak	Altapeti	Sweet gourd	Baromashi
Spinach	Kopi palong	Indian spinach (pui)	Improved green
Onion	Taherpuri, Faridpuri	Bitter gourd	Gaj Karala
Bottle gourd	Khet lau	Snake gourd	Jhumlong
Eggplant	Islampuri	Yard-long bean	Kagar natoki
Cauliflower	Agrahayani	Okra	Pusa Sawni, Paravanikanti
Tomato	Pusa Ruby, Oxheart	Cucumber	Baromashi
Garden pea	Green feast	Papaya	C. O. -2
French bean	Contender	Ridge gourd	Local improved
Hyacinth bean	Local selection		

Released varieties

The objectives of vegetable breeding program are: (a) to develop open-pollinated varieties having high yield and common disease, insect resistance; and (b) to develop vegetable hybrids producing abundant and inexpensive seed. The breeding method is dependent on the nature of crop, objectives and available logistic support. At present, different methods are applied which include mass selection, pure line selection, clonal selection, back crossing, hybridization followed by pedigree method. The released varieties and the promising vegetables lines awaiting for release are shown in tables 8 and 9 respectively.

Table 7. Recommended varieties approved by the National Seed Board in 1985 for cultivation in Bangladesh

Crop	Variety	Crop	Variety
Cabbage	K.K. Cross, K.Y. Cross, Atlas-70, Autumn Hero N.S. Cross, King of Yorks Cross, Glory Diadem, Leo-80, Green Express, Glory of Knkhuizon, Copenhagen Market, Brunswick Early flat, Golden Acre, Summer Best	Broccoli	Green Duke, Express Corona, Green Coommet, Laser, Premium Crop, Decicco
Cauliflower	Kartika, Agrahayani, Pushali, Maghi, Snowball, Early Snowball, Tropical snow-55, Kathmandy, Local, Matra, White Baron, Betolia Potya	Carrot	Chanteny Red Cored, New Kuroda, Nantes improved, Early nnates, Nantes superior, Tokitas scarlet, Summer favour, Kuroda chantensy
Radish	Mino early, Miyashige, Red Bombay, French breakfast, shogoin	Lettuce	King crown, Queen crown, Great lakes, Black-seeded simpson, Butter head
Chinese cabbage	China king, All season ace	Beet	Detroit red, Early wonder
Watermelon	Glory, Grey belle, Empire No.2, Sugar baby, World queen, Top yield, Champion (Korea No.2)	Turnip	Purple top white, Globe, Pusa sweti
Knolkhol	White viena, Purple viena	Capsicum	California wonder, Yellow wonder, Bangla price (BADC), Oriental glory
Onion	Taherpuri, Faridpur bhati, Red creole, Pusa red, RS-2603, Red Bombay, Tropical red	Bunching onion	White evergreen, Sakatas white long, Ishikura long
Leek	American flag	Celery	Utah No.15, Ice ball
Tomato	Roma VF, Oxheart, Sanmarzano, World champion, Marglobe, Large red, Patharkuchi, Tropics, Romulus	Parsley	Velvet, Perfection curled, Champion moss curled
Brinjal	Jhumka, Islampuri, Bhangar, Muktakeshi, Khatkhatia, Singnath	Cucumber	New black pearl, Perfection
Indian spinach	Green red	Squash	Ebony sweet, Delica
Pea	Green feast, Arkel, Progress No.9, Bonneville	Lady's finger	Pusa sawani, Penta green, Green velvet
Yard-long bean	Kagornatoki	Spinach	Kapipalong, All green
French bean	Contender	Lalsak	Altapeti, Rakta lal
Country bean	Ghritakanchan, kartika, Noldog	Stem amaranth	Katoa, Sureswari, Fire field
Sweet corn	Super sweet, Kelvendon glory	Bitter gourd	Gaj karala, Domoushumi
Brussels sprout	Green marvel, Ice ball	Bottle gourd	Summer prolific long, Summer prolific round

Table 8. Released varieties developed by IPSA[a] and BINA[a]

Crop	Variety	Date released	Character
Hyacinth bean[a]			
	Baromashi (purple)	1992	Year-round, violet flower, light purple pod, yield-12.5 t/ha
	Baromashi (white)	1992	Year-round, white flower, yield-11.32 t/ha.
Tomato[b]			
	Bahar	1992	18-20 fruits/plant; harvestable between 85-100 days; fruits are big, fleshy, less-seeded; average yield-66 t/ha

[a]Institute for Postgraduate Studies in Agriculture; [b]Bangladesh Institute for Nuclear Agriculture

Table 9. BARI-developed varieties for registration and release

Crop	Variety	Origin of variety	Harvest season
Bottle gourd	BARI Lau 1	Local(BG0033)	Sept.—Jan
Chinese cabbage	BARI China BandhaA Kopi-1 (CCE-029)	AVRDC, Taiwan	Sept.—Dec.
Edible-podded pea	BARI Motor Shuti Seem 1	AVRDC, Taiwan (GP007)	Nov.—Feb.
French bean	BARI Jhar Seem 1 (FN006)	Local	Nov.—March
Garden pea	BARI Motor Suit (GP001)	Local	Nov.—Feb.
Hyacinth bean	BARI Seem 1	Local (HC0010)	July—Feb.
Hyacinth bean	BARI Seem 2	Local (HC0084)	Aug.—Feb.
Okra	BARI Dherosh 1 (OK0285)	India (CALPK5)	Feb.—Sept.
Pumpkin	BARI Mistikumra (PK0099)	Local	Sept.—May
Radish	BARI Mula 2 (1-3-228, Pinky)	AVRDC, Taiwan	Aug.—Jan
Tomato	BARI tomato 3	FAO (nr.1572); TM0126	Oct.—March
Tomato	BARI tomato 4	AVRDC (TM 0111)	May—Sep.
Tomato	BARI tomato 5	AVRDC (TM0367)	May—Sep.

Breeder seed production and maintenance

The vegetable division of BARI is responsible to produce and maintain the breeder seed of different released varieties and supply the same to BADC for the production of foundation seed. The amount of breeder seed produced in 1991-92 to 1993-94 along with the target of production for 1994-95 is shown in table 10. Recently, BARI provided the inbred lines of watermelon, brinjal to BADC for the production of hybrid seeds. Due to lack of clear- cut policy, breeder seed as well as inbred lines could not be supplied to private seed companies.

Table 10. Breeder seed production at BARI since 1991-92

Crop	Variety
Released varieties	
Kangkong	Gima Kalmi
Radish	Tasaki San
Chinese cabbage	Chinasak
Chinese cabbage	Batisak
Cabbage	Provati
Eggplant	Uttara
Tomato	Ratan
Tomato	Manik
Eggplant	Shuktara F_1
Eggplant	Shuktara F_1
Watermelon	Padma F_1
Prereleased for multiplication	
Bottle gourd	BG0033
Bush bean	FN0006
Cauliflower	Paushali
Cauliflower	1-2-1 (AGN-M)
Chinese cabbage	1-2-79
Garden pea	GP0001
Garden pea	Arkel
Hyacinth bean	HC0084
Hyacinth bean	HC0010
Pumpkin	PK0099
Radish	Pinky
Red amaranth	RM0001
Tomato	TM126
Tomato	TM111
Tomato	TM367

Linkage with private organizations

BARI, through its vegetable division offers technical support and provides information materials (booklets, leaflets, pamphlets, etc.) on varietal characteristics and packages of production technologies. The division regularly imparts training on vegetable production, seed production, hybrid seed production and seed health management to the participants from the private seed companies, NGOs along with other public institutions, e.g. BADC, SCA, etc. Most recently, they (vegetable division) signed a MOU with a number of private organizations like MCC, BRAC, PROSHIKA and some private seed companies to provide quality seeds as well as technologies of BARI-released vegetable varieties.

Contribution to Vegetable Industry

Different promising varieties of winter, summer and year-round vegetables with their package of technologies played a vital role in the vegetable industry. Some important contributions of the BARI-developed varieties and technologies are mentioned here.

1. Local, recommended, promising, and released vegetable varieties under cultivation contributed much towards national income and thus helped to build up a sound basis for the vegetable industry. For instance, Tasaki San (radish), Ratan (tomato), and leafy vegetables e.g. gima kalmi, presently occupy 70% of vegetable areas. Early maturing varieties with economic yield potential have helped the farmers obtain higher price during the lean period. Farmers in Bangladesh obtained maximum return per unit area and time using early maturing varieties which are suitable for different cropping system.

2. Development of off-season varieties along with improved cultural practices as well as vegetable cultivation under protection (e.g. summer tomato and cauliflower) have helped to mitigate the scarcity of vegetables particularly during kharif season.

3. Development of technology packages on land preparation, time of planting, distance, fertilizer requirement, moisture management, integrated pest and disease management, have made the quality-seed production very successful. Thus the breeder's seed production program of BARI has initiated a viable and prospective seed industry.

4. Developing and designing of a homestead garden model (Kalikapur model with 14 different vegetable varieties) has benefited the marginal farmers through poverty alleviation and freedom from malnutrition .

5. Introduction of vitamin and mineral-rich vegetables, e.g., asparagus, vegetable soybean, summer tomato, bush bean edible podded pea, China sak, bati sak, and Chinese cabbage diversified the use of vegetables, thus reducing pressure on other popular local vegetables.

6. Special production techniques, such as grafting watermelon by other cucurbits (bottle gourd/pumpkin as rootstock) and tomato, brinjal with wild solanum (rootstock) to protect from fusarium wilt and bacterial wilt respectively, have overcome the most serious constraint of production. Sprout culture of summer cauliflower has resulted to the development of true-to-type variety.

7. The hybrid varieties, e.g. padma (watermelon), suktara (eggplant) and tarapuri (eggplant) are expected to boost the production of watermelon and brinjal.

8. NGOs like BRAC, PROSHIKA, MCC, and Grameen Krishi Foundation have been provided with varieties along with technical support to promote vegetable expansion in the country.

9. Varietal demonstrations, farmer's training courses, field days, on-farm trials and distribution of booklets and pamphlets; as well as mass media campaign (radio and television) have created a great awareness among the people on the varieties and technologies to increase national production and per capita consumption of vegetables for better nutrition as well as strengthening of farmers' financial security .

10. BARI-developed varieties having the ability to profusely produce quality seeds under Bangladesh conditions have drastically reduced the importation of temperate-type vegetables; and thus reduced the drainage of hard-earned foreign exchange.

Constraints

1. Shortage of widely adaptable and high-yielding varieties.
2. Unavailability of improved seed varieties for the growers which lead them to cultivate local, traditional and low-yielding varieties.
3. Diseases and insect pests affect the vegetable crops adversely leading to reduction in both yield and quality.
4. Non-development of resistant varieties and integrated pest management systems.
5. Perishable nature of vegetables and the labor-intensive operations which discourage the farmers from growing vegetables.
6. Lack of production integration, processing and marketing, leading to poor marketing system.
7. No priority in planning and inadequate fund allocation for vegetable development program compared to cereals and other crops.
8. Unprecedented natural disasters (drought, disease, pest incidence, heavy flood, etc.).
9. Lack of improved production techniques of most vegetable crops.
10. Absence of quality seed production system.
11. Unavailability of hybrid varieties of the indigenous vegetables.

References

Anonymous. 1993. Yearbook of Agriculture Statistics of Bangladesh. Bangladesh Bureau of Statistics. M/O Planning, Govt. of Bangladesh.

Hossain, A. K. M. Amzad, M. A. Haque, and M. S. U. Chowdhury. 1990. In: Vegetable research and development in South Asia. Proceedings of a workshop held at Islamabad, Pakistan, 24-29 September, 1990. S. Shanmugasundaram (ed.). AVRDC publication no. 90-331. AVRDC, Tainan, Taiwan.

Hossain, S. M. M. 1994. Status of vegetable production in Bangladesh with special reference to vegetable hybrid technology. Country paper presented in expert consultation of the regional network on vegetable crops, FAO regional office for Asia and pacific, Bangkok, 29 Nov. to 2 Dec. 1994.

Ramphal and H. S. Gill, 1990. Demand and supply of vegetables and pulses in South Asia. In: Vegetable research and development in South Asia. Proceedings of a workshop held at Islamabad, Pakistan, 24-29 September 1990. S. Shanmugasundaram (ed.). AVRDC publication no. 90-331. AVRDC, Tainan, Taiwan.

Vegetable Seed Production

A. F. M. Habibur Rahman

Project Director, BADC – FAO Vegetable Seed Project, Dhaka, Bangladesh

Abstract

Vegetables are the main sources of vitamins and minerals that play a vital role in fighting against malnutrition. Present per capita consumption of vegetables is only 40 g/head per day against the minimum requirement of 200 g. Lack of awareness and dearth of quality seed supply are the main reasons for low production of vegetables in the country.

To increase availability of quality seed, the Bangladesh Agricultural Development Corporation (BADC) with the assistance of the Food and Agriculture Organization (FAO) started a vegetable seed project in 1986. The Government of Bangladesh (GOB) and FAO Vegetable Seed Project developed technical and infrastructure facilities at BADC/BARI centers for the development and production of high quality seed. The new seed policy of the government emphasized on the development of private sector seed industry. Hence BADC in collaboration with this project started to play catalytic role by providing various services to promote production of quality seed for the private sector through contract growers.

Introduction

Present annual requirement of vegetable seed in Bangladesh is 3,037 t. But supply of quality seed is only 579 t. The remaining 2,458 metric tons of inferior quality seed is used by farmers. Some seeds that can be produced in the country are also being imported. With the expansion of contract grower system, production and supply of quality seed is possible on competitive prices and quality. The contract grower system that has been developed and accepted by the private sector as an area of agribusiness, needs to be further strengthened and continued so that the momentum generated can be fully utilized for increased production and distribution of quality seed.

To help increase vegetable production, BADC started importing vegetable seeds of exotic types and distributing those throughout the country in the late 60s. Later, considering the importance and demand of tropical seed, BADC initiated production of local vegetable seeds in its farms in the late 70s. But progress was very slow due to limited funding, technical knowledge, modern varieties, physical facilities as well as trained manpower and experience.

GOB/FAO National Vegetable Seed Program

In order to improve the quality of breeder seed production and ensure regular supply of seeds to BADC the GOB and FAO with the financial support from the government of Denmark and Belgium started the National Vegetable Seed Project in 1986. The project aims to: (a) utilize improved seeds; (b) improve vegetable productivity; (c) improve economy and nutrition through vegetable seed production; and (d) improve employment opportunities and income

generating activities. Technical trainings of staff including development of infrastructure facilities for production of quality breeders and foundation seeds were arranged by the project at BARI and BADC centers. A flowchart of activities of the National Vegetable Seed Project is shown in figure 1.

During its first phase in 1986-89, the project assessed the quality of seed used by the farmers. The quality of seed was found far below the desired level as there was no organized system of seed production. So, the project identified the western part of Bangladesh extending from Thakurgaon in the north to Jessore in the south, as suitable areas for vegetable production. Because of relatively dry land with longer winter and flood free monsoon and loamy soil, those areas were found technically best suited for this purpose.

The project was revised in 1989 aimed at giving benefits to farmers through production and supply of high quality seed of superior varieties. For popularizing quality vegetable seed among farmers, countrywide field demonstrations were conducted. The success of the field demonstrations convinced the farmers to replicate the technology. They then started demanding quality seeds from private seed companies and dealers.

Impact of the new seed policy

Bangladesh declared its new seed policy in 1991. Provisions were made to involve private sector in production and distribution of quality seed to the farmers. As the base for quality vegetable seed production and distribution laid by the project were at the take off stage, the project objectives were modified to actively involve the private sector. The project launched extensive training program using BADC staff to acquaint the private sector with the technology on quality vegetable seed production, processing, storage, distribution and testing. Within two years, 2,000 seedmen involved in production and marketing of seeds were trained. Side by side annually, 2,500 farmer's field demonstrations with quality seed of superior vegetable varieties were organized country wide using BADC, DAE and NGO extension system.

Grow—out test

BADC conducts grow-out test of private sector seed and evaluates imported seed varieties . This has greatly motivated the private sector to assess the quality of their marketed seed and improve seed quality through the support of this program.

Seed production through contract growers

The awareness created among farmers and the increasing demand of quality seeds encouraged the private sector to produce quality seed through organized contract growers system under the supervision of BADC and the project. In 1992-93 and 1993-94, 1.3 t and 8.5 t of high quality seeds were produced respectively through contract growers in Rangpur, Thakurgaon and Lalmonirhat areas. These were distributed to the vegetable growers all over the country through private seed distribution channel. The farmers' response to the price and quality of seeds of contract growers was found satisfactory. As a result, more and more private entrepreneurs as well as contract growers started accepting the organized vegetable seed production system as an important tool and an area of profitable agribusiness.

In 1994-95, six private entrepreneurs have taken up production program in 121.5 ha for 13 vegetable crops, (20 varieties) through contract growers. Production of quality vegetable seed is 50,840 t. The list of vegetable seed production by the private seed entrepreneurs through contract growers system in 1994-95 is in table 1. During this year, the organized seed production is also introduced in Meherpur, Pabna and Jamalpur areas

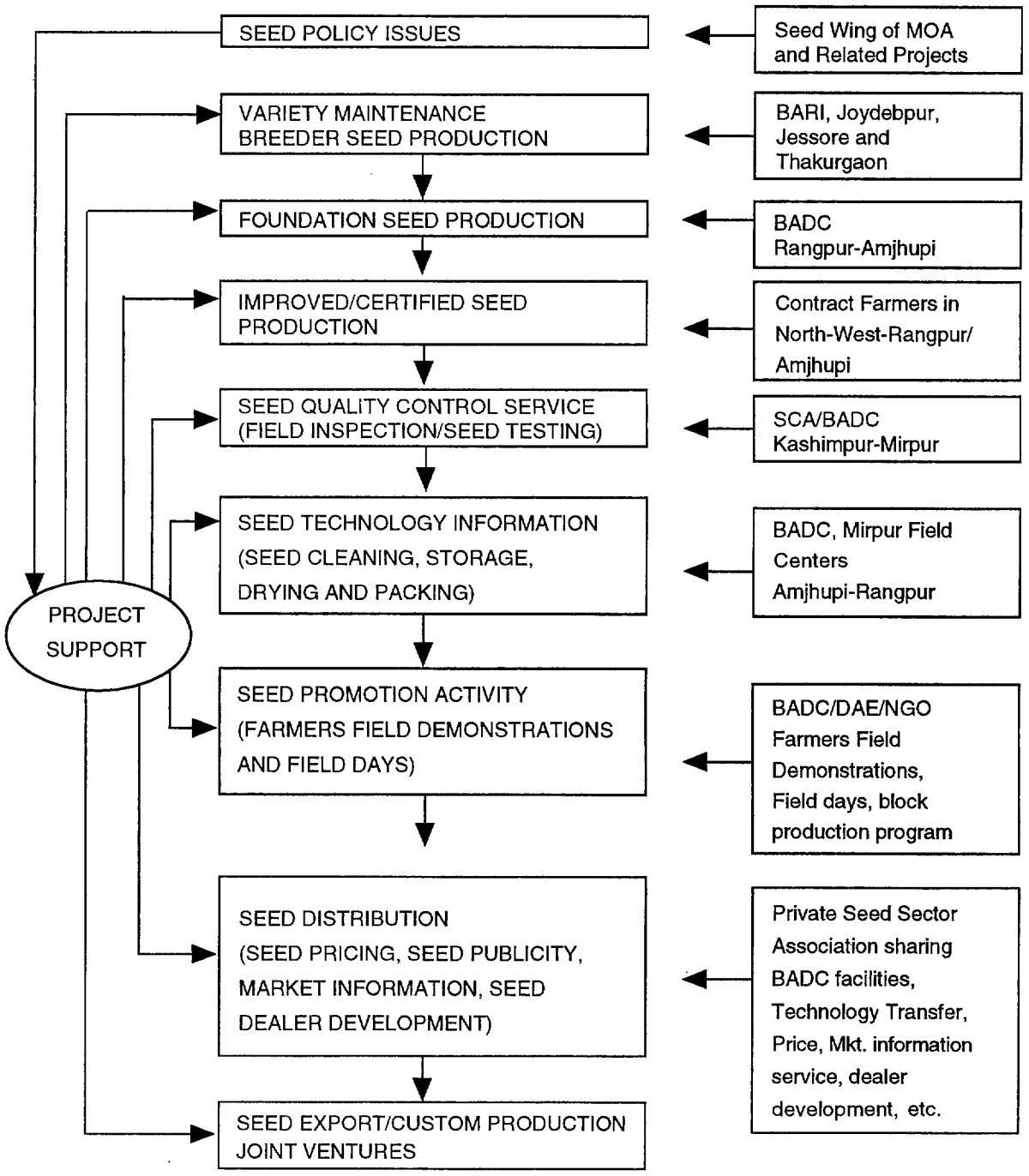

Fig. 1. Flowchart of activities of the National Vegetable Seed Program in Bangladesh

Table 1. Seed production under contract growers system

Vegetable	Variety	Area (ha)	Production (kg)	Range of yield (kg/ha)
Radish	Tasakisan	40.5	24,250	250-400
	Pinky	0.8	200	100-150
Tomato	Manik	2.8	200	30-50
	Ratan	12.2	700	30-50
	Rubi	3.0	150	25-35
Cauliflower	Agrahayani	1.6	375	100-200
Chinese cabbage	Batisak	4.1	1,600	200-300
	China sak	2.4	875	150-300
Eggplant	Islampuri	4.1	800	75-100
	Uttara	6.1	1,500	100-150
Spinach	Kapi Palong	1.4	1,350	400-600
Red Amaranth	Altapeti	30.4	13,000	200-300
Sweet gourd	Baromashi	4.1	700	75-100
String bean	Kegornatoki	1.4	1,000	350-500
Hyacinth bean	IPSA-1	0.2	100	200-300
	IPSA-2	0.2	100	200-300
Okra	Sawani	6.1	3,000	250-350
Garden pea	Green feast	0.8	340	200-300
Bottle gourd	Khetlao	0.8	150	100-150
	BG003	2.6	450	100-150
Total		125.6	50,840	

The adoption of modern technology per unit production of seed for different crops, specially radish, tomato, cauliflower, okra have already been increased substantially. This upward trend will also be seen in other crops in the near future.

Support of BADC to private sector

In line with seed policy mandate, BADC is now playing catalytic role to promote private sector seed industry by providing the following services:

1. Helps private sector choose an area and identifies cooperators (farmers) for seed production;
2. Multiplication and supply of foundation seed to the private sector at cost price;
3. Provides training to farmers for production technology;
4. Inspects seed plots and assists in field management;
5. Assists in cleaning, drying and processing of seed on charge basis;
6. Maintains liaison between seed growers, dealers and entrepreneurs;
7. Implements motivational programs to create market demand;
8. Conducts grow-out seed test of the private and public sectors;
9. Collects, purifies and maintains varieties to cover more crops and climatic needs; and
10. Explores possibility of foreign market and joint venture.

To cope with the increased demand of quality seed and promote private sector participation, BADC will soon establish Private Sector Vegetable Seed Promotional Unit with branches at Mirpur Dhaka, Alamnagar Rangpur, and Amjhupi Meherpur. Further variety development, maintenance and breeder seed production program of BARI including technology generation are expected to be strengthened accordingly.

Vegetable seed requirement

A recent survey conducted by FAO estimated vegetable seed requirement of the country as well as its sources of supply and wholesale market price. Annual requirement of vegetable seed at present is 3,037 tons. Source of seed supply and its value is given in table 2. Two pie charts showing volume and value of vegetable seeds supplied by different sources are shown in figures 2 and 3.

Table 2. Source, volume, and production of vegetable seeds in Bangladesh

Source	Volume (t)	Wholesale value (M taka)	Value in (M US$)	Quality of seed
Organized production	70.00(2.3%)	14.05 (49%)	0.35	Good
a) BADC-20.0				
b) Private Sector-50.0				
Unorganized production (spot market)	864.00(28.4%)	87.00 (29.4%)	2.18	Poor
Import 509.00	(16.8%)	122.00 (41.3%)	3.05	Good
a) Hybrid-11.0				
b) Open pollinated-498.0				
Farmer-retained seed	1,594.00(52.5%)	72.00 (24.4%)	1.80	Poor
Total	3,037.00	295.05	7.38	

Source : GOB/FAO Vegetable Seed Project

Note : 1995 exchange rate - US$1 = 40 Taka

Constraints

Lack of improved varieties

The number of vegetable varieties so far developed by BARI and selected by BADC are insufficient to cover all crops and climatic needs of the country.

Generation of seed technology

Vegetable seed production is still new in this country. Before the FAO project, less attention was given to vegetable research and development of seed production technology. Hybrid seed production technology is not yet available in the country.

Development of infrastructures

With the assistance of FAO project, some infrastructure facilities have already been developed at BADC and BARI Centers. But these are not enough to cope with increasing demand. Presently, the private sector do not have these facilities.

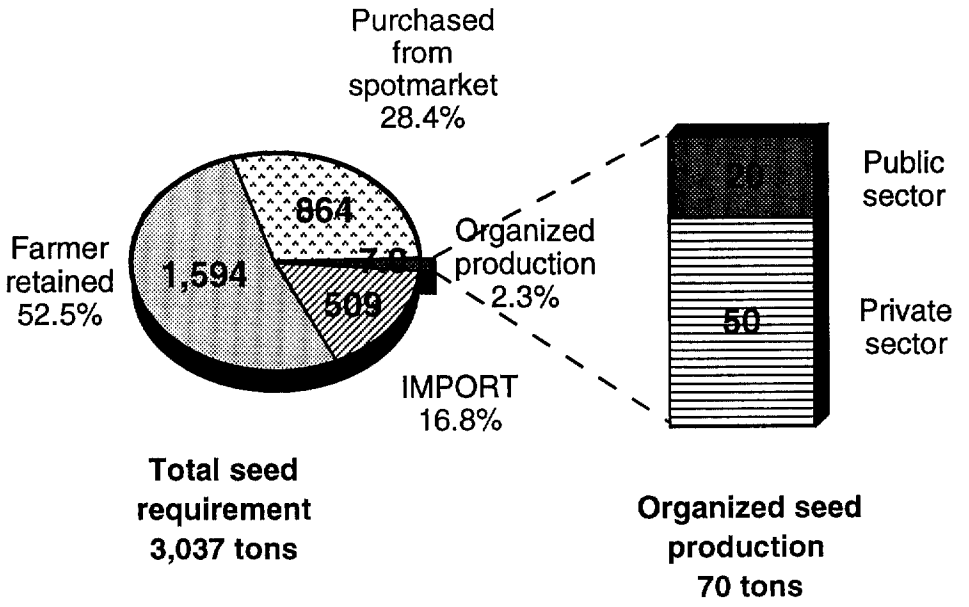

Fig. 2. Volume and source of vegetable seeds in Bangladesh
Source: BADC/FAO project: Strengthening the National Vegetable Seed Program

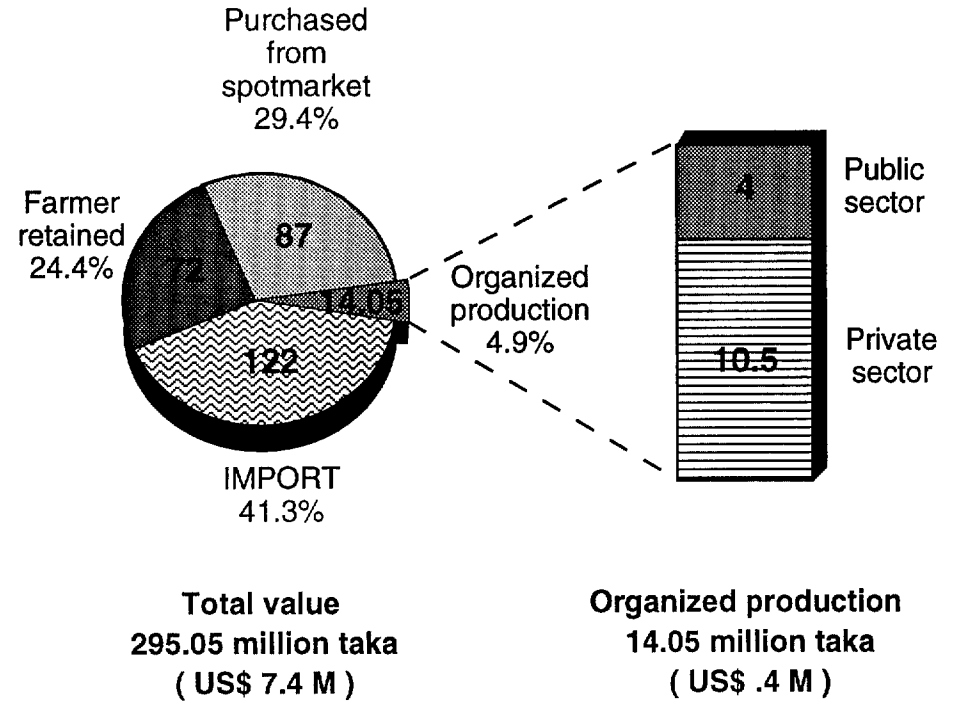

Fig. 3. Value and source of vegetable seeds in Bangladesh
Source: BADC/FAO project: Strengthening the National Vegetable Seed Program

Credit facilities for private sector

The private entrepreneurs are used to import seeds taking 75 to 80% margin from the bank against L/C with insurance coverage. But they do not have a separate credit line on soft term basis covered by crop insurance to finance for seed production and other related activities.

Conclusion

Production and supply of quality vegetable seed should be intensified to increase vegetable production and eliminate malnutrition in the country. The contract growers system of vegetable seed production initiated in the country has been found effective and profitable for agribusiness. This system should be strengthened and supported further by the government with respect to variety development, technology generation, infrastructure development and provided with a separate credit line for the seed industries. The FAO/BADC vegetable seed project which is now equipped with a strong baseline to promote private sector vegetable seed industry, should be extended for another term of five years.

Future Scope

Improve quality seed supply

Presently, only 579 t of quality vegetable seeds which cover 19.1% of the country's requirement are supplied by public and private sectors. The quality of 2,458 t (80.9%) of vegetable seed being used by the farmers either from spot market collection or retained by themselves is unknown and mostly poor. Growing improved quality seed is essential to increase vegetable production and profitability. Organized seed production through contract growers system is the best way for producing more quality seed to replace poor quality seed from the market.

Reduce import

The private sector entrepreneurs import 509 t of vegetable seeds annually costing Tk. 12.20 crores (1 crore = 10,000,000). This includes some seeds of tropical vegetables like okra, onion, radish and different cucurbits which can be produced in the country. Intensified contract growers system shall reduce importation of these seeds and save hard-earned foreign exchange.

Joint venture for seed production

The fast growth of organized seed production involving the trained farmers and seed entrepreneurs is attracting foreign seed companies to open joint venture seed production program and bring in the latest high-yielding varieties to Bangladesh. These joint venture will provide scope to export seed produced in Bangladesh to other countries as some high value hybrid vegetable seed for which manual labor is required, could be produced in Bangladesh at a very competitive price.

The joint venture will open avenues for introduction of superior varieties and hybrids and also help in introduction of latest technology on hybrid seed production.

Improve economy

Contract growers seed production system will generate employment in the rural areas and help improve the economy of small farmers as well as other concerned with the system. Intensified contract growers system shall generate employment and improve economic conditions of the country.

References

Bangladesh Bureau of Statistics, Ministry of Planning Government of Bangladesh.

Siddique M. A. and Aditya, D. B. K. 1992. Vegetable consumption and nutritional status of Bangladesh. Paper presented at vegetable production and marketing workshop at BARI, Gazipur, Joydebpur.

Habib Rahman, A. F. M. 1988. Vegetables and flowers production, marketing and use (Bengali). Mrs.Amina Khatoon.3/DZikatola, Dhaka.

AVRDC. 1992. Vegetable production and marketing. Proceedings of a national review and planning workshop. Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan. Publication No. 92-379.286 p.

Siddiqui, A. K. M. 1994. Country report on sample production of high quality vegetables and vegetable seed. Presented at a seminar held in OSAKA, Japan.

FAO. 1988. Production Yearbook.

Vegetable Seed Program in Bangladesh: Policy and Structure

Md. Nazmul Huda

Chief, Seed Technologist Ministry of Agriculture, Dhaka, Bangladesh

Abstract

Quality seed, the lifeblood for growing crops, is a product of specialized farming, conducted through strict adherence to the seed technological discipline. In addition, as techniques of crop growing develop, varieties are required to be replaced as rapidly as needed at the farmers level. These facts determine the specific nature of the policy and structure required for the development of a seed industry. The overall purpose of the approved seed policy is to efficiently produce the best quality seed of improved varieties for the farmers aimed at increasing crop production and productivity, per capita farm income and export earnings. Some minor amendments in the seed ordinance in 1971 would be necessary for the complete implementation of the policy. The number of varieties available for cultivation is very small compared to neighboring countries in Asia. Vegetables as mentioned in policy are unnotified crops and suitable varieties can only be used after registration. Conducting adaptability trials with wider range of crops and wider range of varieties and hybrids collected locally and abroad should start from the basic short-term policy. The public and private sectors should work complementarily to evolve more varieties. AVRDC can help in providing good materials. Collaboration with AVRDC should be strengthened.

Quantity of quality seed available after following technological discipline is only around 1%. Around 50 % of the requirement is supplied by the private traders after collection (20% import and 30% local). Quality of the vegetable seed used in the country is unknown. Only 1% which is produced and supplied through an organized system by Bangladesh Agricultural Development Corporation (BADC) is known. Quality of the imported seed may be considered good. For development of the quality of the rest seed, post control system may need to be introduced first as educational service and then as seed control measures.

There are organized marketing system for the vegetable seed in Bangladesh. Siddique Bazaar, a wholesale market for vegetable seed is right at the heart of Dhaka City. There are importers, wholesalers and retailers. Seed companies have distributors, subdistributors and dealers. Vegetable seed shops and vendors are well within the reach of the farmers. The market force for raw vegetables may be trained to become quality conscious and start organizing production of vegetables for quality seed of desired variety. The effort of both public and private sectors should be complementary to each other. Public sector with their vast facilities may coordinate activities like adaptability trial, supply of breeder and foundation seeds, provide facilities of production, processing, storage, etc.

Introduction

There is a serious nutrition deficiency in the daily diet of the Bangladeshi. The average vegetable consumption is around 40 g/capita per day against 200 g as recommended. Increase of vegetable consumption can help meet dietary imbalance and nutrition deficiency.

Increased availability of vegetable at a cost comparable to other food items can ensure increased consumption of vegetables. Availability at comparative cost depends on the use of efficient production technology of which quality seed is the critical input. Bangladesh seriously lacks in vegetable seed technology and in many segments of the technology, appropriate policy and structure, which can ensure supply of adequate quantity of quality seed.

Legislatory measures

Seed policy shows the intent of the government in the field of seed activities and seed law is an expression of the government about the implementation of the policy. Seed laws are designed to promote better cash return per hectare and to protect the farmer against the risk of sowing poor quality seed or of being otherwise exploited. Seed law also describes the private sector's participation in the seed industry. In early stages of a developing seed industry, the initiative comes from the government, but it is expected that with progress, an increasing part will be played by private enterprise. The law protects the farmer against fraud, negligence or accident. The reputable merchants are protected against unscrupulous competitors. Seed law therefore imposes certain restrictions on some of the various stages through which seed passes up to the point of sale to farmer (production, processing, testing, packing, and trading). These restrictions are enforced by penal sanctions.

Schools of Thought

Truthful labeling. No legal ban is imposed on the sale of seed no matter how poor the quality may be, but the results of the tests are made available to purchasers on labels.

Minimum standard. A minimum standard is set for each attribute and a ban is enforced on the sale of seed that falls short of any minimum standard. By mixing the two thoughts there can be some other modified methods to address the issue.

In Bangladesh, there is a seed ordinance (Seed Ordinance 1977) and a rule (Seed rules 1980) which have provisions for minimum standard with respect to germination and purity of selling certified seeds of notified crops. If no vegetable crop has been published as notified crop, these restrictions are not applicable.

The seed policy (1992) states that:

"Varieties of crops other than rice, wheat jute potato and sugarcane that are imported or locally developed by private person, company or agency must be registered with the National Seed Board (NSB), giving prescribed cultivar description, but will not be subjected to any other restrictions."

Any individual, company or agency who wishes to import seed, develop and register new seed varieties or package seed in labeled containers must first be registered at the NSB.

Provisional registration of varieties and dealers have already started. It is now necessary to start putting restrictions on some vegetable crops having high trade volume (such as radish) in order to protect farmers from being cheated and protect reputed seed dealers.

The NSB notifies the vegetable crop and the name will be published in the gazette with restriction imposed on it. To start with, only one will be allowed to sell seed of the notified vegetable crop. The seed will be labeled but will not be placed in a container. Training will be provided to the interested dealer to undertake packaging and labeling. This will continue for a few years and then postmarket sampling and testing will start. The dealer will be informed about the quality he has marketed. Those who do not follow this measures will be dealt with as per law. In this gradual way, legislative measures can be imposed in the vegetable seed sector.

Availability of varieties

Variety is the key to any seed development program. Unless there is abundant flow of varieties from research, there cannot be a thriving seed industry. About 15 varieties of eight crops including three hybrids has so far been released by the public sector research. In Bangladesh, the private sector has not conducted research on varietal development unlike Korea who has 43 private seed companies with vigorous program of activities on vegetables. There are 1,707 registered vegetable varieties in Korea of which 470 varieties are open pollinated and the rest are hybrids. Almost similar is the case in Japan and China. About 100 private seed companies are involved in research. These companies released 200 varieties to the government of Japan. Seed research in China has developed huge number of hybrids of most of the vegetables.

Provision of the seed policy in Bangladesh

1. The NARS will continue to pursue plant breeding program for all crops of national importance. However, special efforts will be made to evolve improved varieties for pulses, oil seeds, tuber crop vegetables, fruits and spices.

2. Improved varieties of seed and planting materials should be procured and introduced in the country by allowing their import, especially through private seed entrepreneurs. For this purpose, business contract including joint ventures are to be encouraged between private enterprises and foreign seed companies.

3. Private individuals, companies and other agencies will be encouraged to undertake plant breeding programs and will be allowed to import breeder/foundation seeds of notified crop for variety development and promotion purposes.

Seed policy has made ample scope for public and private sectors for evolving latest varieties through basic research and also through importation. In this context the following issues may be addressed :

1. As the research facilities have not been developed in the private sector, public sector facilities are to be extended to generate good varieties and hybrids (by collecting these from the neighboring countries) through quick adaptability trials. Varieties or hybrids will be registered in the name of the intended seed dealers both in private and public sectors.

2. The existing vegetable research should be strengthened so that it can continuously release varieties and hybrids that can be used by the private sectors.

3. AVRDC is a good source of ample materials which can be put to simple trial and release. The role of AVRDC in Bangladesh should be strengthened.

Supply of quality seed

When a new variety in hybrid is developed and released, it is important that its seed be multiplied and made available in required quantity as soon as possible so that farmers are benefited. The released varieties must be maintained in such a way that pure seeds are constantly flowing into

the commercial channel. Multiplication of improved and adaptive varieties or hybrids, maintaining quality, is an exact task called for a sound policy, and technically and financially sound organization.

BADC is responsible for supplying quality seeds of most of the publicly released varieties. It undertakes multiplication and processing of some of the vegetable seeds. It has two seed farms and three seed processing centers. In the private sector, organized production has not yet taken shape but some of them are entering into it. About 2,500 seed traders are active in procurement (import and local) and sale of vegetable seeds.

The existing system seems to be inadequate to cater the need of the seed requirement of the country. The total requirement of 1,400 tons are used in seed business (500 t imported, 900 t locally produced) and 1,600 t is the farmer's seed.

Provisions of the seed policy on seed multiplication

1. Breeder and foundation seeds of all varieties will be made available through negotiation to duly registered seed producer both in public and private sectors.
2. BADC will concentrate primarily on producing foundation seeds of rice, wheat, jute, potato, and sugarcane on its own farm.
3. BADC will encourage farmers to multiply seeds on a contract basis and will gradually cease to grow certified seed on its own seed farms.

Most of the vegetable seeds are either imported or produced by farmers. The following issues are important in increasing the supply of quality seed.

1. Importation of vegetable seed should continue, but as per policy, importers should register at the NSB.
2. Contract growing should be intensified for organized seed production and should be linked directly to the private sector to ensure increased supply.
3. Foundation seed of locally bred varieties should be supplied by BADC, if necessary, private sector may also be involved through suitable mechanism by providing training and facilities.

Certification

Seed certification is a legally sanctioned system for quality control of seed multiplication and production which consists of the following main control measures :

1. Inspection of field and processing centers
2. Pre-post control tests
3. Quality test

Seed ordinance of the country allows marketing of certified seed of notified crop in labeled container only after the seed is true to variety and has minimum level of germination and purity. Since vegetable crops are not under the list of notified crop, such provisions are not applicable. The provisions of seed policy regarding certification are as follows :

1. Seed certification will be a service provided to private individuals, companies or public agencies who wish to assure their farmer-customer that their seeds are of high quality. Although seed certification is voluntary, public sector breeder/foundation seeds will be certified as a matter of policy.

2. Seed Certification Agency, an independent organization is now certifying seeds of rice, wheat and jute. The capability of SCA is limited. At present, they cannot extend services to other crops. A project to strengthen SCA is under implementation. Intended seed dealer may be encouraged to have their seed certified. But without establishing an organized production system, it would not be possible to have their seed certified. At this stage, it seems premature to put effort in organizing any certification of vegetable seed. On the other hand vegetable seeds are mostly marketed through company logo and quality checks through their internal quality control system. However, a grow-out test of all the registered varieties being sold by registered dealers in labeled container should be conducted using the expertise of the public sector organization in collaboration with NARS, BADC and SCA. Results are published on a regular basis to inform all concerned about the quality of seed being marketed.

Agribusiness

Twofold functions of seed agribusiness :

1. Seed as a commodity for trade; and

2. Seed as an input for producing commodity for business.

Seed declared as industry and process has been started for inclusion in the investment schedule. Establishment of credit line and incentive seems to be necessary in establishing industry for vegetable seeds.

Vegetable crops are being sold in the domestic and foreign markets to meet the requirement of the consumers. Market research in this respect will allow selection of varieties of vegetable crop which are in demand. Seed program for these varieties are to be developed, and, required quantity of seed should be made available. Joint venture has been encouraged in the seed policy.

Complementary effort

Seed policy has indicated about complementary activities in seed development. It has provisions as follows:

1. To promote balanced development of the seed sector by providing equitable opportunities to the public and private sectors.

2. To enable farmers to have access to the best quality planting materials available.

3. BADC's role will be reoriented to promote development of private sector seed industry.

Conclusion

A collaborative effort between the private and public sectors should be strengthened for the development of a sound seed industry.

References

The Seed Ordinance 1977. MOA, Dhaka, Bangladesh.

The Seed Rule 1980. MOA, Dhaka, Bangladesh.

The Seed Policy. 1992. MOA, Dhaka, Bangladesh.

Proceedings of a seminar on the implementation of the seed policy for the development of seed industry, MOA, Dhaka.

Vegetable Seed Technology. 1988. BADC Krishi Bhaban, Dhaka.

Promoting vegetable seed in Bangladesh (Policy and Structure Issues). 1995. Study report FAO/GOB. Strengthening of the national vegetable seed program, BADC Krishi Bhaban, Dhaka.

FAO. Cereal Seed Technology. 1975. Food and Agriculture Organization, Rome.

Country report on seed presented to APSA conference at Chiang Mai, 1994. Thailand, RAPA Office Bangkok, Thailand.

Role of AVRDC/BARC/BARI Vegetable Project in Vegetable Research and Development in Bangladesh

M.A. Hamid Miah [1], Abu Enamdar Hossain[2], Kamal U. Ahmad[3], and M. L. Chadha [4]

[1]BARC, Dhaka, Bangladesh, [2]HRC,BARI, Joydebpur, Gazipur, Bangladesh, [3]Consultant, Vegetable Crops Agribusiness, AVRDC/ARP, Bangladesh, [4]Resident, Senior Horticulturist/Agronomist, AVRDC/ARP, Bangladesh

Abstract

The Asian Vegetable Research and Development Center (AVRDC) is an autonomous, nonprofit international agricultural research and development organization established in 1971. It is mandated to carry out research and training on vegetable crops to promote production, marketing, and consumption of vegetables in Asia. The AVRDC headquarters is in Taiwan. In 1992, the center's activities were expanded with the establishment of the Asian Regional Centers in Bangkok, Thailand, and the Africa Regional Program in Arusha, Tanzania. A third regional center in Costa Rica for the Central and Latin American countries was established in 1993. The key role of AVRDC is to help national systems achieve their desired goal in vegetable research and development. The center works as a catalyst in collecting germplasm, generating and disseminating information, providing training, and stimulating vegetable research.

Active collaboration with AVRDC started with the deployment of one resident scientist at BARC/BARI with USAID funding from April, 1991. The AVRDC/USAID/Bangladesh project contributed in strengthening the national program on vegetable research and development through the introduction of germplasm, improved production technologies, identification of promising lines/varieties; imperative in-country and foreign trainings to scientists/extension workers, nongovernment organizations and farmers; demonstration and transfer of new technologies; developing linkages between the government and NGOs, with its experts, and training facilities in collaboration with the national partners. During the project's implementation period, some notable contributions have been made which will have both direct and indirect roles to play in building up vegetable crop agribusiness in the country.

More than 1,000 lines of different vegetables having good traits like tolerance to many biotic and abiotic factors were introduced and tested. From this germplasm, a number of valuable lines have been identified. Now, it is possible to develop summer tomato, summer cauliflower, virus-free okra, edible podded pea, virus-free mungbean, Chinese cabbage, vegetable soybean and kangkong. The national vegetable planning workshop, the workshop on recent advancement in vegetable development of Bangladesh, 76 other training courses on different aspects of vegetable improvement and production were organized for more than 1,400 scientists and extension workers of BARI, BINA, BAU, IPSA, DAE, NGOs and more than 1,200 progressive farmers. There were more than 1,100 demonstrations on new vegetable varieties and improved technologies throughout the country. The project has successfully linked Bangladesh with the South Asia Vegetable Research Network (SAVERNET) in exchanging vegetable germplasm with South Asian countries. The project has also generated a lot of useful literatures which will go a long way in keeping the concerned people abreast with the latest knowledge in the area.

The presence of AVRDC has contributed much in uplifting the vegetable research, extension and development programs. But a lot more remains to be done. As technology generation and its transfer are a continuous process, strong emphasis should continue to introduce more and more useful germplasm and technologies from AVRDC and other various sources. Also, technology generation and its testing locally should be strengthened and be transferred to the farmers through a large number of farmers' field demonstrations and field days so that the benefit of these technologies shall be adopted by the farmers immediately. The testing of different technologies needs to be done throughout the country by involving different extension agencies for field demonstrations and trainings. More extension agents including NGOs working on vegetable crops need to be technically trained to speed up transfer of vegetable technologies to the farmers so that year-round vegetable production and consumption in Bangladesh shall be increased.

Introduction of Germplasm

More than 1,000 lines per varieties of 33 different vegetable crops were collected from AVRDC and other sources and made available to BARI Horticulture Research Center. These are now being tested in the field (table 1). The introductions carry many desirable characters like high yield, quality traits, heat tolerance, resistance to diseases and insects pests like bacterial wilt, black rot, phomopsis blight, powdery mildew, downy mildew, leaf curl virus complex, yellow vein mosaic virus and tolerance to fruit and shoot borer.

Development and selection of improved varieties

Among the introduced varieties, 45 promising lines of 15 different vegetables have been selected and 35 of these are ready for farmer's field test. These include lines of summer tomato, summer cauliflower, cool season tomato, vegetable soybean, kangkong, virus-free okra, Chinese cabbage, mungbean, malabar spinach, chili, garden peas, edible podded peas, brinjal (eggplant), and radish. A significant initial impact made by the project was its cyclone rehabilitation activities. In 1991, soon after a survey of the cyclone affected areas, the project identified kangkong as a potential crop for such areas. Large quantities of kangkong seed of improved selection from Taiwan was distributed to eight Thanas (districts) in Cox's Bazaar and Chittagong. The kangkong crop was so successful that it is now considered as the perfect vegetable for cyclone rehabilitation activities. This improved-kangkong selection is now widely grown in Chittagong and Cox's Bazaar areas.

Improved technologies

Off-season and year-round production. Now, tomato and cauliflower can be produced in summer. AVRDC/BARI demonstrated the off-season as well as year-round tomato production with the help of AVRDC heat tolerant lines and by the use of hormone, tomatotone (fig. 1). The estimated economic return of year-round tomato cultivation is presented in fig. 2. The normal crop or main-season crop of tomato is grown from October to March. The average yield of this crop is about 60 t/ha, and an average of about Tk 200,000 can be earned from this procedure.

Table 1. Collection of germplasm

Crop	Scientific name	Number of varieties introduced
Tomato	*Lycopersicon esculentum*	26
Chili	*Capsicum annuum*	99
Vegetable soybean	*Glycine max*	60
Brinjal	*Solanum melongena*	39
Peas	*Pisum sativum*	27
Chinese cabbage	*Brassica pekinensis*	21
Onion	*Allium cepa*	15
Cucumber	*Cucumis sativus*	13
Okra	*Abelmoschus esculentus*	11
Muskmelon	*Cucumis melo*	11
Papaya	*Carica papaya*	9
Bitter gourd	*Momordica charantia*	9
Malabar Spinach	*Basella alba*	8
Cauliflower	*Brassica oleracea* var. *botrytis*	8
Radish	*Raphanus sativus*	8
Pumpkin	*Cucurbita moschata*	6
Pai tsai	*Brassica parachinensis*	5
Cowpea	*Vigna unguiculata*	4
Spinach	*Spinacia oleracea*	42
Sponge gourd	*Luffa cylindrica*	3
Turnip	*Brassica compestris* var. *rapa*	3
Bottle gourd	*Lagenaria siceraria*	3
Lettuce	*Lactuca sativa*	3
Seem or Country bean	*Dolichos lablab*	2
Kangkong	*Ipomea reptans*	2
Garlic	*Allium sativum*	2
Roundmelon	*Citrullus vulgaris* var. *fistulosum*	2
Longmelon	*Cucumis melo* var. *Utilizzi*	2
Watermelon	*Citrullus lanatus*	2
Asparagus	*Asparagus officinalis*	2
Leaf beet	*Beta vulgaris*	2
Yard-long bean	*Vigna sinensis* var. *sesquipedalis*	2
Cabbage	*Brassica oleracea* var. *capitata*	1
Methi or Fenu	*Trigonella foenumgraecum*	1
Asparagus bean	*Tetragonolobus purpureus*	1
Celery	*Apium graveolens*	1
Mungbean	*Vigna radiata*	351

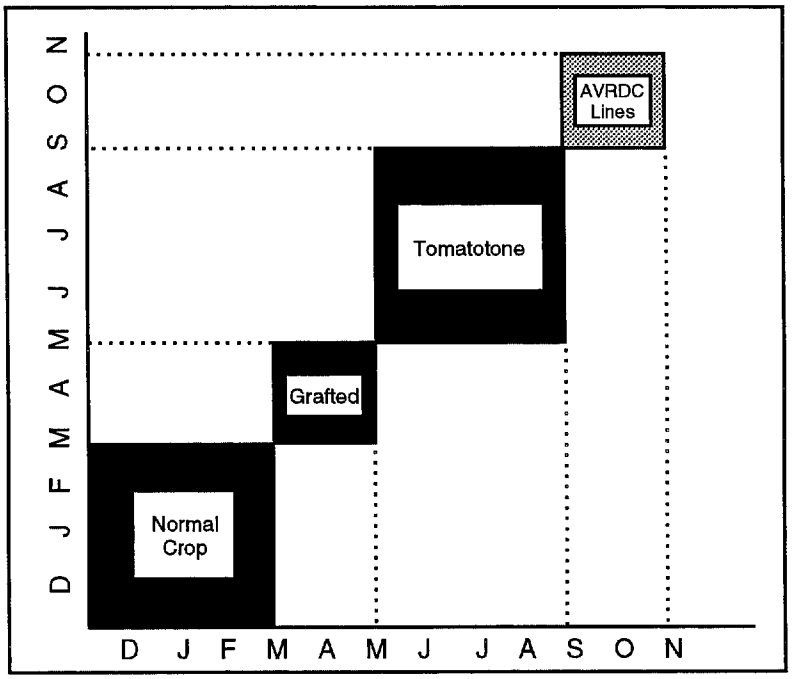

Fig. 1. Year-round tomato cultivation in Bangladesh

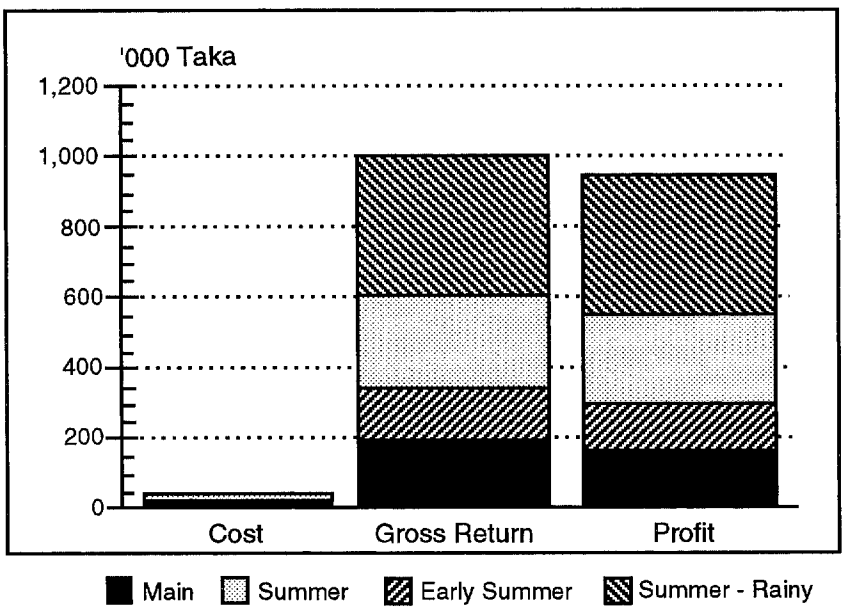

Fig. 2. Estimated economics of tomato cultivation in Bangladesh

Through grafting techniques, the crop growing season can be extended up to June. An estimated average yield of about 40 t/ha may generate as much as Tk 380,000. With the help of growth hormone and heat-tolerant varieties, 2-3 crops can be produced from June to September. The average yield during summer is about 20 t/ha but price of fresh tomatoes during this season is quite high. At that time the price usually ranges from Tk 30 to 100 per kg. But even if we calculate at the minimum price of Tk 10 to 50 per kg during this season, the income of the farmer can be between Tk 200,000 to 1,000,000. During the summer of 1994, one farmer from Narshindi area who had just grown 300 plants of summer tomato, earned Tk.13,000. Another profitable crops from the summer lines can be taken during early winter.

Summer cauliflower technologies (using a heat tolerant line from Taiwan) have been standardized. Four crops of summer cauliflower can be produced from May to October when the curd price ranges from Tk 5 to Tk 20. So, if there are 40,000 plants/ha, expected income shall be Tk. 200,000/ha to Tk 800,000/ha.

Cultivation techniques for early garden pea, edible podded pea, virus-free okra, and mungbean cultivation techniques are ready for demonstration. The farmers shall generate more income if this technology will be adopted in Bangladesh.

Rainy season management of production. A technique of production using the raised bed system identified at AVRDC has been successfully introduced to the farmers in Bangladesh. This ensures good drainage in the field and reduces crop losses during rainy season.

Use of grafting technology in vegetable cultivation. Using *Solanum torvum* as the rootstock, eggplant scions were successfully grafted to overcome the problem of nematodes, bacterial wilt, and high temperature. The national program scientists adopted the technique and grafted the cultivated tomato scions to *S. torvum* rootstock. Since the labor is cheap and easily available, the grafting technique can easily be used by farmers. This technique reduces production cost. Being free from fungicides, the vegetables produced are safe to the consumers.

Use of protection technique in nursery management. The efficiency of cultivation of vegetables has been enhanced by the use of some protection techniques at the early stage of production.

Homestead cultivation model. Extension of the models for vegetable growing in the homestead areas in different locations of the country was supported by AVRDC-developed cultivation technologies. In the new models, previously used vegetables and new vegetable varieties are being introduced to double the present productivity of about 141 kg, ultimately increasing it to about 365 kg, so that 1 kg of vegetables should be available from an area of 36 m^2.

Intercropping of AVRDC crops. Development of intercropping of mungbean, vegetable soybean and tomato, with maize and sugarcane has been attained successfully.

Vegetative propagation. Kangkong has been propagated through the use of cutting.

Training of scientists/trainers

A large number of in-country training programs with the help of AVRDC resource persons were organized to improve the knowledge and efficiency of local scientists/trainers. In-country training courses include the following:

1. Vegetable breeding;
1. Germplasm, collection, evaluation, documentation and conservation;
3. Intensive vegetable production technology for NGOs;
4. Disease and insect pest management of vegetable crops;

5. Experimental design and data analysis;
6. Innovative practices for summer vegetable production;
7. Intensive vegetable growing and utilization;
8. Vegetable breeding and genetic analysis;
10. Off-season and protected vegetable cultivation; and
11. Use of laboratory equipments for vegetable crops improvement.

Transfer of technology

Aiming at quick transfer of new varieties and technologies, several activities in the regimes of training, field days, and demonstrations were undertaken. Training programs were arranged at different locations of the country for extension workers including NGOs and farmers.

Training. There were 25 training programs organized for extension workers benefiting 1,470 participants. Thirty- five training programs were conducted participated in by 1,200 farmers.

Farmers Field Days. Five farmers' field days were organized for different crops at different schedules as mentioned below:

1.	Summer Tomato	— September, 1993
2.	Chinese Cabbage	— December, 1993
3.	Winter Tomato	— February, 1994
4.	Rainy Season Tomato	— September, 1994
5.	Mungbean	— October, 1994

Demonstrations. More than 1,100 demonstrations were arranged on tomato, radish, okra, edible podded peas, kangkong, bati sak, China sak, amaranth, mungbean, summer tomato, summer cauliflower, etc. at research stations and farmers' fields through extension agencies including NGOs at different locations of the country.

Reviewing advancements

Reviewing the program of activities, advancements attained, and prospects and problems were done through the conduct of (1) National Vegetable Review and Planning Workshop, 26-29 January, 1992 with participants from 18 different government and nongovernment organizations and (2) National Symposium on Recent Advancement in Vegetable Development of Bangladesh, 24-25 April, 1994 participated in by Bangladesh Society for Horticultural Science, NGOs and private agencies. The participants reviewed and analyzed the national policies on vegetable production, marketing and consumption. They identified vegetable production and marketing constraints during different seasons. They proposed recommendations to develop priorities in vegetable research and developmental strategies based on resource availability.

Through BARI/AVRDC collaboration, Bangladesh became a member of SAVERNET. Bangladesh participated in the exchange of germplasm/elite varieties and providing platform to work on the common problems of vegetable crops with co-members from Bhutan, India, Sri Lanka, Nepal and Pakistan in the South Asia. A joint SAVERNET planning meeting of was organized at BARC, Dhaka (24-27 February, 1992) participated in by 38 scientists and administrators from six member countries where a work plan was prepared. All member countries also attended the

midterm review meeting at Bangalore, India (12—15 September, 1994) Six participants from Bangladesh attended. At present six countries have agreed to exchange 117 varieties of 12 vegetable crops.

Strengthening the facilities at BARI

Laboratory and field research facilities have been improved by acquiring about G8 new equipments and field materials. The project participates closely in research program formulation, annual research review and implementation of the research program. BARI scientists are being trained in research planning, scientific paper writing and data compilations, project formulation and implementations.

Publications

Books/compilations. Aiming at improving the knowledge-base of agricultural research and extension workers in general and those concerned with vegetable production and allied activities in particular, as well as progressive/educated producers, NGO's and traders, the following publications were used:

1. Vegetable production and marketing. 1992. Proceedings of a national review and planning workshop (286 p).
2. Breeding of solanaceous and cole crops. A compilation of lecture materials of a training course (308 p).
3. A primer on vegetable gardening. 1994. (English and Bangla) (213 p).
4. Germplasm collection, evaluation, documentation and conservation. 1993. A compilation of lecture materials of a training course (95 p).
5. Vegetable research and development in Bangladesh. 1994. Proceedings of a symposium on recent advancement in vegetable development (183 p).
6. Intensive vegetable growing and its utilization. 1994. Compilation of lecture materials of a training course (281 p).

Booklets, handouts. The following publications were used by the farmers, producers and extension workers at the field level.

1. Tomato varieties (Handout in Bangla). 1993. 6 p.
2. Simple seed storage (Booklet in Bangla). 1993. 10 p.
3. Home composting (Booklet in Bangla). 1993. 16 p.
4. Summer tomato (Booklet in Bangla). 1994. 12 p.

Distribution of AVRDC extension materials. AVRDC publications, slide sets, videos, and bulletins were distributed to the local staff.

The impact of the project

As per unit productivity of vegetable crops is quite high compared to cereals, a sustainable vegetable research and development program for the country is needed to fulfill the food gap. BARC/BARI/AVRDC project is already working on these aspects.

It is evident that a considerable progress to date have been made under BARC/BARI-AVRDC project. More than 1,000 lines of different vegetables having desirable traits like tolerance to many biotic and abiotic factors were introduced and tested. From this germplasm, a number of valuable lines have been identified. Now, it is possible to develop summer tomato, summer cauliflower, virus-free okra, edible podded pea, virus-free mungbean, Chinese cabbage, vegetable soybean, and kangkong. The project has successfully linked Bangladesh with SAVERNET in exchanging vegetable germplasm with South Asian countries. The project has also generated a lot of useful literatures which will go a long way in keeping the concerned people abreast with the latest technologies.

The presence of AVRDC has contributed much in uplifting the vegetable research, extension and development programs, but a lot more remains to be done. As technology generation and its transfer are a continuous process, strong emphasis should continue to introduce more useful germplasm and technologies from AVRDC and other various sources. Technology generation and its testing locally should also be strengthened and transferred to the farmers through a large number of farmers field demonstrations and field days. The testing of different technologies need to be conducted throughout the country by involving different extension agencies for field demonstrations and trainings. More NGOs working on vegetable crops need to be technically trained for a speedy transfer of technologies to farmers so that year-round vegetable production and consumption in Bangladesh shall increase.

Future Perspectives

Recently, this project is focusing on introduction and development of adaptive technologies for year-round vegetable production in Bangladesh and transfer of these technologies to the farmers through demonstrations and training. Training programs have been planned and are under implementation to improve the skill of scientists, extension workers including NGOs and growers in the field of vegetable production. Close linkages are being developed among the institutions, NGOs, and private sectors for vegetable research, development and transfer of technology.

NARS has strongly recommended and requested the concerned authority for continuation of AVRDC activities in this country on a long-term basis so that Bangladesh can fully get established in the area of vegetable research and development. Accordingly, the Ministry of Agriculture and the Government of Bangladesh, agreed the extension of MOU between AVRDC and BARC/BARI for the next five years effective 1 June 1994 (Vide No. Kri/15/U -7/94-579 dated 28.12.94).

References

AVRDC. 1990. Vegetable production training manual. Asian Vegetable Research and Development Center. Shanhua, Taiwan. 447 p. Reprinted 1992.

AVRDC. 1994. AVRDC 1993. Progress report. Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan (ROC). 537 p.

Chadha M.L. 1993. Final report. Agricultural Research Project Phase II (Supplement) USAID Project No. 388- 0051, BARC/BARI-AVRDC-USAID Project. 32 p.

Chadha M.L. 1994. Annual Report. BARC/BARI-AVRDC-USAID Project. 23 p.

Kuo, C. Geroge (ed.). 1993. Adaptation of food crops to temperature and water stress. Proceedings of an international symposium, Taiwan, 13-18 August 1992. Asian Vegetable Research and Development Center. Publication no. 93-410, 531 p.

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Vegetable Seed Production Through Contract Growers

Meer Mosharraf Hossain

Manager, Contract Growers, BADC, Bangladesh

Abstract

With millions of mouths to feed, vegetables play an important role in Bangladesh. Thus vegetable seed production must be strengthened to meet the total required consumption. The Bangladesh Agricultural Development Corporation (BADC) started vegetable seed production through contract growers system to add more teeth to vegetable production in Bangladesh.

The area for seed production under contract grower system should be suitable for production of quality seed crops, free from flood during the growing season, and with good communication facilities for easy supervision and transportation of seeds.

The growers' past record of production are checked. Upon registration, they are given a number in order to locate them easily during field inspection. Trainings are conducted to acquaint the growers with improved method of technology on seed production. Seed production through contract growers involves various steps and activities such as crop rotation, isolation distance, roguing, field inspection and certification of seed plots. Efforts has been made in support to contract growers system to increase vegetable seed production.

Introduction

Vegetable plays a vital role in alleviating the nutritional deficiencies of the Bangladeshis. Cognizant of the scenario, the Government of Bangladesh (GOB) has given high priority on the development of vegetable production. To increase production, vegetable seeds suited under Bangladesh climatic condition should be given importance. In 1970-75 BADC started a small-scale vegetable seed production through an organized system. Low quality seeds or indigenous varieties cover major vegetable areas up to the year 1980-85.

The main constrains for limited expansion of the vegetable seed project in the initial years are as follows:

1 Lack of knowledge on quality seed production;
2. Limited numbers of varieties; and
3. Lack of quality control system.

Moreover, due to inadequate funding, trained manpower, physical facilities, and experience, the program did not progress. Recognizing the importance of establishing a National Vegetable Seed Program, GOB with the technical and financial assistance of Food and Agricultural Organization (FAO) strengthened the program extensively from 1980.

The annual requirement of vegetable seed is estimated at about 3,000 tons from (1) BADC- 25 t, (2) Department of Agricultural Extension (DAE- 5 t, (3) Private import- 330 t, and (4) Farmers own seeds/small Traders to farmers/ Farmer-to-Farmer exchange-2,640 t. However, the supply of improved seed constitute only about 360 t which is about 9% of the total requirement of the country. The rest of the seeds are met through farmer to farmer exchange.

The public sector seed supply is inadequate to meet the increasing demand of vegetable seeds. The national requirement of vegetable seeds cannot be met and the quality of seed cannot be improved unless an organized seed production program is undertaken by the private sector.

Seed Production Through Contract Growers by BADC

Since the inception of the seed project, BADC is continuing its effort to produce quality seed. In the initial stage, various problems are encountered. Among these are the following:

1. Lack of technical knowledge among the supervising staff;
2. Wrong selection of production areas;
3. Use of scattered and small plots for multiplication;
4. Lack of isolation of the multiplication plots;
5. Lack of trained manpower and transport facilities;
6. Less inspection and rouging;
7. Insufficient plant protection measures; and
8. Unavailability of appropriate pesticides.

Before 1975, registered growers used to produce certified paddy, wheat, seed potatoes, and jute, etc. But the registered growers were not clustered to a specified area; rather they were scattered to different places which were not favorable for effective supervision. Thus, 15 contract grower zones under wheat/paddy seed program and 10 contract grower zones under seed potato program have been established. The multiplication program of paddy, wheat, and potatoes has systematically started in 1976. The contract growers were organized in a compact block around the sites of BADC under the direct and close supervision of BADC seed technologists.

In case of vegetable seed production, BADC has undertaken improved seed production of vegetable seeds. Seeds produced out of foundation seed at the next generation is known as improved seed. Production of improved seed was initiated through vegetable farmers in the command area of Agro Services Center (ASC) and contract growers in 1977-81. Effective quality control measures could not be adopted due to the involvement of too many farmers and lack of supervision and technical know-how on the part of the BADC personnel. Thus, the performance of seed produced was poor. This has resulted to the termination of the program.

The system of production through contract growers has been highly successful for the crops like paddy, wheat and potato. It is observed that the cost of seed production of any crops produced by public sector was higher than that produced by the contract growers at about 40-60% in some cases . However, the benefits that will be derived from the production of vegetable seeds through contract growers are as follows:

1. Proper training of growers;
2. Possibility of large- scale quality seed production;
3. Reduced cost of production and increased vegetable consumption;
4. Increased utilization of quality seeds ; and
5. Assured market.

To develop an organized group of private sector seed producers and subsequent procurement of seeds from the producers by the private seed companies, BADC seed project will initially select the contract seed producers in the areas suitable for seed production and will tag them with the intending private seed companies. These private seed companies will enter into an agreement with the contract seed producers according to the terms and conditions to be decided among themselves and will buy the seed from seed producers. BADC will provide required quality of foundation seed together with technical supervision and training to the producers. It will also render services like seed processing, drying, and testing upon request by the private seed companies on minimum charges until such time that the private sector establishes its own facilities.

Introduction of Contract Growers System for Vegetable Seed Production

Site Selection for seed production

The criteria on site selection for seed production are based on:

1. Availability of existing facilities for controlled irrigation and favorable topography;
2. Area must be free from flood during the crop growing season;
3. Suitability of land for production of quality seed crop;
4. Good communication facilities for easy supervision and transportation of seeds; and
5. Cooperation of farmers in the area.

One or more of the grower's area may constitute a scheme which must be a compact area with assured irrigation facilities for successful vegetable seed production. This area may be termed as **command area** with 4.1 to 4.9 ha (minimum ha). The area under each selected scheme should be surveyed to assess the land capability and collect particulars of growers.

The growers should be informed of the capability of their area. It is important that a uniform land type and topography should be selected and boundary demarcated. This will ensure production of a particular vegetable seed crop in compact areas.

Selection of scheme and growers

Seeds of different vegetable crops are produced in different seasons. While selecting the scheme for vegetable seed production of a particular crop, past performance of production and procurement, grower's cooperation, and other factors have to be reviewed carefully.

The selection of scheme and growers must be finalized before the distribution of foundation/improved seeds. Steps to be performed for selecting the scheme are:

1. Checking past records of production, procurement, and cooperation of growers;
2. Checking the land suitability for growing the variety, standing crop on the plot and judging the land in question can be available for timely sowing/planting of crop intended for seed production;

3. Discussing with growers and scheme managers/contract farmers to identify their suggested area of the scheme for production according to the size of program in compact plots (potential/progressive growers/scheme managers may be selected as contract farmers); and

4. Verifying and selecting a compact site from within the area of surveyed and approved scheme depending on the size of the target of a particular vegetable seed production and simultaneously the concerned growers should be contacted. Each grower must possess a registration number to locate him easily and trace his performance.

Compact area

The area should be compact for easy and effective supervision on the production activities. It may not be possible to have continuous plots in the scheme. There may be one or two plots whose growers may not agree to produce seeds. In this case, the selected plots may be contiguous and must not be scattered within the command area of the scheme. The unwilling grower within the scheme should be motivated to join the scheme.

Production plan and group meeting

A production plan of each scheme will be made for smooth execution of vegetable seed production program. The essential components include the grower's name and registration number, plot number, area, requirement of foundation/improved seeds and cost, date of sowing, quantity of fertilizer to be used and cost, irrigation cost, pesticide cost, total requirement of labor and cost, total of all costs, total production, date of harvest, volume of seed produced , total value of production (seed, non-seed and by-product) and profit, etc.

After the selection of scheme and growers, the production plan should be prepared by the concerned officer. The growers should also be trained to prepare this program. The plan is necessary to procure the inputs/funds required for production by the growers.

Group discussion. Frequent meetings and discussions with the growers are the key to a successful implementation of seed production and procurement program. The concerned officer will visit the field and conduct practical demonstration on seed production and other related activities.

The growers of the scheme who are selected for production should meet to discuss their problems regularly where the concerned officer can give his comments, suggestions and advice in respect of future activities to be performed for the seed crop. This will create better understanding of the growers as a group for the seed production program.

Selection of seed crops. Selection of seed crop for a particular area is very important to produce good quality seeds. A crop variety grown for seed production must be suitable to the climatic condition prevailing in a particular area.

Regions of moderate rainfall and humidity are much more suited to vegetable seed production than regions of high rainfall and humidity. Most crops require a dry sunny period and moderate temperature for flowering and pollination. Vegetable crops normally require cool conditions, with low atmospheric humidity to flower and pollination. If hot dry weather conditions prevail during flowering, many vegetable crops fail to set seed effectively and produce many seedless fruits. Regionwide selection of different seed crops should be made very carefully considering this scenario.

Isolation of seed crops. The vegetable seed crop must be isolated from nearby fields of the same crop and other contaminating crops as per requirements of certification standards. In hybrid vegetable seed production, if the distance isolation is not feasible for any reason, instead, time isolation could be provided. Even the distance isolation requirement could be reduced in certified vegetable seed production by planting additional border rows.

Supply of inputs

Basic inputs required for vegetable seed production are not essentially different from those needed for ordinary crop production except in certain specific items and agronomic practices used. Timeliness in completion of these practices are vital for obtaining better yield of vegetable seed production.

The required foundation/improved seeds to be used for seed production will be supplied in time by the public or private sectors.

The growers spend for the operation cost of growing the seed crop. They should irrigate the field and apply fertilizers and pesticides at recommended rates and time. They may be assisted in procuring these inputs in cash or in kind (credit).

Credit facilities. Vegetable seed growers have limited income so they can not reinvest from their savings. They need capital to induce investments for quality seed production. Through the cooperative they can avail of loans from the Rural Development Board (RBD), Bangladesh Krishi Bank (BKB), Bangladesh Grameen Bank and other private and public banks. However, they should be assisted in getting loans from these banks. Other companies should also supply them with quality seeds and other inputs on credit.

Execution of agreement with growers

Agreement in the prescribed proforma (2 copies) should be executed with growers for vegetable seed production (Annex). The time of planting and the quantity of seed to be produced should transpire in the agreement. Plots of the selected growers must be thoroughly prepared. Implementation of the agreement takes place when the seeds are planted in prepared plots.

Training of contract growers

Contract growers should be acquainted with improved method and technology involved in seed production. Training enables them to produce good quality seed.

Place and time of training. Training will be arranged in each production zone before the start of planting or when the crop has been established and standing in the field. The approved training syllabus will be followed and the trainers should confine their discussion and prepare their lecture notes/handouts according to the syllabus. Certificate of training will be issued to each grower who participated in the training.

Steps in Vegetable Seed Production Through Contract Growers

Essential activities

BADC personnel supervises the growers' seed production plots. Steps involved in vegetable seed production through contract growers should be followed to assure success of production (fig. 1).

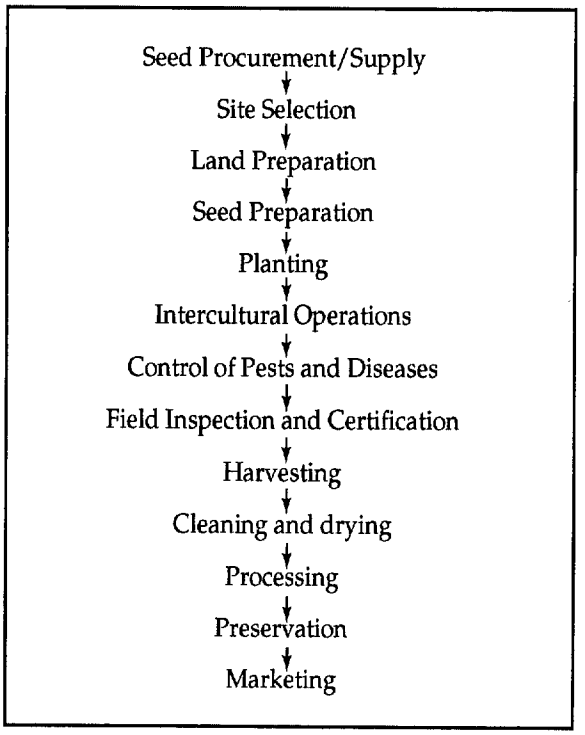

Fig. 1. Steps in vegetable seed production through contract growers

1. **Crop rotation.** Vegetable crops are prone to various soilborne diseases caused by bacteria, nematodes, etc. Specific recommended crop rotations must be followed to assure success on vegetable seed production. Contact growers should follow the recommended crop rotations, otherwise, they are not included in the program.

2. **Isolation distance.** To maintain varietal purity, recommended minimum isolation distance has to be maintained. Concerned contract growers must maintain the required isolation distance for growing seed crops.

3. **Roguing.** Identified off-types must be removed from the field to attain purity of the crop variety so as to conform with the prescribed field standard. Roguing in most of the vegetable seed crops may be done at vegetative/pre-flowering stage, flowering and maturity stage as the need arises. Roguing at harvest time for confirmation of fruit/root characteristics is necessary in tuber and vegetable crops.

4. **Field inspection and certification.** The seed crops are inspected during its growing stage. Each crop will be inspected three times.

   First inspection. This inspection will be done after the establishment of crop i.e. after germination/transplanting. Growers' name, plot number, actual area covered, date of sowing/transplanting, plant population etc. will be verified.

   Second inspection. This inspection will be done after flowering. Inspection includes checking of crop purity, off-types, isolation, weeds, incidence of insects, pests and diseases, whether preventive measures have been taken or not, availability of soil moisture for the rest of the growing period of crop, and assessment of the total yield and seed production.

Third inspection. This inspection is done before harvesting when the crop is in its maturing stage. Purity of seed crop, admixture with their variety, incidence of diseases, isolation etc. will be carefully examined. Approximate day of harvest and availability of seed will have to be estimated in this inspection.

5. **Certification of seed plots.** The Seed Certification Agency (SCA) will inspect and certify the seed plots. Seeds will only be collected from the SCA-certified seed plots.

Procurement, Processing, and Storage

Timeliness in procurement

The seed must be procured immediately after harvesting, when it is properly threshed and cleaned. Delay in procurement will cause insect and pest attack and deterioration of seed quality.

Growers will bring the seed to the procurement center at their own cost and arrangement. The field officer must ensure that the seed brought to the procurement center are properly cleaned, sieved and dried in accordance with the procurement standard.

Pricing

Price of seed should be fixed considering the prevailing market rate, cost of production and 20-30% premium bonus before procurement of seed has started.

Processing and storage

Soon after procurement, the seed will be delivered to the nearest processing centers for grading, drying, packing, and storage.

Marketing of quality seeds

The size and scope of the seed industry depends on seed marketing. It is one of the most vital components of seed technology. Seed marketing comprises the following:

1. Demand forecast (assessment of effective demand);
2. Marketing structure;
3. Arrangement for seed storage;
4. Sales promotional activities;
5. Postsales services; and
6 Economics of seed production and seed pricing.

Distribution of seeds

Farmer-to-farmer distribution. This is the traditional method, where farmers obtain their requirements from neighbors either in cash or exchange basis.

Registered growers distribution. Many private companies like Bangladesh Tobacco Company (BTC), Grameen Bank, etc. distribute improved seed to registered growers but do not plan or undertake procurement. The registered growers are expected to distribute the registered seed to farmers on cash or exchange basis.

Distribution by the BADC. BADC produces vegetable seeds of improved varieties at its own farm and distribute them to the farmers or to the dealer on cash payment during the season.

Distribution of seed by private sectors. The private seed company may import vegetable seeds during the season. These are sold on cash basis to the dealers/farmers.

Recommendations

1. To boost vegetable seed production, a technical program that includes contract growers system in producing vegetable seeds should be prioritized.
2. As the supply of vegetable seeds by the public sector is very nominal (2.70%), the private sector should produce more quality vegetable seeds to meet the growing demand.
3. Vegetable seed production should be undertaken in grower's areas which may consist of one or several small plots.
4. Credit facilities must be ensured to meet the cost of seed production including supply of improved seeds, fertilizers, pesticides, and irrigation.
5. Vegetable seeds produced by the contract growers must be procured in time.
6. Procurement must be ensured at reasonable price.

References

Hashem, A. 1986. Status of vegetable seed industry in Bangladesh.

Samiruddin, Md. 1989. Vegetable seed production, processing preservation and distribution. A paper presented to the national seed technology workshop.

Hussain M. M. 1989. Potato growing industry of Bangladesh. Krishi Bhaban, BADC.

Hussain, M. M. 1995. Seed production and storage technology, by Mr. Meer Intiaz Hussain. 27/1 Uttar Pirerbagh, Dhaka.

Annex

Agreement Bond for the Production and Procurement of Vegetable Seed through Contract Growers

First Party : Name of Contract Growers_____

Father's name_____

Village_____ Block_____

Union_____ Post Office_____

Thana_____ District_____

Registration no._____

hereinafter called the Seed Growers and Seed Growers will mean his successor, executors and authorized persons)

Second Party : (Name of the company responsible for executions of the project)
(hereinafter called and company will mean his/her successor executors and administrators).

As the Seed Growers for the production and procurement of vegetable seed at his/her land under position in the:

Dist_____ Thana_____ Mouza_____

Block_____ C.S. Khatian_____ Dag No._____

has agreed to produce vegetable seed in_____ Acreas

as per prescribed standard of the Company and also agreed to seed to the company at the price fixed by the company. As the Seed Grower's signed the agreement automatically and without any influence:

1. The Seed Grower is hereby bound to maintain isolation distance in seed plot determined by the Company and will arrange production of vegetable seed and also bound to follow the instructions given by the supervising officers/staff of the company.

2. The seed Grower is bound to do all preparations (like land preparation, application of fertilizer, irrigation control of disease and insect pest, rouging of diseased and unwanted plants and intercultural operations as per company standard.

3. The Seed Grower is bound to buy required quantity of foundation or certified vegetable seed from the company's office.

4. a)The company is bound to ensure the supply of fertilizers, foundation/certified seed at government-fixed rate and the grower is also bound to buy the fertilizers, foundation seed supplied by the company.

   b)The seed grower is bound to buy the pesticides (required to maintain the seed standard) supplied by the company.

5. The company will arrange BKB loan in payment of the cost of seed, fertilizer, and pesticide to the seed growers but will never provide cash money. The seed grower is allowed to grow seed without BKB loan.

6. The seed grower is bound to rogue out the diseased and unwanted plants from the vegetable seed plot as per instruction of authorized officers/staff of the company.

7. a) The company inspection team will inspect the vegetable seed plots as per seed standard and will accept plots for seed procurement.

   b) The company is bound to inform the seed grower at the time of rejection of any plot.

8. The seed grower is bound to pay the disbursed BKB loan for the rejected plots, if any.

9. a) The seed grower is bound to sell the quality vegetable seed from accepted plots to the company and the company is also bound to procure entire quality seed as per target after final inspection.

   b) The company is not bound to buy and seed which is not as per seed standard.

10. Sorting and grading will be done by the seed grower at his/her own cost.

11. The procurement price fixed by the company will be treated as final.

12. a) The company will arrange transportation of seed from the procurement center to the processing center at his/her cost. The seed grower will be responsible to carry the seed from the block to the procurement center. The seed grower will get confirmation of receipt from the authorized officer/ staff of the company after handing over the seed.

    b) The company will pay the value of procured seed to the seed grower as soon as possible in cash up to Tk. 5000/= and through cheque above Tk.5,000/= per grower. Before paying the value of seed to the grower, the company will deduct all bank dues against the seed grower in favor of BKB.

13. If the company fails to procure the quality seed from the accepted seed plot, then the company is bound to compensate the seed grower with the seed value at 15% above the prevailing market price.

14. The company is not bound to compensate the seed grower in case of germination failure due to natural calamities or other abnormal situations.

15. Both parties are bound to solve the problems through negotiation if any confusion or deviation arises which has not been covered by this agreement. The company will appoint the sole Negotiator. None of the parties is allowed to file any case in the court before negotiation.

We are signing this agreement on_____ which will be effective from_____(date).

Witnesses:

1.

2.

3.

4.

5.

Signature of the authorized officer of the company on behalf of the company

Vegetable Seed Production: The Experience of Mollika Seed Company

F. R. Malik

Proprietor, Mollika Seed Company, Dhaka, Bangladesh

Abstract

Mollika Seed Company is a private sector seed enterprise. It is a family business engaged in vegetable and potato seeds since 1969. The company was started by a senior member of the family who was a former official of the Bangladesh Agricultural Development Corporation (BADC). This business was started to realize the scope of vegetable seed production, import and distribution business in Bangladesh.

Initially, the company started marketing imported seeds on commission basis because the farmers were responsive to quality seeds. The quality of locally produced seeds were very poor due to lack of appropriate seed system.

Realizing the large volume of tropical and subtropical seed needed by the farmers, the company started the production and distribution of local varieties. When the new seed policy was declared, with the help of BADC and FAO Project, the company initiated an organized seed production for local varieties. In 1994, the company had produced 21 t of vegetable seeds adopting organized system. The company has also identified its own varieties through purification of local materials adopting simple methods taught by the FAO Project.

The company plans to expand its vegetable seed program. In the next 10 years they intend to handle up to 150 tons of locally produced seed. But they will continue importing seeds that cannot be produced locally. Keeping in view current annual requirement of 2,500 t of seed varieties that can be produced locally, the company feels that organized vegetable seed production and distribution could be a very successful agribusiness in providing employment opportunities and increasing income of seed producers.

The company is mainly facing constraint due to lack of better varieties, financing policy to the emerging seed industry to private sector and fluctuating seed demand due to lack of market. The company also feels that better varieties and modern seed production technology could be introduced in Bangladesh through attracting joint ventures with foreign companies. Because of cheap labor the company feels that hybrid seed production could be developed in the lines of garment industry.

Introduction

Mollika Seed Company is managed as a family business. It has two components. The first component deals in multiplication of potato seeds and importation of vegetable seeds and some of the field crop seeds. The second component is engaged in production, procurement and marketing of vegetable seeds, jute, onions, etc. The company was started in 1969 by Mr. A. R. Malik, a senior member of the family. He had a background on seed production being a former employee of BADC since 1962.

The company started operating as a local agent of a foreign vegetable seed company. At that time, BADC was the only importer of vegetable seeds. They import different varieties of seeds once a year only. Later on, the MSC started importing vegetable seeds and distribute the same among the private seed dealers throughout the country up to 1982. Then, the company felt a need for a full-fledged seed company dealing in a wide range of vegetable seeds including local types. At that time, there was no organized system of seed production. So, we started experimenting seed production on red and white skin variety of radish because we thought that we could not maintain our market reputation by selling seeds bought from the open market or from the farmers.

We failed in our first attempt because we lack technical knowledge on seed production. In 1989 we had our first training on seed production from BADC and BARI under the GOB and FAO Vegetable Seed Project. The training enhanced our knowledge on seed production.

Requirement and vegetable seed supply

Based on present level of consumption of 40 g/day per capita the total annual vegetable seed requirement in Bangladesh is approximately 3,000 t (table 1) of which 500 t are imported seeds. Most comprise seeds of temperate vegetables that can not be produced in Bangladesh and seeds of F_1 hybrids which the farmers are demanding. The rest of 2,500 t are of Bangladesh origin. Out of this seeds, traders are procuring 1,000 t from farmers. So, 1,500 t are retained by the farmers. Very recently, with BADC and FAO support, 50 t are produced by the contract growers. Some entrepreneurs are also undertaking their own production.

The total value of seed used in the country is approximately 311 M Taka (US$7.7 M) of which 50% is traded and 50% is saved by the farmers.

It is expected that through public awareness, NGO's motivation and government thrust, vegetable intake will increase and double in the next 10 years. This does not mean that demand of seed will increase in the same proportion, as the increased production of vegetables will have to be achieved through increased productivity. For which, high quality seed of high yielding varieties and hybrids will be required. It is estimated that demand of seed may increase marginally but its value will be doubled to approximately 500 M taka (US$12.5 M).

Supply position by Mollika Seed Company

Presently, Mollika Seed Company is handling about 80 t of vegetable seeds per year. This includes locally produced seeds and 60 t of imported seeds (of which six to seven tons are F_1 hybrid and the rest are open pollinated). Local seed production program is shown in table 2.

We buy foundation seed of Tasakisan from BADC and we multiply this in our own farm and in the contract growers' areas. BADC/FAO Project is providing us technical support and supervisory service.

We are maintaining all other varieties of our own choice. We produce foundation and commercial seeds in our own farm under the same system as we have been taught by GOB/FAO Vegetable Seed Project.

Table 1. Value of present and future seed requirement in the country

Vegetable seed	Quantity (t)	Value (M.Taka)	Value (M.US$)
Imported Seed	509	121.6	3.0
BADC seed supply	20	3.9	0.1
Organized Production support from BADC/FAO	50	13.4	0.3
Organized production by entrepreneurs	100	26.8	0.7
Spot purchased seed	800	75.0	1.8
Farmers' saved seed	1,500	71.0	1.7
Total seed	2,975	311.0	7.6
Total Imported Seed required in next 10 years	3,574	500.0	1 2.5

Based on Statistics collected by FAO Project "Strengthening of the National Vegetable Seed Program –GCP/BGD/025/BEL & -28/DEN and updated to 1994-95 situation.

Note: 1995 exchange rate - US$1 = 40 Tk

Table 2. Local seed production program of Mollika Seed Company, 1994-95

Crop	Variety	Area (ha)	Quality (kg)
Radish	a) Tasakisun	20.2	10,000
	b) Biplob-94	10.1	2,000
Data	a) Red Force	6.1	1,500
	b) Akhi	1.6	400
	c) Preoshi	4.1	1,200
	d) Ruposh	2.0	600
Lalshak	Pinky queen	4.1	1,500
Eggplant	a) Islampuri	1.2	90
	b) Jamalpuri	0.4	30
Cauliflower	Super express	0.4	50
Onion	Swarnolatim	0.8	350
Local Bean	Early market	1.2	600
Bottle gourd	Green sweety	1.2	750
Spinach	Sabuj Bangla	2.0	2,500
Total		55.4	21,570

Support From GOB/FAO Vegetable Seed Project

The role of BADC/BARI and GOB/FAO vegetable seed project is highly appreciable. This project provides us with foundation seeds and technical knowledge on seed production, processing, packaging and marketing. They also trained contract growers, provide supervisory service and made linkages with the private seed companies.

The project is also launching a demonstration program on varieties produced in an organized way. It is encouraging farmers to use quality seeds. The grow-out test program under this project has taught the private seed companies to make self-assessment. If we get this kind of support for a few more years some private seed companies will develop self reliance in managing their business.

Role of Bangladesh Seed Merchants Association

Mollika Seed Company is a member of Bangladesh Seed Merchants Association. Presently, the association has 129 members who are genuine seed entrepreneurs, seed importers and seed dealers from different parts of the country. It strengthens coordination among the concerned agencies like Seed Wings of MOA, GOB/FAO Vegetable Project, CDP, USAID, BADC, and BARI, etc.

Constraints

Much has to be done in order to establish a modern self-sustainable seed industry in Bangladesh. The following are the main constraints in promoting the private sector vegetable seed industry in Bangladesh.

1. **Availability of improved varieties.** Presently, the number of improved varieties in vegetable seeds is very low. We could increase production if we can get more marketable improved varieties of both OP and Hybrid lines from BARI or from any other organizations. We could attract foreign reputed seed companies in a joint-venture program if we produce quality hybrid seeds. So, for mass production of quality seeds, we need more quality varieties and lines.

2. **High risk.** Agriculture is a risky job and seed production is more risky. The crop may be damaged a day before harvest and losses are at our own expense. But in case of seed import, all the risk are fully covered by the insurance company against reasonable premium. We can recover premium by integrating it into the costing. To encourage the local seed production, some sort of incentive or production bonus system should be introduced.

3. **Processing machinery.** Seed processing after harvest is very important. But in Bangladesh, seed processing equipment is not easily available. Thus, we depend on importation, however, import duty and VAT are heavily placed on imported equipments. Therefore, all machineries and equipments used in seed industry must be declared as import duty and VAT free items because these are capital investments with seasonal use.

4. **Packaging/storage.** Proper packing materials and storage facilities are not available in the country. Imported packing materials are heavily placed with import duty and VAT. But seeds are being imported in packed forms as duty and VAT free items. In this case, packing materials are coming in as duty and VAT free items. It seems that importation of seeds is more favorable than the local production considering policies formulated for availability of packing materials.

5. **Credit facilities.** Seed production is a long-term investment. Besides, we complete production six to seven months before the selling season starts. So our stocks are stagnant for almost half a year. Until now, we do not have financial support from any institution regarding this matter. But in case of import, every commercial bank is providing 75-80% margins against L/C. Moreover, we spend a lot of money for research and development but we cannot recover our expenses immediately. Considering these constraints, credit facilities on soft term basis should be introduced in the country.

6. **Lack of policy to attract foreign seed company.** To date, seed importation is completely free. Any company can export their seeds to Bangladesh. With this opportunity, foreign companies are interested to take advantage of ready market but no company is willing to come and invest with a production program. A policy like India should be formulated wherein after certain period of time only chosen companies will be allowed to export seeds

with a production program in collaboration with local partner in Bangladesh. In this way, we can expect at least a few good foreign companies to come up with a production program in the future.

7. **Fluctuation in seed demands.** There is no proper system of marketing fresh vegetables in Bangladesh. Usually, when there is more cultivation, the market is glutted. But the farmers do not get the right price for their produce. The following year, when there is less cultivation, demand of seeds is low. Marketing of fresh vegetables should be developed. Processing of different crops for local and export markets should be intensified.

8. **Export promotion of seed.** Radish, cauliflower, eggplant, and other tropical crops are suitable to the climatic condition in Bangladesh. Export promotion should be strengthened to avoid surplus of production of these crops in the future.

Conclusion

Establishing a seed industry in the country is promising, however, self-sufficiency in seed cannot be attained because of the country's climatic condition (tropical). Temperate crops like cabbage, Chinese cabbage, carrot, kohlrabi, lettuce, mino-early variety of radish, early snowball- type cauliflower, etc., cannot be commercially produced. Thus, importation of these seeds is needed to meet demand.

Crops that could be grown locally should be supported by the government and other concerned agencies. The seed industry will succeed if we can bring in foreign seed companies with good hybrid seed production on contract basis like the garment industry. Hybrid seed production is labor intensive. Third world countries having less expensive labor should avail of this opportunity.

Vegetable Seed Production and Agribusiness in Bangladesh

Md. Nawserul Huda

Executive Director, Agro-Industries and Services Ltd.; Chairman, Seed Growers Association of Bangladesh

Abstract

Site is a very critical aspect in vegetable seed agribusiness. Product displays and location should be attractive to the customers. Developing strategic plans for the products to be produced are imperative considering production cost, pricing, and profit. The existing pattern of agribusiness in the country is the effect developed through the process of evolution occurred over a period.

Introduction

The economists consider marketing as part of production. The agronomists are devoted to maximize the yield of crop production through optimal use of various inputs. Production of a crop and its subsequent movement through channel agents or without them directly to consumers and users in systematic manner is called an agribusiness development. The growers/producers are likely to maximize the yield in order to accrue profit through the investments. Activities at the level of channel agents, processors, etc. must also find benefits in order to gain momentum for development of agribusiness for a product output. The agribusiness development of product like vegetable seeds is the complex part of marketing management. The major reason for such complexities may be identified that the seeds being an agricultural product are produced with seasonal cyclicalities at scattered areas (unlike industrial products) against the erratic demand of a product. Thus, to meet the demand, supply has to be ensured through processing, preservation, and proper storage. Besides, the management of different activities of agribusiness have to be efficient in order to ensure repatriation of fair prices to actual growers and producers of seed product.

Production

Growers/Producers

In view of our estimated demand forecast, the type and varieties of seed-products, the growers and producers have been identified along with approximate areas which are brought under cultivation of each individual crop production. Prior to that, we have a good number of growers who are registered as contract growers located at the designated project areas. The registered "contract growers" have been grouped under broadly three categories namely A, B, and C. The

characteristics of these groups are indexed by taking their capabilities and receptibilities of agri-technologies and power for adoptabilities. For instance, production of seed crops like radish, red amaranths, spinach, etc. can be induced through adoption of simple packages of technologies and these could be allocated to the growers under category A. The seed crops like tomato, brinjal (eggplant), okra, etc. involving simple packages of agri-technologies but with known and evolved postharvest processing technological aspects are allocated to the growers/producers under B category, and the seed crops like cauliflower, yard-long bean, onion etc. involving higher technologies would go to the growers/producers under C category. There are several merits and advantages for maneuvering the management of growers in this manner. Some of these are the following:

1. Easy access to training;
2. Cadre of the growers could be created for inducing improved packages of technologies;
3. Human development towards production management and enhancement of receptibility and acceptance of higher technologies which are usually perceived as "unacceptable" by general seed crop growers; and
4. Develop integrity and cohesive attitude towards the organization.

The inputs

To induce production through the registered contract growers, we organized the required inputs and made those items as deliverables to the indicated groups. The harvested semiprocessed seeds, ripe fruits (in case of tomato, brinjal, cucumber, etc., dried pods (in case of okra, cauliflower etc.) are being procured under buy-back contracts at the rates mutually agreed upon between the producer/grower and the industry. Under this arrangement the targeted production mechanism and its cost is shared by both parties. However, certain types of overhead costs are borne by the industry's interest. These overhead costs constitute mainly on training (classroom and field), supervision, motivation towards crop production etc. as inputs for production. Notable inputs for production may be noted as follows:

1. **Training**. Mostly related to crop production, rouging, plant protection and all other important aspects of pre harvest technologies to maximize good seed yield and postharvest technologies before delivering the "raw seeds" to the processing center of the industry.
2. **Foundation seed.** The contract growers must receive the foundation seed from the industry as an important input. However, in some rare cases, we have allowed contract production where we established 'seed growing villages' for low value seed like red amaranths, spinach, yard-long bean, etc.
3. **Plant protection materials**. There are common incidence of severe pest attacks during crop production for seed like aphids for radish and mites for brinjal (eggplant). These pest attacks cause severe damage to the crops within 12 to 48 hours when they are not controlled within stipulated period. Emergency stock of several types of pesticides is being maintained for the affected growers. Besides, there are specialized type of pesticides and fungicides which are required for production of seed crops. The industry maintains an inventory to facilitate production. Free technical assistance towards other plant protection measures are also provided as the need arises.
4. **Irrigation.** The registered contract growers are only qualified when their land is irrigated either by deep/shallow wells or other sources of water. We are also renting out water pumps to seed growers upon request.

5. **Fertilizers and other inputs.** We could not organize a loan program for inputs but we can provide loans to very limited number of growers against their emergency needs. However, the amount for such loan is adjusted at the time of delivery of "raw seeds" to the processing center.

To maneuver and to induce a management system in the production component of agribusiness, development of various seeds as products, Agro-industries and Services Ltd., by looking at the different dimensions of complexities, has evolved a pattern wherein both the industry and the growers can ensure production by sharing their own available resources.

Indexes

While monitoring and implementing the production program we have set several types of indexes in order to prepare proper planning, quantification of inputs and outputs to measure the extent of deviation from the expected outputs, etc. Ratio is a very important management tool for the industry. In the implementation of radish seed production program, the project manager and the store manager must be aware about the ratio of foundation seed and raw seed in their field condition so that the requirement of foundation seed can be calculated against the set of production target. This will also be helpful in estimating the packaging materials, requirement of fund for the contact growers, etc. Similarly, the ratios like FS: Fruit: Seed are also important for the seeds which are procured in the form of fruits. The other indexes for fertilizers, packaging materials, etc. are very useful for this type of agribusiness development. Below the level of standard deviation in case of accruable production output, the management or the industry can find out actual reasons for rectification for the future program.

The Product

The economist considers marketing as part of production. What are we producing? What are the products in the market place? Can this be offered to the market place? Answers to these questions can only be realized when we think about the processor, channel agents etc. The seed, as a product, is meant to offer value package of benefit bundle.

The concept of a product

Two major concepts for a product in agribusiness are "core product" and "core benefit." In organizing production, all activities are devoted with the concept of "core product." What will the buyer really buy? Will it be Red Bombay (radish seed), Agrahaioni (cauliflower seed), Ratan (tomato seed), or what? Packaging of "core product" is the problem solving service. Mr. Z. is buying Ratan (tomato) seed, a type of benefit and hope. The grower's job is to produce "core product" and the marketers job is to sell "core benefit." The other concept of product is on "formal product" which is the smaller packaging of "core product." The "formal product" is the tangible offer recognized by the target buyers at the market places. The "formal product" originates from the "core product."

The Agro-industries and Services Ltd., after processing and packaging of seeds as "core product" are packaging in smaller sizes to prepare "formal products" for the channel agents which ultimately go to the end users. Quality level should be maintained. Brand names, information on packets, etc. are provided. A part of the core product is also supplied to other marketer who in turn uses their brand name in smaller packets etc. to prepare "formal products."

The new product

What is a new product? What is its significance to agribusiness? These two major questions are important to both the producer and the industry when inducing productions of a seed crop is required. We find that there is considerable confusion over the meaning of new product. It depends on what the customer perceives or is motivated to perceive. Even an old known product can be set as 'new' as far as the buyer is concerned. 'New' and 'product' are subject to various situations, interpretations and environment.

1. **New to whom?** A product is new to a consumer who has never used the product for himself or other members of his family. Several examples can be cited in this context such a radish (Tasakisan), tomato (Ratan), cauliflower (F_1 Hybrid), pickle-type cucumber, yellow water melon, Gima kalmi, etc.

2. **New in what way?** The newness of a product may be perceived by the end users in various ways. The same known product may appear as new if it is available at the time of necessity. The product may be different in size, texture and color than that of the usual available type. The less perishable products find easy access to various channel agents to enter into different market places of the country. And these products loose their identities quickly as new products.

3. **How new?** The extent of 'newness' will depend on the earlier discussed phenomena. How long would this product remain new? The "newness" of perishable product, like seed, being tied with seasonal cyclicality in a year is renewed mostly once a year.

4 **New product is new market.** Due to research and development and technological renovation, the phenomenon of new type and variety when grown and appeared in a market, can be compared with a manufactured product. The behavioral pattern would resemble as a new product in new market. Under our situation, radish-tasakisan, red cabbage seed, AVRDC-tomato seed etc. can be cited here as new product in new market.

5. **New product in old market.** Until the buyers and potential buyers in a market are familiar with a product potential, this remains as new product in old market.

6. **Old product in new market.** There are situations where, one product which is being used for a long time but did not appear in some identified market places may be seen in a new market place. How long would the product remain new? It could be one year, two years, or longer.

The second major question on the concept of new product and its definition can only be answered through review of various situations related to production, its influence to the consumers and profit. In other words, the extent of success of agribusiness development of a seed product could be measured only when the production and its subsequent movement towards the end users can be ensured with profit. Without which the activities for agribusiness development will not be sustainable.

Types of products

Another most important aspect which has been considered in formulating strategies for more effective agribusiness development is to group the seed products into more and less perishable products, distinctive and commodity products, new and old products. The accepted concept is that pricing policy which is open to a seller, vary by product category in ways that may be independent of the state of customer of market structure. We were very careful in preserving the shelf life of various products to make it less perishable and make them appear as distinctive or commodity product.

Further classifications of products

The seeds are divided into three classes in determining strategic approaches for marketing. These are:

1. **Convenience products.** The customers usually purchase products immediately without searching for other alternatives. Under this group we usually include radish (Red Bombay type), spinach, bottle gourd, common red amaranths, etc.

2. **Shopping product.** The customers characteristically purchase products after having chosen based on suitability, quality, price and style. Under this group, we put Red Bombay, radish (jumbo), red amaranths (Altapetty), tomato (Pusa Ruby), onion (Taherpuri), etc.

3. **Specialty products.** A group of buyers will purchase expensive products. However, our industry could not create such product for the general market. There are few products which are in the trial stage of commercialization. Some imported varieties are being marketed under this category. Considering these product concepts and classifications, suitable agribusiness development pattern is emerging in our situation through planning and providing the required support services accordingly. There might be various opportunities existing to induce production considering many agronomic and social factors to obtain the best product outputs at our growers level. But the most important aspects to consider are the customers' choice, needs or wants, because, the fate of the products depends on the customers. Therefore, the development of agribusiness along with production and marketing has to be integrated. Our experiences in marketing management will be briefly narrated in the theme of marketing mix.

The Marketing Mix

There are different versions to depict the concept of marketing mix but the traditionally considered and represented by four Ps and two Cs have been chosen for this paper. Four Ps stands for product, price, promotion and place while the two Cs stands for cost and customer. Our industry, while implementing the marketing program within the limits of budgetary means for the produced inventory of different kinds and varieties of seed products are indicated components of the marketing mix.

Product

As earlier indicated, out of our organized contract growers, the 'raw seeds' after processing, cleaning, drying etc. were converted into "core product." These are packed into smaller packets for market distribution. Due to inevitable fate of a product for "product life cycle," we are always looking for new varieties and types of various potential seeds locally and abroad. A mini R and D program is the integral component of our product development activities. Besides, the product samples are tested by the Food and Agriculture organization (FAO), Dhaka for evaluation. The processing, cleaning and drying operations are completed in our own processing center. In some cases, we usually use the local processing center of the BADC. We pay the usual service charge. We package both 'core' and 'formal' products. We have not created the specialty products yet, but we have already generated matured technologies in carrot, mino early radish, and pousali cauliflower seeds. Soon, these products will enter into the market as specialty product.

Price

We are aware that the basic price concepts of product in agribusiness specially for seed products are varied and complex in nature for various reasons and factors. Production of seed products

and its uses being tied with seasonal cyclicalities, influences of varied agroecological factors, early and late rainfall, consumption, geographical regions, vegetable production areas for designated market(s), competitiveness, variabilities on prices of similar products, etc. are factors that make the pricing for most of the products very difficult. At the initial stages of the project, we attempted to introduce straight line pricing of an individual product, like the industrial product. But this policy was not effective. The variances on the unit prices are difficult to implement from the corporate management point of view. Lastly, we have introduced the 'selling price' mechanism by marking up over the cost of production. This was delegated to the field executives to bring variances over the 'selling price' in order to protect the loss and thereby accrue profit. We have introduced "slab pricing" for a good number of products having high volume of sales. But the pricing is not very dependent on monopolistic and oligopolistic situations. Cost/price relationship is the fundamental for decision making. The major factors of "supply and demand" guide the pricing. As earlier indicated that the products created through "nature's factory" are greatly controlled by cyclicalities and the extent of uses are influenced by agroecological, geographical and other socioeconomic factors. We have also identified "price zones" for different seed products which greatly influence the pricing mechanism.

Promotion

While developing agribusiness for the seed products and thereby developing marketing infrastructure, we provide great importance to improve communications in various disciplines. Though we have not done much in this regard, personal selling and other forms of persuasions could have been strengthened gradually. In respect to advertisement, we have only prepared the leaflets for the dealers, retailers and end users. We have also introduced some mechanisms for sales promotions. Promotional activities should be strengthened.

Place

Place/site has been regarded as a very critical aspect to develop the pattern of agribusiness development for the industry. The questions; "Who are they? Where are they? How many are there and might be there ? What are their needs and wants? etc., are vital in choosing the site for marketing of seeds. In fact, while answering these questions, the strategic approaches to locate the places for positioning the seed products could be made more easily. And thus, this important component in the marketing mix could be determined for particular product(s). We deliver the products to the dealers and retailers who in turn sell the products to the users or ultimate consumers. The need for intermediaries (dealers and retailers) in the delivery of goods are often questioned and their roles are criticized particularly the extent of profit they make out of their services. The profit they make are adding to the cost of product. These intermediaries can mostly perform the function more economically and efficiently in comparison to the industry. Transferring of products to intermediaries provides protection against risks which are always embodied with perishable products in the agribusiness.

Customer

Our country requires a lot of vegetable seeds of various types and varieties in large quantities. But there is no market guarantee of our produce. If we carefully analyze individual seed production it would be visible that there are dearth of customers of many products though they can be produced in bulk through our management and known production technology. Therefore, we must think about the customer and market in a composite manner.

Cost

The cost component is carefully analyzed in generating various packages of services to induce product outputs and their marketing. Our approach towards production up to the implementation of marketing program are tied in a "framework of a cost" that should permit us to accrue profit. The cost component like fixed cost, variable cost, discretionary cost etc., are always taken into account. We also take the break-even analysis to determine the break-even volume of production and for other purposes.

Conclusion

The existing pattern of agribusiness in the country is an outcome developed through the process of evolution over a period. We must also recognize that the existing agribusiness of seed product is one of the efficient types. There are lots of opportunities for improvement. Some private organizations have entered into the development of seed agribusiness in the country. The modern agri-technologies for production and the known methodologies of marketing management will enhance the agribusiness development more rapidly.

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UPAKAR: Mobilizing Small Farmers in Vegetable Production

Tapan Kumar Palit

Executive Director, UPAKAR, Raozan, Chittagong , Bangladesh

Introduction

UPAKAR is a nongovernment development organization. Its literal meaning is "Organization for Benevolence. "It started in 1986, in response to the need of the people for social workers and philanthropists.

The main objective of UPAKAR is to improve the living conditions of the less privileged people.

Development programs

UPAKAR has been implementing development programs in its target areas. This include NGO Gardening and Nutrition Education Surveillance Project (NGNESP) assisted by Helen Keller International (HKI). It has also conducted information campaign on the importance of vitamin A present in vegetables in support to the National Nutrition Blindness Program.

UPAKAR- NGO is working in three thanas in Raozan, Hathazari and Kowkhali in Chittagong and Rangamati Hill Tracts districts.

Implementing NGNESP project

Each thana has a central nursery and a gram nursery including home gardening. Seeds were distributed and technical support was provided to 1,600 families. Participating farmers harvested a lot of vegetables and collected seeds and saplings.

Soybean cultivation

UPAKAR encouraged soybean cultivation in its project area. Recently, a fair quantity of good-quality seeds were grown in different thanas.

Chapter 2

Vegetable Production

Session III: Vegetable Production

Part A

Chairman : Dr. Shah M. Hasanuzzaman
Rapporteurs : Mr. A. T. M. Salehuddin Chowdhury
Mr. Ali Mohammad

Part B

Chairman : Dr. Kazi M. Badruddoza
Rapporteurs : Dr. A. Razzaque
Mr. Indrajit Roy

Experience of the Agro-Service Centers of BADC

Mohammad Alam

General Manager, Agro-Service Division, BADC, Bangladesh

Abstract

The role of agro-service centers (ASC) in Bangladesh cannot be over emphasized. The centers organize farmer groups and help them intensify vegetable production by providing inputs, on-farm demonstrations, and trainings on improved farm practices. The ASCs also provide transportation facilities to market the project farmers' produce.

Each ASC has 4,048.2 ha of project areas in support to vegetable production. Each has also a 4.9 ha demonstration farm intended for the trainees and nearby farmers interested in improved vegetable production.

The ASCs have been established in different areas of Bangladesh to develop viable and productive agricultural economy geared toward self sufficiency in food.

Introduction

In Bangladesh, vegetables are grown in three ways: as sole crops in the field, in the homestead and intercrop. Previously, homestead was occupying the major production. Current production of vegetable as sole crops in the field is gradually getting momentum. Area planted to vegetables is only 1.7% of the total rice areas (table 1) therefore intercropping technology should also be considered to enhance vegetable production.

Table 1. A comparative study on area, seed requirement, and seed use of some major and minor crops, 1990-92

Crop	Area ('000 ha)	Estimated total seed requirement ('000 t)	Public sector supply of quality seed	
			Quantity	Total seed used (%)
Rice	10,257	450	5.38	1.20
Wheat	589	87	14.18	16.30
Potato	123	18	6.39	3.51
Pulses	677	26	0.02	0.07
Oilseeds	414	5	0.07	1.42
Vegetable	171	1	0.03	2.50

Source: BBS Report 1992.

Government policies for vegetable development

Vegetables are still considered a minor crop. There were no specific national targets set for production of vegetables, fruits, spices and sweet potatoes. The principal thrust of the national policy is to increase food production and achieve food self-sufficiency. Only limited attention was devoted to the development of crops such as vegetables and fruits. However, there has been a growing awareness on the role of vegetable production in the country's agricultural economy. The improvement so far achieved in this regard are worth mentioning:

1. Varieties of some crops are already developed and extension activities are in the field level.
2. Production and supply of quality seeds both by public and private sectors are increased with the assistance of Food and Agriculture Organization-National Vegetable Seed Program.
3. Some vegetable growing areas are developed in different parts of the country. Some vegetables and fruits are already exported to different countries (table 2) and some are sold in the urban areas.

Table 2. Export of vegetables and fruits from Bangladesh

Year	Commodity	Quantity (M. t)	Value ('0 00 Tk.)
1981-82	Vegetables	920	29,530
	Fruits	23	1,560
1982-83	Vegetables	1,770	57,000
	Fruits	95	4,100
1983-84	Vegetables	1,980	78,800
	Fruits	112	5,400
1984-85	Vegetables	2,585	102,022
	Fruits	153	7,934
1985-86	Vegetables	8,578	408,442
	Fruits	367	23,885
1986-87	Vegetables	10,811	531,111
	Fruits	141	9,506
1987-88	Vegetables	8,010	461,563
	Fruits	347	23,141
1988-89	Vegetables	5,329	299,339
	Fruits	269	15,722
1989-90	Vegetables	5,563	259,700
	Fruits	516	22,848
1990-91	Vegetables	3,751	154,104
	Fruits	894	45,702
1991-92	Vegetables	5,141	208,000
	Fruits	645	28,130
1992-93	Vegetables	8,042	313,220
	Fruits	1,249	50,710
1993-94 (Upto Dec., 94)	Vegetables	4,055	156,740
	Fruits	577	28,720

Source : Bangladesh Export Promotion Bureau.

Vegetables as agro-based economy

Vegetables and fruits supply vitamins and minerals needed in the human diet. Dietary habits in Bangladesh, India and Sri Lanka are about the same. But, giving more emphasis on crop diversification program especially on vegetable production and consumption, India and Sri Lanka have attained self-sufficiency. Nutritional deficiency has also decreased substantially. Diversification of crop production and diversified food habit play a vital role in fighting against malnutrition and attaining self-sufficiency in food (table 3).

Table 3. Per capita production of cereals/vegetables in Sri Lanka and Bangladesh

	Production (kg)	
Crop	Sri Lanka	Bangladesh
1. Cereal crops	98	158
2. Minor crops		
a) Tubers	55	20.
b) Vegetables	72	35
c) Fruits	74	14
Total	201	69

Source: Kamal U. Ahmad Oct., 1992.

Role of Agro-Service Centers in upgrading vegetable production

In the past, vegetables were mostly grown in the homestead. The farmers neither followed the improved method of growing vegetables nor used quality seeds. This has caused poor production over the years. Further, vegetable supplies were inadequate because village farmers were the sole producers of vegetables.

To promote overall vegetable production in the country and to increase supply in the urban areas, four Agricultural Development Estates (ADE) were established in 1967 in Kashimpur near Dhaka; Patiya near Chittagong; Jhumjhumpur in Jessore, and Pabna in Rajshahi.

Objectives

1. To meet the required amount of vegetables, fruits, eggs, meat, milk, fish, etc. needed for growing population in the important cities.
2. To organize each ADE to enter into a village-based farmer cooperatives for integrated development of vegetable farming, horticulture, poultry, and dairy farming through modern production techniques. These cooperatives were offered packaged facilities of farm inputs, extension services and credit facilities .
3. To provide project-farmers with improved transport facilities for marketing their produce.
4. To establish linkage between growers and exporters; facilitate packaging, grading, and sorting; and to conduct training on production, grading, packaging of vegetables and fruits.

The performance and service of the ADEs were appreciated by national and international agencies. Considering the active participation of the farmers in vegetable and fruit production, their awareness and success, it was decided to strengthen the four ADEs, and establish more new ADEs thus, giving birth to 16 ADEs in different suitable vegetable growing areas of the country.

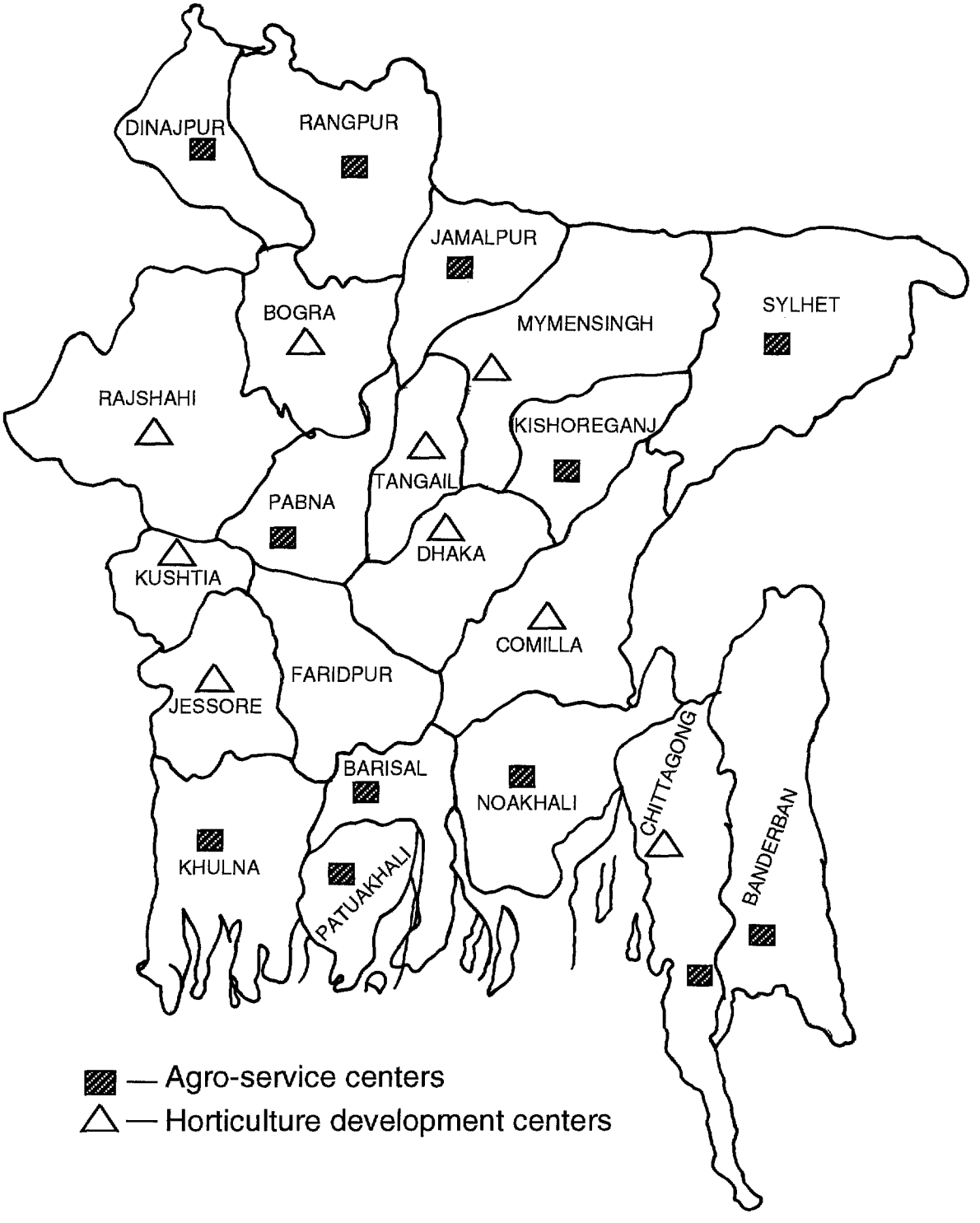

Fig. 1. Agro-service Centers and Horticulture Development Projects in Bangladesh

In 1982 the activities of the 16 ADEs were discontinued. Later on, seven ADEs (of the 16 ADEs) were brought under Horticulture Development Project assisted by Asian Development Bank (ADB) and the rest (9 ADEs) were redesignated as Agro-Service Centers. Locations showing Agro-Service Centers and Horticulture Development Projects are shown in figure 1.

Present Agro-Service Centers

After independence, one of the tasks of the government was to develop a viable and productive agricultural economy leading to self-sufficiency. However, self-sufficiency can only be achieved when each individual is ensured of a balanced diet. Vegetables and fruits are the only natural sources of protective food as they supply nutrients, vitamins and minerals. In the country where the population is predominantly dependent on rice, this can be achieved through diversified crop production and changing food habit. For this purpose, special emphasis has been given in increasing production and consumption of vegetables and fruits. In this regard ASC is playing a vital role in motivating farmers on vegetable and fruit production.

Activities of the ASCs

1. Each ASC has 4,048 ha of project areas which are supported for vegetable production.
2. ASCs are conducting trainings on modern technologies of vegetable production, fruits, graft, gooties, etc., to their project farmers assisted by the extension department and the BADC Horticulture Development Centers.
3. Each center has a 4.9 ha demonstration farm for the trainees and the nearby farmers to witness on the modern production techniques on vegetables, grafts, and gooties.
4. The centers organize farmer groups in the project, help them intensify vegetable production by supplying inputs, providing training/technical assistance on improved technology and farm practices.
5. The ASCs are conducting demonstrations at the project areas on production technology and introduction of new varieties.
6. Through the ASCs, the farmers started using quality seeds which has resulted to a gradual increase in vegetable production.
7. The centers are also providing transport facilities for the project farmers to market their produce thus encouraging them to get due price of their products.

Conclusion

Vegetable production has been under the control of the government sector. However, some areas of the management has been taken up by the private sector for development, whose impact is not yet significant in the context of national requirement. The problems in these areas are varied and complex in nature comprising of factors related to socioeconomic and agroecological conditions, technology, coordination, etc.

Vegetable crops require ready market. Market price declines when there is bountiful harvest causing serious setback to producers. Proper and timely marketing should be ensured to encourage more production with reasonable price support.

More attention is needed to suitable varieties of most of the vegetable which are unavailable in summer. Systematized seed technological approach starting from variety development and release up to distribution to the farmers also needs attention.

Bangladesh has been exporting vegetables but very little attention was given to processing and packaging. Thus, training on vegetable processing and packaging is needed to ensure quality of products.

Expansion of vegetable export market is necessary not only to earn foreign exchange but to boost local production in promoting more vegetable consumption. Therefore, to develop an export market, aggressive export promotion activities are necessary. Cooperation between public and private sectors involved in the management of vegetable and seed production should be strengthened to attain increased production.

References

Anonymous. 1992. Proceeding of national review and planning workshop on vegetable production and marketing. 26-29 January 1992. BARI, Joydebpur.

Anonymous. 1992. Statistical Yearbook of Bangladesh (13th Edition).

Kandi-Bairh System of Vegetable Production in Pirojpur Zone

Maij Uddin Ahmed, M. Kafil Uddin, Mrinal Kanti Das, and A.B.M. Nazmul Huda

Department of Agricultural Extension

Abstract

According to the local people, the "Kandi-Bairh" system was developed about 250 years ago in "Atghar-Kuriana" Union under the Thana of Neserabad (Swarupkati) of greater Barisal District, now in Pirojpur. The system was innovated as it was not possible to produce crops in the lowlands of Atghar-Kuriana because most of the areas were submerged under water for almost round the year (for about 8-9 months).

This adverse condition challenged the farmers to be innovative in their farming operations. Thus the birth of "Kandi-Bairh" system. Farmers started digging up soil in alternate strips. The strips from where the soil was dug up were called bairhs, and the strips where soil was dumped were called kandis.

Then, the farmers started growing pani-kachu, auspaddy and different kinds of vegetables. The result proved satisfactory. This scenario had encouraged more farmers to produce various crops, especially vegetables. This system had been replicated in different areas of Atghar-Kuriana. Now, the "kandi-bairh" system is widely practiced in East Deulbari-Dobra Union of Nazirpur Thana, Atghar-Kuriana Union, Baldia Union of Nesarabad Thana under Pirojpur district and Bisher-Kandi Union of Banaripara Thana under Barisal District.

In Rabi season (winter months from October-March), as much as 1,890 and 300 ha of vegetable crops were grown in Nazirpur and Neserabad respectively. In the Kharif season (summer months from April-September), vegetables were grown in 700 and 178 ha respectively.

During the rainy season, most of the kandis were submerged under water. Lady's finger, turmeric, and cucumber were grown at about 1.5 m thick floating beds.

Though in most cases, crops were grown mixed, it was observed that some of the vegetables produced extremely high yield. For example, Indian spinach, danta, cabbage yielded, on the average, 75, 66, 74 t/ha, respectively.

Growing of a large number of seedlings of different vegetables on floating beds was also a big business. As much as 5.2 million and 2.1 million vegetable seedlings were raised annually in Nazirpur and Neserabad, respectively.

The produced vegetables and seedlings were sold to the *Farias* and *Mahajons* at the local market. *Farias* and *Mahajons* distribute vegetables to different areas of greater Barisal, part of greater Faridpur.

Introduction

The "Kandi-Bairh" was originated in Atghar-Kuriana union under the Thana of Neserabad (Swarupkati) of greater Barisal District, now in Pirojpur. The system was developed because it was not possible to produce crops in the low lands of Atghar-Kuriana and its surrounding areas following the normal methods of crop production because most of the areas were submerged under water. To overcome this adverse condition, farmers adopted the "Kandi-Bairh"system. The strips from where the soil was dug up were called bairhs and the strips where dug soil was dumped were called kandis. Kandis and bairhs were made alternately. Before, the shapes and sizes of kandis and bairhs were not as uniform as today.

Description of the System

Land type

Before kandis (flat ridges) were made, the land was so low that no crop can grow under normal method of production.

Soil type

After a long period of using the kandi system, the soil of Atghar-Kuriana Zolabari, and Samudyakati of Nesarabad had turned into silty clay from peat soil. However, the soil of East Deulbari-Dobra Union under Nazirpur and Baldia Union under Nesarabad was still peat soil which was very loose and spongy. It became productive when silty clay soil was mixed with it.

Kandi-Bairh

It was necessary to raise waterlogged land for the production of different kinds of vegetables. Thus, the farmers developed the Kandi-Bairh system. They started digging up the land with long sickles in alternate strips. The strips (furrows) from where the soil was dug up were called bairhs, and the strips where dug soil was dumped were called kandis. This made the furrows (bairhs) canals of water but the ridges (kandis) remain above inundation throughout the year.

The width of the kandis and bairhs were not similar everywhere. In Zolabari, Samudaykati, and Atghar-Kuriana areas, it ranged from 3-4 m and 2.5 to 3 m respectively. In East Deulbari Dobra and Baldia areas, it ranged from 2-4 m and 3-4 m respectively. The length is normally as long as the land allows, but mostly within the limit of 55 meters.

As the lands with silty clay soil were rigid and steady, the kandis needed only minor repair every year. On the other hand, the kandi borders in peat soil areas required major repair. For example, in East Deulbari-Dobra and Baldia areas, after every year, when the kandi and bairh needed repair, farmers dig from the bairh and dump the soil into the kandi. Repair was necessary due to erosion of kandi and siltation in bairh. It was already mentioned that the existing peat soil of Deulbari-Dobra and Baldia areas had turned productive when mixed with silt. Silt was available from bairh siltation. It was interesting to note that bairh water surface was used for plying small boats. Farmers did various operations such as repairing of macha and kandis, spraying vegetables and harvesting of crops by reaching the bottom of the macha by using small boats.

Crops grown in the kandi-bairh system were mainly vegetables. Other crops grown include rice, sugarcane, chili, turmeric, onion, garlic, water melon, futi (muskmelon), mungbean, mustard and maize. Grown during rabi season were lalsak, palongsak, cauliflower, cabbage, knol-khol, radish, tomato, brinjal, bottle gourd, sweet gourd, sorma (a kind of cucumber), string bean,

turnip, and coriander leaf. Grown during kharif 1 season were lady's finger, ribbed gourd, cucumber, bitter gourd, brinjal, pani kachu, and snake gourd. A huge quantity of country bean is grown in Atghar-Kuriana. Grown during kharif 2 season were cucumber, lady's finger and turmeric (grown in floating beds).

Cultivation

Cultivation procedures were not exactly the same in all areas. Initially, the farmers of Atghar-Kuriana made the kandi (about 1/2-3/4 m high) by cutting bairh beside the kandi (from December to March).

In November and December of every year, farmers grow chili, cabbage, cauliflower, tomato, brinjal (eggplant), potato, and radish at the middle part of the kandi and morma, bitter gourd, snake gourd, at the outer side of the kandi after putting water hyacinth and muddy soil from bairh in layers. This goes on for three to four years. As a result, the height of the kandi has increased. After three to four years of making the kandi, farmers started planting guavas. Vegetable cultivation goes on side by side. Farmers made *macha* over the bairh to support climbing/creeping type vegetables grown at the outer side of the kandi. After five to seven years, when the guavas start bearing fruits, vegetable cultivation decreased. At this stage, country bean and string bean were mainly grown on the kandi, and they are allowed to climb/creep at the guava tree.

In East Deulbari-Dobra Union and its adjacent areas, farmers made kandis, for the first time in December to March, dhaincha and mesta plants were grown in the first year of kandi making. For the first time, vegetable cultivation started from the month of September to October. Farmers put water hyacinth on the kandi 15-20 days before sowing/planting.

When the water hyacinth has rotted or dried, farmers started making pits using aquatic plants, such as dulalilata, khudi pana, chuna-sheola, and cover them with "fash mati" (soil mixed with rotted plants). Farmers sow seeds or plant seedlings on the prepared pit. Irrigation is done from the bairh as required. This practice is very systematic and regular.

Vegetables (other than the creeping ones) are cultivated at the middle part of the kandi, and the creeping ones are planted at the outer side of the kandi just like in Atghar-Kuriana. As vegetables grow, farmers put loose, wet and silty soil around the vegetable when required. This system is locally called as giving *lata* .

In the rainy season, most of the kandis were submerged under water, and at that time, only pani kachu, mesta and jute were grown on it. However, the older kandis were planted with sugarcane used for preparing goor and for chewing. It was also noted that, at early winter, tomato, brinjal, and chili (and to some extent, mung) are grown in the sugarcane kandi as intercrops.

It has been noted earlier that in Kharif 2 season farmers grow cucumber, lady's finger, turmeric on the floating beds. In this method, they made 1.5 m thick beds of water hyacinth and spirogyra without using soil. Seeds/seedlings are sown or planted in rotted water hyacinth.

Cropping patterns

The following cropping patterns were practiced :

1. Potato+Cabbage+Brinjal+Bitter gourd+White gourd
2. Potato+Knolkhol+Brinjal+Bitter gourd+Morma
3. Potato+Cabbage+Brinjal+Bitter gourd+Morma

4. Onion+Brinjal+Morma+Bitter gourd
5. Garlic+Chili+White gourd+Bitter gourd
6. Tomato+Pani kachu+Sweet gourd
7. Sugarcane+Tomato+Brinjal+Chili
8. Jute Mesta Dhaincha (in the first year only)

Vegetable areas

It was noted earlier that kandi-bairh system of vegetable production was in Nazirpur and Nesarabad Thanas (tables 1 and 2). In the rabi season, as much as 1,988 and 300 ha of crops were grown in Nazirpur and Nesarabad, respectively. In the kharif season, vegetables were grown in 700 and 178 ha, respectively.

Yield

Though in most cases, crops are grown mixed, yields are moderately good. Details are shown in table 3. It will be observed that some of the vegetables produced extremely high yield. For example, Indian spinach, danta, cabbage and palong sak yielded, on the average, 75, 66, 74, and 51 t/ha respectively. The production may be increased if improved management will be provided (table 3).

Production of seedlings

Producing vegetable seedlings in floating beds has also been a good business for the farmers aside from vegetable cultivation. There are two ways of producing vegetable seedlings. First, the farmers make *tama* using aquatic plants like dulalilata and khudi pana. Then the farmers sow sprouted seeds of bottle gourd, country bean, bitter gourd, morma, snake gourd, cucumber, and lady's finger into the ball-shaped *tama* and cover them up with rotted water hyacinth. Second, the farmers use coconut husk dust. They spread about 10-15 cm thick coconut husk dust on the floating beds. Afterwards, seeds of cabbage, tomato, cauliflower, knol-khol, chili, brinjal, etc., are sown and covered with the same dust. Number of seedlings produced are shown in table 4.

Marketing and storing of vegetables

The farmers bring their produce to the local market namely; Baithakata, Monoharpur Bazaar, Inderhat, and Swarupkathi Bazar, using small country boats. These are bought by the *Farias* and *Mahajons* who distribute the same to different areas of greater Barisal, part of greater Faridpur and to Dhaka using hired launches or trawlers. But these transportations are not big enough to accommodate volumes of vegetables. When a strike occurs, most of the vegetables are damaged because there are no storage facilities available. Besides, there are no good communication system which can transmit messages immediately to the buyers in different areas in case of delayed delivery. This situation compels the farmers to sell their produce at a very low price (that may not even be equal to cost of production). Thus, farmers do not get enough benefit from their efforts.

Marketing of seedlings

Seedlings are also transported to the local market by means of small boats. *Farias* buy them and distribute the same to different areas in greater Barisal, part of greater Faridpur and other places. It is worth mentioning that sometimes, growing vegetable seedling is more profitable than vegetable production itself.

Table 1. Hectarage of various vegetables grown in two thanas during the rabi season

Vegetable	Production Area (ha)					Total
	Nazirpur	Necarabad				
	East Deul Bari Dobra	Atgar Kuriana	Samudoy Kathi	Jalabari	Baldia	
Lalsak	60	8	1	2	11	82
Palong Sak	12	3	1	1	3	20
Potato	460	38	1	6	12	517
Cauliflower	113	7	1	1	2	124
Cabbage	200	13	2	2	5	222
Knolkhol	132	10	1	2	7	152
Radish	80	7	1	4	6	98
Tomato	48	5	-	1	6	60
Bottle gourd	40	9	2	3	7	61
Brinjal	120	19	-	1	2	142
White gourd	45	2	-	1	2	50
Sweet gourd	170	8	1	1	6	186
Morma	145	14	1	2	4	166
String bean	15	2	1	1	1	20
Turnip	5	-	-	-	-	5
Country bean	-	3	1	3	5	12
Chili	135	20	1	3	4	163
Coriander leaf	25	-	-	-	-	25
Onion	40	-	-	-	-	40
Garlic	45	-	-	-	-	45

Table 2. Hectarage of various vegetables grown in two thanas during the kharif season

Vegetable	Production area (ha)					Total
	Nazirpur	Necarabad				
	East Deul Bari Dobra	Atghar Kuriana	Samudoy Kathi	Jalabari	Baldin	
Cucumber	36	10	1	1	3	51
Ribbed gourd	40	12	1	3	5	61
Lady's finger	32	6	1	1	4	44
Snake gourd	54	7	1	1	3	66
Pani kachu	325	4	1	1	7	338
Bitter gourd	182	40	1	1	20	244
Futi	24	-	-	-	-	24
Stem amaranth	-	7	1	1	3	12
Teasle gourd	-	3	2	1	1	7
Owl kachu	-	4	1	1	1	7
Indian spinach	-	5	1	1	2	9
Papaya	7	3	1	1	1	13

Table 3. Average yield of different vegetables under kandi-baihr system

Vegetable	Total area (ha)	Yield/ha (kg)	Total yield (t)	Price/kg (taka)
Lal sak	82	4,000	410	5
Palaong sak	20	51,000	1,020	3
Potato	517	9,900	5,118	3
Cauliflower	124	19,800	2,455	5
Cabbage	222	74,000	16,428	2
Knol khol	152	59,300	901	2
Radish	98	69,000	6,762	2
Tomato	60	37,000	2,220	4
Bottle gourd	61	34,600	2,110	1
Eggplant	142	39,520	3,616	3
White gourd	50	7,400	370	3
Sweet gourd	186	14,800	2,753	2
Morma	166	24,700	4,100	3
String bean	20	12,350	247	4
Turnip	5	9,800	49	4
Country bean	12	10,500	126	3
Cucumber	51	4,650	441	5
Ribbed gourd	61	14,800	903	4
Lady's finger	44	8,650	381	4
Snake gourd	66	22,200	1,465	3
Pani kachu:				
Kachu	338	29,650	13,402	1
Lati	338	9,900	3,346	4
Bitter gourd	244	12,350	30	5
Danta	14	65,500	917	2
Kakrol	7	12,500	88	5
Owl kachu	7	25,250	177	4

Table 4. Seedlings produced in floating seedbeds[a]

Thana	Union	Type of seedbed[a]						
		Direct seedbed			Sprouting seedbed			
		No. of seed-bed	No. of seed-lings /bed (M)	Total seed-lings (M)	No. of seed-bed	No. of seed-lings /bed (M)	Total seed lings (M)	Grand total of seed-lings (M)
Nazirpur[b]	East Deul Bari Dobra	50	60	3	400	5.5	2.2	5.2
Nesarabad[b]	Baldia	20	60	1.2	175	5.5	0.9	2.1
Total		70		4.2	575		3.1	7.3

[a]*Seedbed size: 56 x 1.4 m*

[b]*Includes the following vegetables: bottle gourd, country bean, bitter gourd, morma, snake gourd, cucumber, okra, cabbage, tomato, chili, brinjal, cauliflower, knolkhol, etc.*

Recommendations

1. Availability of credit facilities;
2. Availability of improved and quality seeds;
3. Conduct training on seed preservation;
4. Improvement of communication facilities;
5. Construction of farm to market roads;
6. Building of cold storage facilities; and
7. Conduct further research on kandi-bairh system of vegetable cultivation.

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Grameen Krishi Foundation: Supporting Vegetable Production

M. S. Akter

Scientific Officer, BARI, and Team Leader, GKF/BARI Joint Program

Abstract

Bangladesh Agricultural Research Institute (BARI) initiated a joint program with Grameen Krishi Foundation (GKF) for the transfer of improved technology and boost the economic condition of the farmers. Several vegetables were grown like tomato, radish, cauliflower, cabbage, garden pea, China sak, bati sak and sweet gourd. GKF provided production input such as seed, fertilizer, irrigation, pesticides and agricultural machineries under different sharing arrangements. Farmers provided land, animal labor and human labor for different intercultural operations. It has been found that the program ensured increased income to the beneficiaries and at the same time 100% loan recovery.

Introduction

Due to the application of modern technology during the last three decades, the agriculture of Bangladesh has become more capital intensive. Capital and technology are so interrelated that one cannot bring about positive results without the other (Bashar and Alam 1985). The modern technology includes high-yielding variety (HYV) seeds, irrigation, chemical fertilizer, pesticides, agricultural implements, and other machineries. All these investments need big capital which cannot be met fully by the farmers from their own savings because of their hard pressed financial position. The availability of farm credit is essential in order to introduce the modern technology intensively in the agricultural sector.

Besides technology and capital, two other factors are also very important specially in the agricultural sector. These are marketing and technical supervision during production period. In Bangladesh, different government agencies provide different production inputs e. g. Bangladesh Agricultural Corporation (BADC) supplies seeds, Krishi Bank provides credit, Department of Agricultural Extension (DAE) provides modern

technology but nobody is there to see the market. Practically there is no effective integration among these agencies. Though the government of Bangladesh is continuously expanding institutional sources of credit in the rural areas, still, the situation has not improved accordingly.

Presently, GKF is serving as "four in one" and sharing agricultural sector's development benefit with the poor farmers through increasing the overall production in the project areas. GKF

provides HYV seeds, chemical fertilizer, pesticides, irrigation water, agricultural machineries and overall technical supervision. At the same time GKF provides marketing facilities for the nontraditional crops like maize, soybean, etc.

To date, BARI has a joint program with GKF. The overall objective of GKF-BARI joint program is to improve the economic condition of the farmers by transferring improved technology developed by the research institutes. Under the present GKF system, several vegetables were grown during the last two years, both for family consumption and market as well as for seed. The present paper focuses on the productivity, profitability and sustainability of cultivating some vegetables under GKF/BARI joint program.

Background of the Study

The GKF was formally created in January 1992 as a nongovernment organization, a project of Grameen Bank. It is operational in the greater districts of Rangpur and Dinajpur with its headquarters at Rangpur. GKF has 805 DTWs of which about 500 is usually brought under operation in a year.

Besides DTWs it has a substantial number of shallow tube wells. GKF promotes agribusiness and runs a joint profit-earning agricultural production activities with the farmers. Major part of its activities concentrates on crop production under irrigated conditions in deep tube well areas. It provides inputs like seeds, fertilizers, irrigation water, pesticides, etc. on credit to the farmers for crop production. In return, farmers provide an agreed portion of the produce to the foundation. The foundation is also trying to venture in seed production, poultry, dairy farming, and fish culture.

The GKF authority requested BARI to look into the systems and recommend cooperation that can be rendered to GKF for profitable crop production. BARI conducted one Rapid Rural Appraisal (RRA) with highly qualified professionals from different organizations. According to the recommendation of the RRA, BARI will send a team of scientist and scientific assistants from its on-farm research division to help GKF personnel in transferring appropriate technologies developed by BARI and other research organizations in selected DTW areas. It was agreed that BARI would provide technical assistance to the GKF personnel and the latter would implement the field activities as they did in other farms. The collaborative sites would eventually be used as training grounds for the field workers.

Based on the Memorandum of Understanding (MOU) the collaborative work was initiated in May 1993. The initial activities involved understanding of field situation by the BARI personnel. An inventory of the existing land and soil condition crops and crop production was done through a survey. Based on the survey results, several pulse crop, oilseeds, sugarcane, rootcrops, and vegetables were tried in some selected DTW areas.

Methodology

The study was conducted at eight farms in Rangpur and Kurigram districts. A DTW with its command area constitutes a farm of GKF. There is a farm manager in each farm who is responsible for distribution of inputs and collection of crop share from the farmers. Four scientific assistants from BARI were deputed to four farms in Rangpur region. In the other four farms at Kurigram region, BARI scientist helped the farm manager to execute the program. Tomato (Ratan), cauliflower (C1-0096), radish (Tasakisan), garden pea (GP-001) sweet gourd (local), cabbage (KK-cross) and squash (hybrid) were tried in the last two years. Tomato,

cauliflower, radish, garden pea, China sak, bati sak and sweet gourd were cultivated for seed. The GKF provided the farmers with seed, fertilizer, insecticide, irrigation, and technical assistance. Different sharing arrangements were made in different farms for different crops. In most of the farms, farmers had to pay 50% of the produce to GKF. In some farms, 20% service charge were taken from the farmers by GKF. In case of seed production, after harvest, the total produce were brought to GKF custody for better threshing, cleaning, and drying. After taking the agreed share, the rest of the produce (seed) were bought by GKF based on the previously agreed price. In case of vegetables, farmers sold the produce and paid back the loan including service charge in cash. But in 50% sharing system, the farmers took their share and sold it to the market. GKF helped the farmers in marketing the nontraditional crops like garden pea.

Results and Discussion

Vegetable production. Five different vegetables have been evaluated at the farmers field (table 1). There were eight locations for tomato, two for cabbage, seven for garden pea, five for radish and one for squash. The total area for tomato, cabbage, garden pea, radish and squash were 0.36, 0.45, 0.20, 0.40, and 0.20 ha, respectively. Tomato yield varied from 30-54 t/ha which is six times higher than the national average (BBS 1992). Cabbage yield varied from 28-30 t/ha which is four times higher than the national average (BBS 1992). The cabbage yield might have been increased than the recorded yield since the farmers sold the heads well ahead of maturity for higher market price. The national average yield of radish is 8.7 t/ha (BBS 1992) which is 7.5 times lower than the present yield (60-70 t/ha). The yield of squash was 21.2 t/ha.

Table 1. Area and yield of different vegetables under GKF-BARI joint program

Crops	Area (ha)	Yield (t/ha)	Average yield (t/ha)
Tomato (Ratan)	0.36	30.0-54.0	42.0
Cabbage (KK-Cross)	0.45	28.0-30.0	29.0
Garden pea (GP-001)	0.20	4.2-8.8	6.5
Radish (Tasakisan)	0.40	60.0-70.0	65.0
Squash (Hybrid)	0.02	21.5	21.2

Vegetable seed production. Six different vegetables were grown for seed production (table 2). There were three locations for cauliflower, seven for garden pea, nine for radish, two for sweet gourd and one each for China sak and bati sak. The total area for cauliflower, garden pea, radish, sweet gourd, China sak and bati sak were 0.22, 0.136, 0.44. 0.128, 0.024, 0.032 ha, respectively. Cauliflower yielded 100-208 kg/ha seeds with an average of 154 kg/ha. Its yield might have been increased than the recorded yield since one field was infested by bacterial soft rot. Moreover, ryceness in cauliflower ultimately decreased the seed yield. The garden pea yielded 1,500-1,750 kg/ha seeds with an average of 1,650 kg/ha. Radish yielded 375-750 kg/ha seeds with an average of 562.5 kg/ha. Both China sak and bati sak yielded 750 kg/ha seed. All seed yields are similar to the seed yield of BADC farm in Rangpur.

Table 2. Area and yield of different vegetable seeds under GKF-BARI joint program

Crops	Area (ha)	Yield (kg/ha)	Average yield (kg/ha)
Cauliflower (Agrahani, poushali- CI-0096)	0.220	100-208	154
Garden pea (GP-001)	0.136	1,500-1,750	1,625
Radish (Tasakisan)	0.440	375-750	563
Sweet gourd (Local)	0.128	150	150
China sak (BARI)	0.024	750	750
Bati sak (BARI)	0.032	740	740

Economics of vegetable production. The farmers' cost of production varied from 6,750 (Tk/ha) in squash to 11,916 (Tk/ha) in garden pea (table 3). The cost of production included mainly on working animals, human labor, and cost of support material in case of garden pea. The farmers obtained highest gross margin in tomato (195,080 Tk/ha) followed by radish (152,813 Tk/ha), and the lowest in cabbage (35,280 Tk/ha). The BCR (farmer) was higher in tomato (18.10 and in radish (17.59).

Table 3. Economics of vegetable cultivation under GKF-BARI joint program

Crop[a]	Cost of production (Tk/ha)			Gross income (Tk/ha)	Income share (Tk/ha)		Gross margin (Tk/ha)		BCR	
	Farmer	GKF	Total		Farmer	GKF	Farmer	GKF	Farmer	GKF
Tomato	10,776	20,120	30,986	23,000	205,856	24,144	195,080	4,024	18.10	1.20
Cabbage	6,800	15,825	22,625	84,160	42,080	42,080	35,280	26,255	5.18	1.66
Garden pea	11,916	7,666	19,582	87,083	58,055	29,027	46,139	21,361	3.87	2.78
Radish	8,687	11,250	24,937	175,000	161,500	13,500	152,813	2,250	17.59	1.20
Squash	6,750	22,050	28,800	49,000	24,500	24,500	17,750	2,540	3.63	0.11

[a]Price (Tk/kg) : Tomato=2.00-9.00; Cabbage=2.00-3.00; Garden pea=12.00-15.00; Radish=2.00-3.00; Squash=2.00-3.00; US$1=40 Taka (1995)

Economics of seed production. In case of seed production the farmer had the highest gross margin from radish (29,423 Tk/ha) and the lowest from bati sak (13,700 Tk/ha) table 4). The BCR (farmer) was highest in radish seed (2.96) and the lowest in garden pea (1.5). In case of garden pea the farmer had to give the support for the crop which increased the production cost resulting to low BCR.

Table 4. Economics of vegetable seed production under GKF-BARI joint program

Crop[a]	Cost of production (Tk/ha)			Gross income (Tk/ha)	Income share (Tk/ha)		Gross margin		BCR	
	Farmer	GKF	Total		Farmer	GKF	Farmer	GKF	Farmer	GKF
Cauliflower	9,335	17,754	27,125	52,336	26,168	26,168	16,833	8,414	1.80	0.47
Radish	9,937	13,900	23,837	78,720	39,360	29,423	21,100	25,100	2.96	1.80
Garden Pea	12,000	7,175	19,175	60,000	30,000	30,000	18,000	22,825	1.50	3.18
China sak	8,541	12,125	20,666	45,000	22,500	13,959	10,375	10,375	1.63	0.85
Bati sak	8,430	12,125	20,555	14,400	22,200	22,200	13,700	10,075	1.63	0.83

[a]Price (Tk/kg) : Cauliflower=350.00; Radish=60.00; Garden pea=40.00; China sak=60.00; Bati sak =60.00

Economics of the farmers' practices. The economic analysis of the farmers practices are presented in table 5. Farmers usually grow tobacco, wheat, potato and chili in those plots where selected vegetables and vegetable seeds were produced. Previous results clearly revealed that, farmers obtained very low gross margin (2,143-10,225 Tk/ha) except in potato. Potato is basically a cash intensive crop and mostly practiced in the large-scale plantations. The farmers obtained higher gross margin in the joint program than in their own practice. It is worth mentioning that in their practice they had to manage the input cost. But in the joint program they only spent for the cost of land preparation and intercultural operations.

Table 5. Economics of farmers' practice

Crops[a]	Yield (t/ha)	Production cost (Tk/ha)	Gross return (Tk/ha)	Gross margin (Tk/ha)	BCR
Tobacco	2.0	22,857	25,000	2,143	0.09
Potato	26.0	18,000	97,500	79,500	4.42
Wheat	1.5	5,693	7,500	1,807	0.32
Chili	2.8	7,050	17,272	10,225	1.45

[a]*Price (Tk/kg) : Tobacco=12.50; Potato=3.75; Wheat= 5.00; Chili =6.16*

Insect and disease infestation. During the production period, several insects and diseases were recorded (tables 6 and 7). It becomes very difficult for a farmer to identify and control these insects and diseases. It is essential to provide training to these farmers before introducing any improved technology for large-scale vegetable production. All the profitable technologies need high input.

Table 6. Insects in vegetables and seeds and their recommended control measures

Crops	Insects	Control measures
Vegetable		
Cabbage	Cabbage butterfly	Ripcord
Squash	Fruitfly	BARI-recommended trap
Garden pea	Pod borer	Nogos
Tomato	Whitefly	Dimecron
Radish	Cutworm	Dursban
Seed		
Cauliflower	Cabbage butterfly	Ripcord, Nogos
	Aphids	Zolon, Nogos
Garden pea	Podborer	Nogos
Radish	Cutworm	Dursban
	Aphids	Zolon, Nogos
Sweet gourd	Fruitfly	BARI-recommended trap
China sak	Aphids	Zolon, Nogos
Bati Sak	Aphids	Zolon, Nogos

Table 7. Disease infestation in vegetables and seeds and their recommended control measures

Crop	Disease	Control measures
Vegetable		
Tomato	Leaf curl virus	Dimecron
	Tobacco mosaic virus	Dimecron
	Late blight of tomato	Ridomil MZ
Garden pea	Powdery mildew	Thiovit, Tilt
	Rust	Calyxin, Tilt
Seed		
Cauliflower	Bacterial soft rot	Uprooting and controlled irrigation
	Alternaria leaf spot	Rovral
	Hollow heart	Boron spray
	Curd rot	Noin
Garden pea	Powdery mildew	Tilt, Thiovit
	Rust	Tilt, Calyxin
Radish	Bacterial soft rot	Uprooting and controlled irrigation
	Alternaria leaf spot	Rovral
	Curling and chlorosis of leaf	Boron spray
China sak	Alternaria leaf spot	Rovral
Bati sak	Alternaria leaf spot	Rovral

Conclusion

Cultivation of vegetables and production of vegetable seeds are more profitable than other competitive rabi crops. If more farmers as well as more lands could be brought under vegetable cultivation, the farmer would be highly benefited. The productivity, profitability, and sustainability of vegetable cultivation are positively related to the ensured supply of quality seeds, fertilizers, insecticides, fungicides, irrigation, agricultural machineries, technical know-how, and improved marketing.

References

BBS. 1992. Yearbook of agricultural statistics of Bangladesh.

Bashar, M. A. and Alam, M. F. 1985. Structural changes of rural credit over time in two villages of Bangladesh. Bangladesh J. Agric. Econ. 2 December 1985.

Hossain, M. M. 1995. Seed production and storage technology. M. E. Hossain. Mirpur, Dhaka-1216.

MCC: Supporting Profitable Vegetable Production

Amal Krishna Roy

Principal Technical Officer, FFDP, Agricultural Program, MCC

Abstract

The Mennonite Central Committee (MCC) has been extending vegetable cultivation to the resource-poor farmers of the greater Noakhali district since 1972. Currently, the MCC agriculture program provides vegetable assistance directly to around 3,500 farm families in Noakhali and Lakshmipur districts. This includes rendering technical assistance, training on homestead vegetable gardening and seed preservation, and making good quality vegetable seeds available to the farmers. In November 1993 to October 1994, most of the farmers working under the program received 75% of their total farm income resulting from our activities from vegetable cultivation, which reflects its potential in this area. Besides, the agriculture program provides some assistance to 14 NGOs in seven districts to improve their agriculture extension activities emphasizing vegetable cultivation. Some of the major problems in vegetable cultivation in Noakhali areas are lack of enough highlands for vegetable cultivation; lack of irrigation facilities; late drying of lands for early winter vegetable cultivation; soil salinity; and lack of a good marketing facility. For the last two years, the agriculture program has started an agribusiness with soybean seed multiplication and marketing. In the future, the program may start a similar kind of agribusiness for vegetable seed.

Introduction

MCC food production effort in Bangladesh started in 1972. Vegetable crops extension activity have been an integral part of the program since its inception. Throughout the past years the most important activity was to help subsistence farmers gain technical knowledge on vegetable cultivation. The activities included: (1) kitchen gardening program in homesteads; (2) school program on vegetable cultivation techniques; (3) training program for general nutritional knowledge; (4) seed multiplication projects with farmers; and (5) vegetable seed sale to subsistence farmers at subsidized rates.

In the past, the MCC agricultural extension areas were located in greater Noakhali and part of Comilla and Rangpur districts. Currently, the horticultural extension activities are confined to new Noakhali and Lakshmipur districts. Now the MCC's major effort in providing assistance to small farmers for profitable vegetable cultivation includes:

1. Technical assistance to farmers for successful vegetable cultivation;
2. Production of vegetable seeds;
3. Selling of seeds to subsistence level farmers at cost; and
4. Encourage farmers to save certain kinds of vegetable seeds.

In addition to vegetable extension activities, the MCC agriculture program has also started vegetable research in 1976. The emphasis on vegetable research was increased during the following years. Today, MCC vegetable research is considered to be a very important part of its agricultural activities. MCC's vegetable research component is trying to develop more technologies relating to vegetable cultivation in saline soil.

Besides MCC's direct work with farmers, its agriculture program is currently sharing experience and expertise with some selected NGOs to strengthen their vegetable extension activities in seven districts.

Target group and working area

The agriculture program works directly with around 3,500 subsistence or below subsistence-level farm families in 20 different unions of three thanas under Noakhali and Lakshmipur districts. The program has some vegetable activities through 14 partner NGOs in Faridpur, Kustia, Jessore, Jhenaidha, Pabna, Sirajgonj, and Noakhali districts.

MCC Major Vegetable Extension Activities

Year-round vegetable cultivation plays a vital role in increasing farmers' income. Vegetable cultivation also helps them meet their nutritional requirements through increasing vegetable consumption, especially during the marketing period.

Two programs are directly working with farmers to assist them in cultivating vegetables profitably along with other activities. These programs are the Farm Family Development, in which, the working methodology is through individual contact with the farmers; and the Homestead Resource Development where the activities are performed through group formation.

In the Farm Family Development Program (FFDP), it has been found that the farmers are receiving a significant part of their income from vegetable cultivation. In November 1993 to October 1994 nearly 75% of the farmers' income resulting from our activities came from vegetable cultivation projects (table 1). Input costs for vegetable cultivation is low compared to livestock raising or fish culture. We provide more technical assistance to farmers for vegetable cultivation because of our long experience in vegetable extension. During this period, the total acreage covered by vegetable cultivation was 52 ha by 1,235 families.

In the Homestead Resource Development Program (HRDP), during winter in 1993-94, a total of 396 group members planted winter vegetable seeds. Of the members, 247 (62% of the 396) planted at least three varieties and 329 group members (83% of the 396) successfully harvested vegetables. Of the group members who harvested vegetables, 16% saved seed. During summer in 1994, a

total of 358 group members planted summer vegetable seeds of which 227 group members (63% of the 358) planted at least three varieties and 241 group members (67% of the 358) successfully harvested vegetables. Of the group members who harvested vegetables 33% saved seed.

Table 1. Farmers' income per project in Nov. 1993-Oct. 1994

Project	Number	% Total projects	Net income (taka)	% Total net income
Vegetables	3,405	87.4	1,790,783	74.5
Rice	155	4.0	175,785	7.3
Nurseries	21	0.5	36,060	1.5
Fish	199	5.1	246,462	10.2
Poultry	6	0.2	1,420	0.1
Livestock	20	0.5	46,795	1.9
Others	88	2.3	107,508	4.5
Total	3,894	100.0	2,404,813	100.0

Currently, the MCC agriculture program is providing assistance to its partners in vegetable cultivation in the following ways:

1. **Availability of vegetable seeds.** Most of the winter vegetable seeds such as cauliflower, cabbage, turnip, kohlrabi, carrot, and tomato are purchased from seed dealers while most summer and rainy season vegetable seeds are multiplied in the FFD program by experienced farmers. The program repackages all seeds and sells them to the farmers at cost price (including the cost of packaging but not transportation). In November 1993 to October 1994, the program multiplied lalshak, palong shak, puishak, kangkong, bitter gourd, snake gourd, cucumber and borboti. There is no subsidy in our vegetable seeds. In an attempt to create a sustainable seed source, local seed dealers are being contacted by our field extensionists. The field extensionists are motivating seed dealers to sell good quality seed and motivate farmers to buy seeds from them. However, demand for MCC seeds is high since some partners are wary of the quality and purity of seed from local dealers. In the future, we want to help these dealers. The vegetable seeds sold to farmers and other MCC programs from November 1993 to October 1994 are listed in table 2.

2. **Providing technical assistance.** Each field extensionist initiates vegetable projects with their listed partners and maintains progress records through weekly field visits. In November 1993 to October 1994, the program provided technical assistance to 1,235 farmers for 3,405 vegetable projects aimed at increasing yield.

3. **Saving seeds.** The partners are assisted in preserving vegetable seeds from their production. In November 1993 to October 1994, the field extensionists motivated 668 farmers to preserve at least one type of vegetable seed for the next year's cultivation. Ten field extensionists provided lessons to 480 women partners on vegetable seed preservation techniques. The vegetable seeds stored are red amaranth, palong shak, puishak, yard long bean, okra, bitter gourd, snake gourd, and sponge gourd.

4. **Vegetable garden lessons.** The HRDP provides vegetable cultivation lessons to its group members for them to become profitable in vegetable cultivation at their homesteads. In November 1993 to October 1994, a series of three winter and summer season garden lessons were provided for 12 male and 27 female groups. The information provided through

lessons and practical demonstrations focused on compost making, seedbed preparation, sowing of seed, transplanting and management of seedlings, and seed storage.

5. **Compost making and its use.** Realizing that compost is an excellent source of homemade fertilizer, the program continuously encourage its partners to make and use compost in their vegetable plots. There were 443 partners who adopted compost for the first time in November 1993 to October 1994.

6. **Making more lands suitable for vegetable cultivation.** As vegetables give higher return than any other field crops, we encouraged the farmers to use land which is suitable for year-round vegetable cultivation. In November 1993 to October, 19,4 97 partners cultivated a total of 1.4 ha of land suitable for year-round vegetable production.

7. **Availability of sprayers and pesticides.** The FFDP continues to work with dealers to make pesticides and sprayers available in the working areas.

8. **Keeping the environment free from pollution.** The program encourages its partners to use nonchemical pesticides. In November 1993 to October 1994, partners used nonchemical pesticides in 213 vegetable projects.

9. **Relay and intercrop.** The program continues to motivate farmers to relay and intercrop some vegetables. While both of these methods refer to the planting of different crops on the same land, in the relay technique, one crop is established earlier than the other.

10. **Multiple planting dates.** We encourage partners to vary vegetable planting dates to diversify yield and reduce market risks. Partners who plant vegetables early, get a higher price than that which prevails later, when the market is flooded.

11. **Planting different crops and varieties.** We motivated our partners to plant different crops and varieties to reduce weather-related risks.

12. **Technical assistance to other NGOs.** Currently, six experienced field staff from MCC are directly working with 14 NGOs to strengthen their vegetable and other agricultural activities with farmers. The MCC field staff are sharing their agricultural experience in Noakhali with the field staff to the NGOs and the farmers they are working with. In addition, the MCC research component is also conducting some field trials on vegetables and other crops to address their location-specific problems.

13. **Vegetable research activities.** In order to deal with the location specific problems of the farmers, the agriculture program has developed a vegetable research component. This focuses on screening appropriate and new varieties for the saline char areas, and generating low cost technologies for successfully growing vegetables in saline soils. We conduct both station trials under MCC management at our research station and on-farm trials with our farmers. We also conduct collaborative research with Bangladesh Agricultural Research Institute, Bangladesh Agricultural University and with international research institutes like AVRDC in Taiwan.

Table 2. Vegetable seed sales (kg) in November 1993 to October 1994

Vegetable	Variety	FFDP	PARE	HRDP	Total
Bitter gourd	Local	12.930	4.06	0.820	17.81
Black chili	Local	0.002	-	2.210	2.21
Borboti	Korea	0.280	-	0.190	0.47
Borboti	K.N.	39.100	11.00	0.060	50.21
Borboti	Manan Nager	0.280	-	-	0.28
Bottle gourd	Local	0.020	-	-	0.20
Cabbage	K.K. Cross	0.470	0.35	0.108	0.93
Cabbage	Atlas-70	0.852	1.32	0.152	2.33
Cauliflower	ESB	2.440	0.59	0.090	3.12
Cauliflower	N.B. Big Top	1.240	0.07	0.060	1.37
Cauliflower	Snow Crown	0.100	-	-	0.10
Carrot	N.K.	2.045	0.69	0.350	3.09
Country bean	Bata	24.960	6.00	0.60	31.02
Cucumber	Local	5.340	0.67	2.570	8.58
Cucumber (Khira)	Local	1.750	-	-	1.75
Data sak	Local	1.540	0.70	1.540	3.78
Eggplant	Islampuri	0.620	0.05	-	0.67
Eggplant	Bolanath	0.320	0.04	-	0.36
Irri Morich	Local	0.510	-	-	0.51
Jute sak	Local	0.020	-	-	0.02
Kangkong	Gima	11.670	1.44	-	13.11
Kohlrabi	W.B.	1.090	0.55	0.120	1.76
Lal sak	Local	17.130	3.10	2.450	22.68
Okra	P.S.	62.100	30.70	3.450	96.33
Palong sak	Local	4.050	9.54	2.730	16.32
Puisak	Local	13.670	2.95	9.050	25.67
Radish	M. Early	16.910	6.40	1.970	25.28
Ridge gourd	Local	4.390	0.26	0.960	5.61
Snake gourd	Local	18.140	2.30	7.470	27.91
Sweet pea	Green Feast	0.630	-	-	0.63
Sweet pumpkin (R)	Local	3.180	0.65	-	3.83
Sweet pumpkin (W)	Local	4.880	2.27	0.010	7.16
Til data sak	Local	1.960	0.42	-	2.38
Tomato	R.V.F.	3.714	0.72	0.276	4.71
Tomato	Ratan	1.192	0.23	-	1.41
Tomato	Manik	0.026	0.14	0.004	0.17
Tomato	Marglobe	1.160	1.18	0.330	2.67
Turnip	P.T.W.G.	0.240	0.04	2.480	2.76
Watermelon	Glory	0.830	0.01	-	0.84

Constraints to vegetable extension in Noakhali Char areas

Though MCC has long been successful in extending vegetable cultivation in greater Noakhali and Comilla areas, it encounters a number of specific problems in Noakhali char areas. The following are some of the major constraints:

1. Lack of available highland for growing vegetables.
2. Lands do not dry up immediately at the end of rainy season resulting to non-cultivation of early winter vegetables which command higher market price .
3. Scarcity of water during winter and summer seasons (including drinking water).
4. Most of the char lands are saline, which hampers successful vegetable cultivation. During dry season, where there is a heavy accumulation of salt, vegetables could hardly be grown.
5. Lack of good vegetable marketing facility which often compels farmers to sell their produce at a lower price.

MCC agribusiness project: New Life Seeds

MCC has started a small agribusiness project to ensure a stable and sustainable seed supply for soybean called the New Life Seed (NLS) aimed at sustainable and independent business. NLS has been buying and selling soybean seeds for three years. This year, it has functioned semi-independently from MCC.

Certified seed is produced through contract growing system. Breeder's seed is produced on MCC research sites. Breeder's seed is produced in a highly selective way under the supervision of research staff. Diseased and visibly off-type plants are rouged several times during the growing season, and insect control is done as needed. This seed is sold on a contract basis to a very limited group of farmers. These farmers produce foundation seed under the supervision and assistance of trained extensionists. All foundation seed is purchased and sold by contract to a slightly larger group of farmers. These farmers are also assisted by trained extensionists for insect and disease control and for rouging. The production of this crop is considered certified first generation seed. Certified first and second generation seeds are the only seed marketed as certified by NLS.

Seed is produced both in the summer and winter growing seasons. Seed produced in winter is stored in a climate-controlled warehouse with low levels of humidity and temperature. This seed is monitored throughout the storage period for seed moisture, seed vigor, and germination.

All sales and purchases are done through a network of local, main, and sub-dealers. Some marketing is also done through NGOs which have a soybean component to their agriculture program. This allows NLS to function with a limited staff and ensures the sustainability of the seed supply system.

Seed is marketed in 5 kg bags, along with the correct amount of inoculant. Five kilograms is sufficient for twenty decimals (1 acre = 100 decimals) which is a convenient amount for many small farmers in the soybean-growing areas. All seed is marked with a certification tag which lists the variety, seed class, and germination level.

Although NLS has yet to turn a profit, the signs are encouraging that it will be successful. For the past two years it has come close to breaking even. The major problems facing this business are related to the volatile nature of soybean cultivation in Bangladesh. It is still a relatively uncommon crop, and acreage from year to year tends to fluctuate broadly. This makes it difficult to predict seed demand for the coming seasons. Demand fluctuations also drive a high price of seed discouraging potential buyers. NLS is being encouraged to diversify its product base. Last year, limited amount of mungbean and groundnut seed were stored and marketed with some success. In the future, they will venture on vegetables, sunflowers , and other types of seeds. NLS

also faces competition from farmer-stored seed. Farmers are becoming more proficient at storing their own seed and prefer to do this rather than buying seed each year.

Conclusion

For the last 25 years MCC has been successful in creating awareness among poor farmers of the greater Noakhali areas for growing more vegetable and having more nutrition and additional income. Now, MCC agricultural programs continue vegetable extension activities in remote saline char areas where both seed availability and marketing of the produce is a big problem. The programs will continue to deal with those problems ahead aimed at providing farmers with a sustainable good quality seed source and a good marketing facility.

References

MCC. 1993. Agriculture Program. Report No. 20. Mennonite Central Committee, Bangladesh.

MCC. 1994. Agriculture Program. Report No. 21. Mennonite Central Committee, Bangladesh.

Strategies to Promote Vegetable Agribusiness

M. Enamul Hoque

Director, Training Wing, DAE, Kamarbari, Dhaka, Bangladesh

Abstract

The need to strengthen vegetable production has been emphasized to overcome malnutrition and bring about much needed income for the people of Bangladesh. In the early 1960s productive agricultural programs were implemented to achieve self-sufficiency in food grain. Vegetable production however was given the least of priorities. But when vegetables were recognized as the cheapest sources of vitamins and minerals with bigger returns compared to other crops, various programs have been made to increase its production. The Department of Agricultural Extension has packaged strategies to promote vegetable production involving farmers of all categories. These include farm demonstrations, trainings, farmers field days, district and thana fairs, and introduction of integrated pest management.

Introduction

"Food first" has been the policy of Bangladesh for a long time. Several planned steps in extension activities have been made to achieve this objective. The country is now almost self-sufficient in food grains.

People in general is accustomed with a dietary habit dominated largely by rice and wheat. As such, relatively less emphasis has been given to produce crops like vegetables having much more nutritional and economic values than cereals. Thus, the routinary diet of majority of the people is unbalanced.

Vegetables play an important role in the human diet. It provides energy and vital protective nutrients like minerals and vitamins. Comparatively, vegetables are one of the cheapest sources of natural nutritive foods. Vegetable cultivation is more profitable than any field crops (rice, wheat, pulses, oil seeds). It is highly income generating if cultivated around urban areas where good market facility prevails. Vegetables are labor-intensive crops. Hence, it gives more employment opportunities specially for the women.

In the recent years, the importance of producing and consuming vegetables to maintain good health and other economic benefits is being realized by the Bangladeshi as a result of continuous motivational activities.

In 1973-74 to 1992-93 vegetable crop areas increased from 1.88 lakh ha to 5.70 lakh ha (1 lakh = 100,000). The production was increased from 14.09 lakh t to 25.92 lakh t during the aforesaid

period. The rate of annual increment was around 0.16 kg/ha only which was very negligible.

Twenty years ago, vegetable areas and production in Taiwan were almost the same as our country. But after 20 years Taiwan produces enough vegetables to meet the local demand and also export appreciable quantities for earning foreign exchange.

Immediate attention should be given to formulate necessary programs to improve the neglected but very promising sector of vegetable crop production.

Extension Mechanism

In the early 60s a viable and productive agricultural program leading to self- sufficiency in food grain was developed in the country. To make the program a success several steps and planned efforts were made. As a result, the country almost achieved self sufficiency in cereals. Very little extension mechanism was developed to popularize vegetable cultivation in the cereal- based cropping pattern. Aware of the scenario the following steps were made to promote vegetable cultivation:

Horticulture Development Board

Realizing the importance of horticultural crops to overcome malnutrition and to explore its economic benefit, the Horticulture Development Board (HDB) was created in 1972-73. The board continued its function for ten years from 1972 to 1982. Earlier, vegetables were almost considered as poor man's diet. Commercial cultivation and marketing of vegetables at that time were very inadequate. In this unfavorable trend HDB rendered special extension services to the people to popularize production and consumption of vegetables. To create awareness, mass media campaign were undertaken. The growers were also provided with inputs (seeds, seedlings) and information by organizing regular training programs. Some NGOs (UNICEF, RDRS, etc.) also played an active role to popularize vegetable cultivation.

Previously, vegetable crops were mostly cultivated in homestead areas, commercial cultivation for domestic and export markets were not significant.

To render the unified extension service, the Department of Agricultural Extension (DAE) was created and the HDB was merged with it. This system created wider opportunities to popularize the horticultural crops all over the country. But the specific activities and special thrust were diluted in the new extension mechanism.

Homestead vegetable production program

Growing vegetables in a home garden both for consumption and family income is a unique example for agricultural growth which can be done functionally even by the landless.

AVRDC first introduced its home garden techniques in Thailand and subsequently extended it to Indonesia and the Philippines. Vegetables and a few fruits were planted in 4 x 4.5 m sized plots consisting of three beds (4 x 1.5 m) per plot. From this area average harvest was about 1.0 kg per day. This production appeared to be enough for a family of five members.

BARI has also undertaken similar experiment and harvested 200 kg of vegetables out of 6 x 6 m plots, which fulfilled the total requirement of a 7- member family. BARI subsequently transferred the home gardening technology to increase production and consumption as well as to earn extra income out of small unit. Accordingly, the Department of Agricultural Extension has undertaken home garden vegetable production program for the landless and marginal farmers' homesteads

in 20 thanas of 13 districts in the first year and extended to 70 thanas of 42 districts. This homestead program covered 471 villages of 337 thanas in the country. The program was evaluated and the results appeared to be very encouraging for securing nutritious food in a reasonable amount.

Multicrop Demonstration Program (MDP)

This program was undertaken in 1989 and continued for two years. It aimed at promoting the production of short-term fruits and promising vegetables like teasle gourd in different parts of the country. The program was implemented in 103 thanas all over the country funded by BARC (PL-480). The main beneficiaries were marginal and small farmers.

Homestead program for the cluster villages

This was a seasonal program implemented by DAE which covered 471 villages in 337 thanas of 61 districts. The project aimed at motivating household families to grow vegetables, fruits, raise poultry, and undertake different nonagricultural economic activities around their small surroundings. Although this program was implemented out of special arrangement, it was very successful in rehabilitating and creating awareness for production and consumption of vegetables.

Ongoing DAE Programs in Promoting Vegetable Crops

Homestead production program

Under ASSP, three components namely (2) technology transfer; (2) training; and (3) homestead production program were implemented by DAE.

One of the important areas of the homestead component is to encourage the household members for more production and consumption of vegetables. As per project concept, this component needs to be implemented by DAE in collaboration with NGOs. Due to some complications this component is now directly implemented by the Ministry of Agriculture (MOA).

However, to fulfill the present need in promoting vegetable crops, DAE is taking necessary steps out of financial assistance of technology transfer component. During the first two years, about 10,000 crop demonstrations were set and about 20,000 field days were organized in order to motivate and encourage the vegetable growers to use appropriate technology.

Homestead garden under CDP

The objective of the homestead gardening project of the Crop Demonstration Program (CDP) is to meet the demand of family nutrition through growing vegetables on unutilized spaces of homesteads. It is possible to grow year-round vegetables and fruits in homesteads to meet the demand of five to six-member farm family. An important aspect on the implementation of this program is the involvement of women, landless, and marginal farmers.

From 1993-95, this program involved 60 districts and 168 thanas. Farmers' field days and demonstrations conducted totalled 2,037 and 1,402, respectively.

DAE horticulture development project for vegetable crops

The objective of the Horticulture Development Project (HDP) is to develop human resources in the field of horticulture as well as to develop the infrastructure of the Horticulture Centers in order to produce better quality of vegetable seeds and other horticultural planting materials.

To fulfill the objective of the project, HDP and DAE started training subject matter specialists, subject matter officers, horticulturists, and assistant horticulturists. They will serve as trainers in the areas of vegetable, spices and fruit production, and propagation of fruits and vegetables. In the meantime, the project provided hands-on training on vegetable and spice production technology and fruit production to the farmers at the project areas as well as group members of several NGOs

Group methods of extension has been adopted for effective horticulture extension service. Result demonstrations of homestead vegetable cultivation model were also established following the modified "Kalikapur Model." Field days and competition among the vegetable producers are regularly organized by the HDTC's.

The program has created enthusiasm among the marginal farmers at the project site where the participation of women are about 50%. But the scope of the project is very limited. In order to address the nutrition and food of the country, the project area should be extended to 64 districts. About 4 tons of vegetable seeds and 20 million tons of vegetable seedling were distributed to the vegetable growers each year through DAE Horticulture Centers all over the country.

Mushroom cultivation project

This project was initiated in 1978-79 by the then Horticulture Development Board. A mushroom center at Savar was established in 1981 with financial assistance from Japan International Cooperation Agency (JICA). From that period, JOCV and JICA experts worked at the center to popularize mushroom cultivation in the country. About 7,000 mushroom growers and private entrepreneurs were trained on mushroom cultivation. They were facilitated with technology and mushroom spawn. A subcenter was also established at Rangamati, where, about 700,000 people were accustomed to consume mushroom from natural sources.

Until now, spawns are supplied to the growers. No entrepreneur has established an independent mushroom industry. DAE could not also develop bigger project to support the growers and industry for marketing their product.

Initially, the project can only grow mushroom in the summer season. Now, the center can supply quality spawn for year-round mushroom cultivation.

Domestic consumption of mushroom is limited. It bears wide export possibility. Common mushroom growers have difficulty in marketing their produce as the Bangladeshi are not used to eat mushrooms and export potentials were not being explored to solve the problem.

IPM program

DAE has recently taken up Integrated Pest Management (IPM) program for vegetable growers to ensure safe environment and save the consumers from health hazards. Motivational activities, massive training program, mass media campaign etc. are continued to create awareness among the vegetable producers.

Household food security through home gardening

This subproject under the BINP was approved on January 1995 aimed at reducing malnutrition in Bangladesh. It is in its preliminary stage of implementation. It envisions to reduce micronutrient deficiencies (i. e. vitamin A and iron) among women of reproductive age and children aged less than five years through increased production and consumption of different vegetables and promoting healthy food habit. Emphasis will be given to bring a sustainable behavioral change in food intake pattern and cooking practices. The project also expects to improve economic status

of the target households through their active participation in the project. The project will cover 388,880 households of 3,240 selected villages in the country.

Present Extension Strategies

Previously, even in the early 80s, the extension services were limited to mainly large and medium farmers specially those growing cereal crops. The small farmers rarely enjoyed such opportunity but the marginal and landless categories had almost no access to extension services. Thus, only a few percentage of farmers were benefited from extension services. At present, extension mechanism includes all farmers in all categories.

The following are the main strategies taken up by the DAE to promote vegetable crop production involving farmers in all categories :

1. Extension approach is introduced to a group of farmers having common interest instead of individual contact which was practiced earlier.
2. Bottom up extension approach to identify and to address the local needs and problems of the farmers effectively .
3. Demonstrations are organized to include :
    a) 50% small and marginal farmers;
    b) 30% medium and large farmers;
    c) 20% homestead vegetable gardening;
    d) 80% women for conducting homestead demonstrations; and
    e) less than 20% cereal crop demonstration.
4. Arrangements are being made to organize massive training programs for the farmers, dealers, traders and nurserymen for technology dissemination.
5. Motivational trainings through observation tour to research stations, horticultural centers, and farms of model farmers are being organized for innovative farmers.
6. Field days and chashi rallies are being organized for the farmers having common interest to exchange views.
7. District and thana fairs are being organized to create awareness, and for the farmers to exchange views and ideas on newly evolved technologies.
8. Arrangements are being made to organize farmers to cultivate vegetables without using chemical or using minimum quantity of chemicals to ensure safe environment.
9. All extension activities are being directed to encourage intake of balanced food and changing food habit to uplift nutritional status of the country.

Constraints of extension mechanism to promote vegetable crops

The soil and climate of Bangladesh are suitable for cultivation of a large number of year-round vegetables. Despite these favorable condition and demand, cultivation could not be expanded due to the following constraints.

1. Lack of appropriate technology for vegetable cultivation;

2. Insufficient trained manpower for conducting research and extension activities;
3. Inadequate training opportunities for farmers and extension workers;
4. Limited knowledge on the importance of vegetables and its requirement in the daily diet;
5. Sow development of agro-based industries;
6. Lack of storage facilities;
7. Lack of proper transportation and marketing facilities;
8. Inadequate export promotion opportunities; and
9. Unavailability of inputs at the doorsteps of the farmers in time.

Recommendations

1. Homesteads should be intensively used for vegetable production in order to alleviate malnutrition and poverty. Special programs should be undertaken on this regard all over the country. Vegetable cultivation is labor intensive, thus, it will also help solve unemployment problems in the country.
2. Food habits of the people should be diversified to decrease dependence on rice.
3. Intensify the potential of women in home gardening.
4. Formal field training may be arranged for the growers and appropriate technology may be transferred through setting demonstrations, organizing field days, and other related activities to ensure maximum vegetable production.
5. Nonformal education program on nutrition should be introduced among the people. Formal education on health and nutrition need to be introduced in all primary, secondary and madrasha educational institutes developing appropriate curriculum.
6. Timely supply of quality seeds, seedlings of improve variety and other inputs like fertilizers, pesticides, etc. for home gardening. Supplies may be obtained free of charge as incentive to the landless or poor farmers at the nearest village point.
7. Maximum export market should be explored on quality vegetables grown in the country for foreign exchange and to encourage the growers to obtain fair price.
8. Research and development on maximization of vegetable production under different agroecological zones should be undertaken.
9. Promotion of vegetable production and its nutritional value through radio, TV, and other mass communication media.
10. To avoid poor market, housewives should be trained on vegetable processing so that they can use their knowledge especially during bountiful harvest. Processed vegetables can be used during lean period.
11. Conduct special trainings on postharvest technology and cooking tips on vegetable preparation to attract family members to eat more vegetables.
12. Conceptualize a special research program to meet the demand of exporters, growers and consumers.
13. Conceptualize a special project to popularize commercial vegetable cultivation in the field and in home garden in collaboration with BARI and DAE exploring the experience of AVRDC.

Homestead Vegetable Production

A.K.M. Amzad Hossain

Former Director, HRC, BARI

Abstract

Food habit of the people in Bangladesh had always been heavily rice-based. So, efforts were made to increase cereal production to overcome food shortage, thus, improvement of horticultural crops were neglected all the years. While 68 g vegetable was available per capita/day during 1950-51, only 24 g is available today. It adversely affected the national health. The nutrition survey in 1962-64 revealed that eye disease which is caused by vitamin A deficiency was so much prevalent that of every 500 boys under five, three to four were totally blinded. There was high mortality of children and many had retardation of growth. Subsequent nutrition survey during 1975-76 and 1981-82 had similar findings with no sign of improvement.

In a socioeconomic condition like Bangladesh, where 85% of the population live in villages and more than 50% are landless, how could they get rid of appalling nutrition related problems? The poor masses neither aware of the importance of vegetables in their daily diet nor they have the means to buy vegetables everyday. Besides, there are no daily markets in the villages. So, homestead vegetable production was conceived to solve the problem

The BARI, DAE, and nongovernment organizations (NGOs) have been working since the 1980s to produce year-round vegetables in the homestead of landless and marginal farmers in some selected areas and create awareness about the importance of vegetables in their daily diet. But their activities were not coordinated to address the problem nationwide.

It is therefore suggested that the activities of GOs and NGOs in this field should be coordinated. In the beginning, they should have selected one or more thanas in a few districts and delineate areas within each thana for each of the organizations to implement homestead vegetable production program. There should be one full time coordinator to help in the implementation of the program. A massive program like that of the erstwhile V-AID organization should be taken up for implementation during the Fifth- Five Year Plan.

Introduction

The geographical area that constitutes Bangladesh had been deficient in vegetable production for quite a long time. Even during repatriation days before 1947 the children were reported to have been suffering from vitamin and mineral deficiencies. So, the then Bengal Government started executing the green revolution program. Since the Directorate of Agriculture lacked man power to implement the program, the responsibility was given to the district administration through public representations at union level. But still, it was never implemented until high government officials visited artificial homegardens which were created just to show success of the green revolution.

After independence in 1947 the policymakers considered food shortage as being shortage of

After independence in 1947 the policymakers considered food shortage as being shortage of staple food. Shortage of fruits and vegetables were not seriously considered. All efforts were given to increase production of cereal crops which has resulted to unchanging food habit over the years. With more thrust on rice, wheat, and other crops, area under vegetables declined and turned into marginal land. As a result, while 50% of the population had malnutrition problem during 1962 to 1964 (Scheafer 1965), 90% of the population at present have been suffering from vitamin and mineral deficiencies.

It was not certainly right. Had there been equal thrust on fruits and vegetables, food intake pattern could have been changed and we could have attained self-sufficiency in food and nutrition much earlier with 300 g cereal/capita per day like Sri Lanka as against achieving food sufficiency today with 500 g cereals. It could thus fulfill the aspirations of quality life having self sufficiency in both food and nutrition which is essential for a healthy nation.

Status of Vegetable Production

There was no vegetable research and development activities before 1947 except some activities in homegarden program in selected thanas in the 1950s by V-AID organization which was closed in June, 1962. As a result while population had been increasing production of vegetables was decreasing as shown in table 1.

Status of national health. The nutrition survey data in 1962-64 (Schaefer 1965) showed that eye disease (*Keratomalacia*) which is caused by vitamin A deficiency is so much prevalent that of every 500 boys under five, three to four may succumb to or be totally blinded. Further, considerable retardation of growth between nine and 24 months of age was recorded. A total of 26% of all live born children die before their fifth birthday as against 2.4% European average.

Subsequently, another nutrition survey was made in 1975-76 (Ahmad et al. 1977) which showed vitamin A intake was extremely low (70 IU) and 89% household were deficient in vitamin A. Likewise vitamin C was extremely low (9.5 mg) and 93 % household were deficient. Subsequent surveys had similar finding with no sign of improvement yet.

Government intervention. The government was extremely concerned and came up with an idea of creating Green Belt near to or around big cities to ensure vegetable supplies to cater the need of the urban areas. Accordingly, four Agricultural Development Estates were established in Kashimpur (Dhaka), Patya (Chittagong), Jhumjhumpur (Jessore) and Pabna (Rajshahi) in 1966 aimed at providing technical know-how, training, seeds and other inputs to farmers of their respective command areas to produce vegetables and help market their produce in the cities. This proved to be a very successful project. However, there was still no program to alleviate the acute malnutrition problem of the rural masses who constituted 90% of the population. Their plight was such that tomatoes which is so widely cultivated today could not be found in any market in 1975 season in Ishurdi/Pabna area during our visit (Hossain and Hoque 1975). This neglect has resulted to night blindness to 0.8 million people and 58% of the children had growth retardation (Ahmad et al. 1977).

Table 1. Status of vegetable production and population growth in Bangladesh (tubers not included)

Year	Production ('000 t)	Year	Population growth	Per capita/day availability (g)
1950-51[a]	1,100	1951[b]	44,165,740	68
1960-61	573	1961	55,222,663	
1970-71	603	1974	76,398,000	
1983-84[b]	888	1981	89,912,000	
1990-91	992	1991	111,455,185	24

[a]*Anon. 1966. Agricultural Production Levels in East Pakistan (1947—1965). BBS, Directorate of Agriculture, East Pakistan, Dhaka,* [b]*BBS. 1993. Statistical Yearbook of Bangladesh, Statistics Division, Ministry of Planning, Bangladesh.*

Immediately after independence the Horticulture Development Board was constituted in 1973 to provide extension services to farmers' crops specially on the development of fruits and vegetables in the country. They earned quite a good name in a few years time. However, HDB was merged with the Directorate of Agriculture Extension in 1980. BADC and DAE were producing a very little quantity of vegetable seeds compared to requirement. BADC was also importing vegetable seeds for sale to the growers. Availability of quality HYV vegetables seeds was very limited which was considered to be the number one problem for implementing homestead vegetable production program by GOs and NGOs.

Homestead Vegetable Production Program

There are 15.4 million households in rural Bangladesh and 4.0 million in the municipality and metropolitan areas. Soon after achieving independence there had been great crisis of vegetables in the urban areas. Encouraged by the government, the people started growing vegetables in their homesteads. BADC arranged mobile units to supply seeds, seedlings, and other inputs to the people. Later on the Horticulture Board implemented a project to provide tiller, spray equipment, etc. on rental basis for the urban people. It was a great relief as if nation building activities started to overcome the devastation inflicted during the war of liberation. It continued for a few years quite satisfactorily and then gradually declined for lack of continued support.

Government machineries were not adequately organized to help the needy. Then, the world community through the NGOs came up with a rehabilitation program. In the beginning there were so many things to do than grow vegetables. However, in the 70s, a few NGOs included home gardening as one of the components of their activities but there was no research support.

Farming system research

In the early 1980s, the project on Farming System Research was initiated but it did not include homegarden research for fruits or vegetables. In 1984 we (with Dr. R.N. Mallik) drew up a program on homegarden vegetable production demonstration to be implemented at Kalikapur as an activity of On-farm Research Division of BARI. In the meanwhile, Jack Gershon, nutrition specialist of AVRDC visited Bangladesh with whom Dr. Kamal Uddin Ahmad and myself went to USAID to obtain funding for Homegarden Research and Demonstration Program. USAID was quite magnanimous in providing fund to implement homegarden program at Kalikapur. The implementation of the project was started by the late Dr. Md. Ashraful Islam, the then CSO, RARS, Ishurd. At the same time research to develop models for year-round vegetable production in homegardens started at BARI, Joydebpur under the leadership of Dr. S.M. Monwar Hossain,

program leader for vegetable research and Mrs. Rowshan Ara Begum. BARI recommended five patterns of year-round vegetable production in the homegarden which were subsequently fine-tuned by OFRD scientists for different AEZ regions.

Fact-finding survey for homestead vegetable production

In 1986, BARI scientists were sent to Chittagong, Jessore, Ishurdi, Rangpur, Rajshahi and Joydebpur areas to find the status of vegetable production in the homesteads and its constraints. Their reports revealed that one or more kinds of creeper vegetables like beans or some kind of gourds are mostly grown in their homesteads. But there was no massive information campaign yet for homestead gardening and the importance of vegetables in the daily diet.

The landless families were not growing vegetables. While the male head of a family goes to work, the women and the children are left with no work at all. However, they were found keen to work for homegarden. But they need technical assistance and seeds to start working. In some areas water during dry months was found to be limited for vegetable production. Water available at the nearby ponds is reserved for the cattle and not for home gardening.

There were few kinds of vegetables grown in the rural villages which cannot sustain year-round production. Technical know-how, availability of seeds, and water are the constraints for year-round vegetable production in the homestead.

Year-Round Homestead Vegetable Production Program

The government organizations and NGOs had been striving to help the landless and marginal farmers to produce year-round vegetables in their respective areas to overcome diseases related to malnutrition.

Transfer of homestead vegetable production technology by government organizations. BARI initiated technology generation on homestead vegetable production in 1985 at Kalikapur site, Ishurdi with USAID financial support. The technology was packaged for demonstration in 200 homesteads in 20 thanas of 13 districts in 1989. It was subsequently extended to 20,000 homesteads covering mostly landless and marginal farmers in 135 thanas of 54 districts in 1992-93. The evaluation team (Maniruzzaman et al. 1993) found that the program created awareness to the farmers on nutritional value of vegetables. The farmers displayed enthusiasm in production and consumption of vegetables and majority of them expressed willingness to continue homestead vegetable production even after the end of the program.

This program involves not only medium and large farmers but also marginal or landless farmers. Demonstration is no doubt a good tool for technology transfer. However, the target beneficiaries need further information to sustain the program. Further, DAE conducted massive demonstrations on homestead vegetable production technology with CDP and ASSP funding. These demonstrations proved success and made a good impact in the rural community.

Homestead vegetable production technology transfer by NGOs. Local and foreign NGOs with diverse activities have been surveying our people. It is estimated that there are about 40 NGOs involved in agricultural program. Agriculture accounts for about 15-20% of the aggregate budget of agro-oriented NGOs. However, it is found that many of the NGOs have year-round homestead vegetable production program as one of the components of their activities. Homestead vegetable production activities of some NGOs like Helen Keller International, BRAC, RDRS, CCDB, Proshika, MCC, UPAY, and UPAKAR have been creating awareness on the diseases associated with vitamin and mineral deficiency, the importance of vegetables in the daily diet and the overall benefit the farmers may accrue by growing vegetables in their homesteads. They

have convinced their group members, 50-80% of whom are female and landless, to grow year-round vegetables in their homestead involving women and children.

This program has benefited farmers, women, and children. More vegetables are consumed everyday. They even earn some cash by selling vegetables. Children are healthy and showed less signs of illness.

Vegetable Agribusiness

There are some areas where vegetables are produced commercially. Some of these areas are located in Jessore, Ishurdi, Bogra, Dumuria and Phultola of Khulna, Mirarsarai, Sitakunda, Patya and Satkania of Chittagong, Chandina of Comilla, Narsingdi, Sherpur, Tangail and Savar of Dhaka. These vegetable are sold at the markets nearby production centers which are then transported to city markets.

But less vegetables are available in the village markets throughout the country. People may not be used to buy vegetables as much as they need. It is therefore important to introduce homestead vegetable production in the villages particularly the landless people who constitutes half of the population and live through hand-to-mouth existence

Projection of vegetable production in the Fourth-Five Year Plan. According to the BBS vegetable production was 0.95 million tons in 1987-88. Homestead vegetable production does not appear to have been incorporated in it. This is proposed to be included in the Fourth-Five Year Plan since tremendous potential exists in augmenting homestead vegetable production. Projection of vegetable production as planned in the Fourth-Five Year Plan is shown in table 2.

Table 2. Projection of vegetable production in the Fourth-Five Year Plan

	Vegetable production (Million t)					
Crops	1987-88	1990-91	1991-92	1992-93	1993-94	1994-95
Vegetables (Field Production)	0.954	1.014	1.079	1.148	1.223	1.302
Vegetables (Homestead Production)	0.250	0.407	0.579	0.764	0.966	1.181
Vegetables (Field + Homestead)	1.204	1.421	1.658	1.912	2.189	2.483

Anon. 1989. A Report of CDP committee for FFYP development process, MOA, Dhaka, Bangladesh.

The projection as shown in table 2, if fully realized, the per capita/day consumption will be as shown in table 3.

Table 3. Anticipated daily per capita consumption of vegetables in the Fourth—Five Year Plan

	Daily per capita consumption (g)					
Crops	1987-88	1990-91	1991-92	1992-93	1993-94	1994-95
	(106.64)	(114.19)	(116.80)	(119.47)	(122.21)	(125.01)
1. Vegetables (Field)	24.51	24.33	25.31	26.34	27.42	28.53
2. Homestead vegetables	6.42	9.77	13.58	17.52	21.66	25.88
3. Vegetables (Field + Homestead)	30.93	34.09	38.90	43.85	49.07	54.42

Source: Anon. 1989. A report of CDP committee for FFYP development process. MOA, Dhaka.

Note: Figures in parentheses under each year represent anticipated population in million growth rate from 1990-91 to 1994-95 being assumed at 2.29% (Statistical Yearbook of Bangladesh, Published by BBS 1987. 71 p.)

If this projection is realized, per capita/day consumption of vegetables will be around 54 g at this terminal year of FFYP which will still be much below the requirement of 200 g/capita per day.

Hence, efforts are to be made for increased production of vegetables in the homestead. Homestead vegetable production should be particularly intensified among the landless and marginal farmers who could hardly buy their daily needs.

Benefit of homestead vegetable projection. The villagers can eat adequate quantity of fresh vegetables produced in their respective homestead or buy the same from their neighbors. They need not wait for the 'Hut day' (market day) to eat vegetables everyday.

The women and children can help and maximize their time fruitfully thus contributing to their family's needs. They can also earn some money by selling some of their produce. The villagers can thus be free from nutrition- related maladies.

Constraints in homestead vegetable production. Availability of quality seeds of improved high yielding varieties appears to be the major constraint. This could be arranged through federation of farmers' groups or farmers' cooperatives under the supervision of DAE officials and local public representatives.

Augmenting Homestead Vegetable Production

Both GOs and NGOs have done much in augmenting homestead vegetable production. But all these efforts could have been meaningful if a comprehensive program could be materialized for homestead vegetable production to attain sufficiency in food and better quality of life.

This could be done though a collaborative effort between the GOs and the NGOs. For a start, they should select one or more thanas of a few districts and delineate areas within each thana for each of the organizations for implementation of homestead vegetable production program. There should be one full time coordinator to help in the implementation of the program. A massive program like that of the erstwhile defunct V-AID organization may be drawn up for implementation during the Fifth-Five Year Plan.

Conclusion

Self-sufficiency in nutrition can only be achieved through a strong homestead vegetable production program. This will help increase family consumption of vegetables produced in one's own homestead. In order to improve widespread malnutrition in the country, food and nutrition should be considered as an integral part of national development activities.

References

Ahmad, K.U., Md. Nazmul Huda, and Probodh Chandra Nath. 1977. Nutrition survey of rural Bangladesh. 1975-76. Institute of Nutrition and Food Science, DU, Dhaka, Bangladesh.

Hossain, A.K.M. Amzad, and Md. Mofizul Hoque. 1975. Report on the introduction of vegetable varieties. Bangladesh Agricultural Research Council, Dhaka.

Maniruzzaman, A.F.M., Chowdhury, M.S.H., Haq, M., and Khaleque, M.A. 1993. An evaluation report on homestead vegetable production technology transfer project 1992-93. Bangladesh Agricultural Research Council, Dhaka.

Schaefer, A.E. 1965. Nutrition survey of East Pakistan. Directorate of Nutrition Survey and Research. East Pakistan Secretariat, Dhaka.

Management of Insect Pests of Vegetables

M. A. Karim

Chief, Scientific Officer and Head, Entomology Division, BARI, Joydebpur, Gazipur, Bangladesh

Abstract

The major insect and mite pests of vegetable crops in Bangladesh are the cucurbit fruitfly (*Bactrocera cucurbitae*), red pumpkin beetle (*Aulacophora foevicollis*), Epilachna beetles (*Epilachna vigintioctopunctata* and *E. duodecastigma*), diamondback moth (*Plutella xylostella*), greasy cutworm (*Agrotisipsilon*), prodenia caterpillar (*Spodoptera litura*), the brinjal shoot and fruit borer (*Leucinodes orbonalis*), aphids of cruciferous and solanaceous crops (*Lipaphis erysimi, Aphis gossypii* and *Myzus persicae*), the thrips (*Thrips tabaci, T. palmi* and *Scirtothrips dorsalis*), shoot and fruit borer of okra (*Earias vittlella*), whitefly (*Bemisia tabaci*), cotton jassid (*Amrasca devastans*), hyacinth bean aphid (*Aphis craccivora*), hyacinth bean flower and pod borers (*Maruca testulalis* and *Helicoverpa armigera*) and red mites (*Tetranychus* spp.). Effective management of these pests are essential for profitable production of vegetable crops.

The constant use of synthetic chemical pesticides has resulted to insecticide resistance in insect and mite pests, increased infestations due to the destruction of natural enemies of the pest species, increased costs of pesticides, high pesticide residues in crops, and other ecological imbalances. Checking of crop fields at short intervals; collection and destruction of infested plant parts; spot-spraying of only infested plants or plant parts at the right time with the most effective chemical pesticide; identification and conservation of the natural enemies of insect and mite pests; and alternative methods of pest control by using less toxic or safer products and methods have been suggested for the effective management of the pests and profitable production of vegetable crops. Known techniques and others known to be followed in other developing countries are described in this paper for the management of insect pests of vegetable crops with minimum disruptive effects on the environment.

Introduction

All components for the integrated management of vegetable insect and mite pests have not been developed yet in Bangladesh because of the limitations of research entomologists and lack of financial support. Insecticides are mostly being used by the farmers for the control of vegetable insect and mite pests at dosages and number of applications determined by the farmers themselves. A recent survey of 250 farmers in Jessore district showed 2-150, 1-45, 2- 90, 3-90 and 3-60 applications of insecticides per crop per season for brinjal, cabbage, cauliflower, hyacinth bean and bitter gourd respectively (Kabir et al. 1994). About 7,000 t of insecticides was used in Bangladesh in 1993.

Insect pest management of vegetable crops for better environment is still in its infant stage. It is believed that the increased utilization of synthetic insecticides has lead to a number of problems such as development of resistance to insecticides in some insect pests, high insecticide residues in produce, increased infestations due to the destruction of natural predators and parasitoids changing pest status of mites and other minor insect pests, ecological imbalance, and danger to

pesticide applicators. These adverse effects call for immediate attention for the testing and adoption of insect pest management techniques which are economically, ecologically and sociologically acceptable and sustainable for the poor farmers in Bangladesh.

Insect pests

Cucurbit fruitfly

As repeated spray applications of insecticides at short intervals are necessary for the control of fruitflies in cucurbits crop fields, such spray applications are not advocated because of toxic insecticide residues on crops and adverse effects on insect pollinators and natural enemies of insect pests. The following control measures should be followed:

1. Collect and destroy all infested fruits by burying them in one- meter deep (or more) in the soil. This will help reduce its population.

2. A bait of 100 g uncooked mash of sweet gourd, cucumber, squash or any suitable baits mixed with 0.5 g Dipteryx 80 SP or 12 drops of dichlorvos 100 EC and 100 ml water, are effective to kill both sexes of the adult fruitflies and to reduce the fruitfly infestation in crops up to 78% (Nasiruddin and Karim 1992). Place the bait in earthen pots and set at the field on raised bamboo support at 10 m intervals. Change used baits within 2-3 days with freshly prepared baits to attract increased number of fruitflies.

3. A protein hydrolysate bait spray mixed with 20 g or 20 ml protein hydrolysate in one liter of water with 10 g (a. i.) malathion (=18 ml Malathion 57 EC) has been found to be very effective in controlling fruitflies in other countries when the bait mixture is applied as a spot spray on the crop foliage in a grid of 10-15 m between spots and 100 ml bait mixture per spot (Drew et al. 1978). Apply the bait spray to the adult fruit flies. Repeat bait spray application at 7—day intervals. Any amount of rainfall will reduce the efficacy of the bait spray.

Red pumpkin beetle

1. Collect and destroy the pumpkin beetle adults using a sweeping net.

2. Spraying of contact insecticides like isoprocarb (Mipcin) 75 WP, carbaryl (Sevin) 85 WP, or fenitrothion (Sumithion) 50 EC at 2.0 g (or ml) per liter of water has been found effective in controlling the pumpkin beetles. But repeated applications at seven-day interval are necessary (Anonymous. 1991-92). Weekly spray applications of the aqueous extract of neem kernel powder (25-50 g/liter of water) can be tested for pest control.

3. Control soil larvae, by applying 1.0-2.0 kg a. i. per ha of diazinon (=10-20 kg Basudin 10 G) or carbofuran (=20-40 kg Furadan 5 G) directly to the soil followed by light irrigation. If crops are grown in raised beds, irrigate the furrows to control the larvae and pupae of the pest in the soil without application of any insecticide.

4. The use of ashes on the leaves has not been found to be effective for controlling the pest (Anonymous. 1991-92).

Epilachna beetles

1. Handpick and destroy eggs, larvae, and adults from the infested leaves soon after detection.

2. At higher infestations, spray the crops with dichlorovos (Nogos) 100 EC at the rate of 1.0—2.0 ml/l of water.

3. Spraying of the aqueous extract of the neem seed kernel powder (25-50 g/l of water) has been found effective against this pest (Stoll 1992).

Diamondback moth

The diamondback moth has been found resistant to almost all insecticides, *Bacillus thuringiensis*, and the insect growth regulators (acylureas) in many countries of the world due to their excessive uses (Sun et al. 1986; Hama 1987; Perng et al. 1988; Tabashnik et al. 1990; Talekar 1990; Kobayashi et al. 1992). In Bangladesh, the diamondback moth is still a minor pest in poor farmers' cabbage and other cruciferous crop fields, but it has become a major pest in the cabbage and some radish crop fields of the BADC farms, seed growers' farms and farms of big farmers. The following control measures should be followed:

1. Spray alpha-cypermethrin (Fastac 2 EC) or cypermethrin (Ripcord/Fenom 10 EC and others) or deltamethrin (Decis 2.5 EC) or esfenvalerate (Sumi Alpha 5 EC) or cyfluthrin (Bethroid 050 EC) on infested plants (with larvae, pupae or adults) at the rate of 1.0 ml per liter of water. Avoid repeated applications of the above insecticides.

2. In areas with severe infestations of the diamondback moth, commercial formulations of *B. thuringiensis* and insect growth regulators should be tested by the research entomologists for their efficacy in controlling the pest. These products are safe for the natural enemies of the pest, environment, and the consumers.

3. Weekly spray applications of the aqueous extracts of the neem seed kernel powder (25-50 g/l of water) has been found to be effective against the diamondback moth in cabbage fields (Dreyer 1986; Schmutterer 1992).

4. Natural parasitoids of the diamondback moth have been observed in some cabbage crop fields in Bangladesh. They can probably suppress the diamondback moth infestations in small farmers' crop fields where chemical insecticides are not used. The Entomology Division of Bangladesh Agricultural Research Institute is trying to introduce some parasitoids of the diamondback moth from Taiwan for artificial rearing and testing of their efficacies in Bangladesh.

Greasy cutworm

1. Irrigate the field to destroy cutworm larvae hidden in the soil. Birds generally feed on the exposed larvae in irrigated crop fields.

2. Place a poison bait mixed with 100 kg rice or wheat bran with 2.0 kg carbaryl (Sevin) 85 WP or cartap hydrochloride (Padan) 50 SP and sufficient water (to make a non-sticky mixture) per ha around the plant bases at the seedling stage of the crop late in the afternoon (Anonymous. 1991-1992).

3. Spray chlorpyriphos (Dursban 50 EC) in the soil around the base of the seedlings of the cutworm-damaged winter vegetables at the rate of 2.5-3.0 ml/l of water.

4. Traps baited with molasses and vinegar are used in China for mass-trapping of the cutworm moths (Matthews 1991).

Prodenia caterpillar

1. Check undersides of cabbage leaves, cauliflower, tomato, potato, and colocasia to detect early instar caterpillars of the pest in the aggregated condition. Eliminate aggregated caterpillars along with the infested leaves by spraying dichlorvos or other contact insecticides.

2. The prodenia caterpillars have also developed resistance to insecticides in some countries due to its excessive use.

3. The microbial pesticide, *B. thuringiensis*, and the insect growth regulators have been found to be effective against this pest.

4. The aqueous extract of the neem seed kernel powder (25-50 g/l of water) has been reported to be effective against the larval and pupal stages of the pest (Stoll 1992).

Shoot and fruit borers of brinjal and okra

The effective control of the shoot and fruit borers of brinjal and okra by methods other than chemical insecticides has not been found yet. Application of chemical insecticides at weekly (sometimes one day) interval has been practiced by the farmers.

1. Weekly application of alpha-cypermethrin (Fastac 2 EC) or cypermethrin (Ripcord/Fenom 10 EC and others) or deltamethrin (Decis 2.5 EC) or esfenvalerate (Sumi Alpha 5 EC) or cyfluthrin (Bethroid 050 EC) at the rate of 1.0 ml/l of water is found necessary for the effective control of the brinjal shoot and fruit borer. The shoot and fruit borer of okra can be controlled by these insecticides and their recommended application rates. It is suspected that these pests have developed resistance to insecticides in most places of Bangladesh.

2. Use of pheromone traps for monitoring adult insects for timing of insecticide applications and weekly application of aqueous extract of the neem seed kernel powder can be tested for controlling the pest.

Aphids

1. Spray a liquid detergent with water to infested vegetable crops (25 ml detergent/l of water).

2. Spray the underside of infested leaves with a mixture of fine white flour and water (2 cups flour in 5-10 l of water) at weekly intervals (Van der Werf 1985; Stoll 1992).

3. Most standardized insecticides in Bangladesh have been found to be effective against aphids. Pirimicarb (Pirimor 50 DP) at the rate of 1.0-2.0 g /l of water is very effective against the aphids. It is safe or less toxic to the honey bees, other insect pollinators and parasitoids and predators of aphids and other insect pests.

Thrips

1. As thrips pupate in the soil (Sastrosiwojo 1991), irrigate thrip-infested crop fields to help reduce its population.

2. Use black plastic mulch to suppress the population of thrips on chilies (Sastrosiwojo 1991).

3. Spray the plants with dimethoate (Perfekthion/Roxion or others) at the rate of 2.0 ml/l of water. Thrips are also known to have developed resistance to insecticides in many Southeast Asian countries, so repeated use of insecticides for its control should be avoided (Bernardo 1991).

4. Spray liquid detergent with water at the rate specified for aphid control and the aqueous extract of the neem seed kernel powder at weekly intervals (Stoll 1992).

Whitefly and cotton jassid

1. Whitefly populations can be reduced considerably by using 20 x 30 cm yellow-orange-painted boards coated with mobile oil or other sticky substances (Stoll 1992).

2. Spray the undersides of infested leaves with some systemic insecticides (dimethoate, monocrotophos, phosphamidon etc.). The whitefly is also capable of developing resistance to insecticides very rapidly.

3. CIBA-GEIGY has developed a novel chemical (CGA 215'944) which is selectively effective against homopterous insects and especially against the whiteflies with very low level of mammalian toxicity (Fluckiger et al. 1992).

Hyacinth bean flower and pod borers

1. Spraying with insecticides is the only method known for the control of the pests. Starting from flowering, fortnightly application of alpha-cypermethrin (Fastac 2 EC) or cypermethrin (Ripcord/Fenom 10 EC and others) or deltamethrin (Decis 2.5 EC) or esfenvalerate (Sumi Alpha 5 EC) or cyfluthrin (Bethroid 050 EC) at the rate of 1.0 ml/l of water may be helpful for the control of the pests.

2. Weekly spray applications of the microbial pesticide, *B. thuringiensis*, and the aqueous extract of neem seed kernel powder (25-50 g neem kernel powder/l of water), starting from flowering, should be tested for their efficacy in controlling the hyacinth bean flower and pod borers.

Red mites

The red mites can be serious pests of colocassia, cucurbitaceous crops, and brinjal, especially when the synthetic pyrethroid and other insecticides with high activity as a contact poison are used in these crops for controlling other insect pests.

1. Control aphids and red mites by spraying the underside of infested leaves with a mixture of white flour and water (two cups flour in 5-10 l of water) at weekly intervals during a sunny weather (Van der Werf 1985; Stoll 1992).

2. Spray acaricides, namely wettable sulphur, Kelthane, Neoron, and Torque (2.0 ml or g/liter of water) on the underside of the mite-infested leaves. Among the synthetic pyrethroids, Danitol 10 EC and Talstar 2 EC (1.0 ml/l of water) are also effective against the red mites.

Insect pest control measures through cultural methods like shifting dates of planting and harvest, balanced applications of fertilizers and irrigation water, destruction of crop residues and alternate hosts, crop rotations, etc. should be practiced for the management of vegetable insect pests. Use of resistant varieties against insect pests is still controversial because of the absence of proper data base and commercially cultivable resistant varieties. Conservation of spiders, coccinellid predators, syrphid flies and hymenopterous parasitoids of vegetable insect pests should be done by not applying chemical insecticides when they are present. Researches on the uses of insect pathogens, parasitoids, predators, sexpheromones, and botanical pesticides should be encouraged. Introduction of some exotic parasitoids and insect pathogens of some of the most important insect pests of vegetable crops and their mass rearing facilities should be financially supported.

Conclusion

The farmers seem to prefer ready made pesticides rather than tedious procedures necessary for the use of natural plant products. Insecticidal plant products are required to be applied at a very high rate per unit area per application (25 to 50 kg of dry neem seed kernel/ha/application), and they are readily degradable in the sunlight (due to ultraviolet ray) within seven days. It may therefore be impractical to get sufficient quantities of plant materials for effective control of vegetable insect pests.

Synthetic pesticides have become synonymous with modern agriculture, and they provide the most effective means of controlling the pests inspite of their harmful effects on the environment. It is impossible to increase food and vegetable production in the challenging twenty-first century without using chemical pesticides along with other inputs. As our knowledge and understanding of the interactions of chemicals with living organisms become more complete, newer pesticide chemicals should be carefully developed to save friendly insects/organisms and the environment. Such chemicals will be more expensive as the development costs continue to escalate, but we have to pay that price for the sake of our survival.

References

Anonymous. 1991-92. Annual report, 1991-92. Division of Entomology, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. (Unpublished).

Bernardo, E. N. 1991. Thrips on vegetable crops in the Philippines. In : Talekar N. S. (ed.). Thrips in Southeast Asia. Proceedings of a regional consultation workshop. Bangkok, Thailand, 13 March 1991. Asian Vegetable Research and Development Center. Publication No. 91-342. pp. 5-11.

Drew, R. A. I., Hooper, G. H. S., and Bateman, M. A. 1978. Economic Fruitflies of the South Pacific Region. Department of Primary Industries, Indooroopilly, Queensland. 137 p.

Dreyer, M. 1986. Field and laboratory trials with simple neem products as protestant against pests of vegetables and field crops in Togo. Proc. 3rd Int. neem conf. Naorobi, Kenya, 1986. pp. 431-447.

Fluckiger, C. R., Kristinsson, H., Senn, R., Rindlisbacher, A., Buholzer, H., and Voss, G. 1992. CGA 215'944. A novel agent to control aphids and whiteflies. Brighton crop protection conference pests and diseases 1992, 1: (in press).

Hama, H. 1987. Development of pyrethroid resistance in the diamondback moth, *Plutella xylostella* Linne (Lepidoptera: Yponomeutidae). Appl. Entomol. Zool. 22: 166-175.

Matthews, G. A. 1991. Cotton growing and IPM in China and Egypt. Crop protection, 10(2): 83-84.

Mehta, D. N., and Lall, B. S. 1981. Comparative susceptibility of different brinjal cultivars against brinjal fruit and shoot borer. Indian J. Ent. 43(1) : 108-109.

Mote, U. N. 1981. Varietal resistance in eggplant to *Leucinodes orbonalis* Gnee. I. Screening under field conditions. Indian J. Ent. 43(1) : 112

Kabir, K. H., Baksh, M. E., Rouf, F. M. A., Mondal, N. A., Hossain, M. A., Satter, M. A., Asaduzzaman, M. S. M., and Karim, M. A. 1994. Insecticide usage pattern on vegetables at

farmers' level of Jessore region. A survey report. Unpublished report of the Entomology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. 20 p. (mimeo.).

Kobayashi, S., Aida, S., Konayashi, M., and Nonoshita, K. 1992. Resistance of diamondback moth to insect growth regulators. In : Talekar, N. S. (ed.). Diamondback moth and Other Crucifer Pests. Proceedings of the second international workshop. Tainan, Taiwan, 10-14 December 1990. Asian Vegetable Research and Development Center. AVRDC Publication No. 92-368. pp. 383-390.

Kawase, E., Nakagawa, T., Tasaki, S., and Mannan, M. A. 1982. Screening and selection of brinjal varieties on the basis of their performance against the shoot and fruit borer. Unpublished report of the Citrus and Vegetables Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur.

Lewis, T. 1973. Thrips: Their biology, ecology and economic importance. Academic Press, London and New York. 349 p.

Nasiruddin, M., and Karim, M. A. 1992. Evaluation of potential control measure for fruit fly, *Bactrocera* (Dacus) *cucurbitae*, in snake gourd. Bangladesh Journal of Entomology, 2(1 & 2): 31-34.

Perng, F. S. Yao, M.C. Hung, C. F., and Sun, C. N. 1988. Teflubenzuron resistance in diamondback moth (Lepidoptera: Plutellidae) J. Econ. Entomol . 81: 1277-1282.

Sastrosiswojo, S. 1991. Thrips in Vegetables in Indonesia. In: Talekar, N. S. (ed.). Thrips in South East Asia. Proceedings of a regional consultation workshop. Bangkok, Thailand, 13 March 1991. Asian Vegetable Research and Development Center. AVRDC Publication No. 91-342. pp. 12-17.

Schmutterer, H. 1992. Control of diamondback moth by application of neem extracts. In: Talekar, N. S.(ed.). Diamondback moth and other crucifer pests. Proceedings of the second international workshop. Tainan, Taiwan, 10-14 December 1990. Asian Vegetable Research and Development Center. Publication No. 92-368, pp. 325-332.

Stoll, G. 1992. Natural crop protection in the tropics. Verlag Josef Margraf Scientific Books, Muhlstr. 9, Weikersheim, FR Germany. 188 p.

Sun, C. N., Wu, T. K., Chen, J. S., and Lee, W. T. 1986. Insecticide resistance in diamondback moth. In :Talekar, N. S., and Griggs, T. D. (ed.) Diamondback moth management. Proceedings of the first international workshop. Asian Vegetable Research and Development Center. Shanhua, Taiwan, pp. 359-371.

Tabashnik, B., M. W. Finson, N., Schwartz, J. M., Caprio, M. A., and Johnson. 1992. Diamondback moth resistance to *Bacillus thuringiensis* in Hawaii. In : Talekar, T. S. (ed.). Diamondback moth and other crucifer pests. Proceedings of the second international workshop. Tainan, Taiwan, 10-14 December 1990. Asian Vegetable Research and Development Center. AVRDC Publication No. 92-368. pp. 175-183.

Talekar, N. S. 1990. Development of an integrated pest management program for the control of diamondback moth on cruciferous vegetables. In : Opena. R. T., and Kyomo, M. L. (ed.). Vegetable Research and Development in SADCC Countries. Proceedings of a workshop held at Arusha, Tanzania, 9-13 July, 1990. Asian Vegetable Research and Development Center. AVRDC Publication No. 90-328. pp. 147-157.

Van der Werf, E. 1985. Pest management in ecological agriculture. AME Foundation, Groenekan, Holland.

Status of Common Fruit Vegetables in Bangladesh

Abul Quasem and S.K. Saha

Horticulture Research Center, BARI, Bangladesh

Abstract

Vegetables from fruit trees at different stages of fruit development are termed as fruit vegetables. Two identified major fruit vegetables were green Papaya (*Carica papaya)* and Plantain (*Musa* spp.). Fourteen were identified as minor fruit vegetables namely: tender/young Jack fruit (*Artocarpus heterophyllus*), Green mango (*Mangifera indica*), Satkara (*Citrus macroptera*), Indian olive (*Eleocarpus floribundus*), Bilimbi (*Averrhoa bilimbi*), Chalta (*Dillenia indica*), Otaheite apple (*Spondias dulcis*), Watermelon (*Citrullus vulgaris),* Karanda (*Carissa carandas*), Fig (*Ficus carica*), Muskmelon (*Cucumis melo*), Star goose berry (*Phyllanthus acidas*), Coconut (*Cocos nucifera*) and Pineapple (*Ananas comosus*) in Bangladesh. Their nutritional values as vegetables were described. Production potentials and production constraints were focused in brief. Research areas were suggested in relation to varietal improvement, determination of commercial maturity, agronomical manipulation, identification of effective production and marketing areas, shelf life maintenance and exploring the export potentials.

Introduction

Vegetables occupy 67,411 and 104,419 ha of land during kharif (summer months from April-September) and rabi (winter months from October-March) seasons respectively with a total production of 1,089,830 t per annum excluding potato and other root crops (Anonymous. 1993). This production is much lower than our requirement. The world produces about 37 million tons of banana each year (Lahav and Turner 1993). Nearly 50% of bananas worldwide are used as cooked vegetables (Biswas et al. 1992). Bananas (plantain) are staple food in Uganda, Tanganyika, Ivory coast and South Cameroon (Simmonds. 1960, Techounguv. 1972 and Guillemot 1976).

Fruit vegetables are rich sources and comparatively cheaper sources of vitamins and minerals. It plays key roles in neutralizing the acid produced during digestion of proteins and fatty foods and provides valuable roughage which promotes digestion and helps in preventing constipation (Kale et al. 1986).

Nutritive value of some important fruit vegetables

Nutritive value of some important fruit vegetables is given in table 1. Fruit vegetables contains good amount of protein, carbohydrate, carotene, vitamins, and sufficient amount of iron. Tomato provides lesser amount of iron as compared to fruit vegetables.

Table 1. Nutritive value of some important fruit vegetables (per 100 g)

Fruit vegetable	Calories	Moisture content (%)	Carbohydrates (%)	Protein (g)	Fat (g)
Jackfruit (unripe)	51	84.0	9.4	2.6	0.3
Mango (green)	44	87.5	10.1	0.7	0.1
Muskmelon	17	95.2	3.5	0.3	0.2
Papaya (green)	27	92.0	5.7	0.7	0.2
Plantain (green)	64	83.2	14.0	1.4	0.2
Watermelon	16	95.8	3.3	0.2	0.2
Tomato	20	94.0	3.6	0.9	0.2

Table 1. Continued.

Fruit vegetable	Carotene (mg)	Vitamin B (mg)		Vitamin C (mg)	Minerals (mg)	
		Thiamine	Riboflavin		Ca	Fe
Jackfruit (unripe)	0	0.05	0.04	14	30	1.7
Mango (green)	90	0.04	0.01	3	10	5.4
Muskmelon	169	0.11	0.08	26	32	1.4
Papaya (green)	0	0.01	0.01	12	28	0.9
Plantain (green)	30	0.05	0.02	24	10	0.6
Watermelon	0	0.02	0.04	1	11	7.9
Tomato (red)	351	0.12	0.06	27	48	0.4

Area and production

Statistics of area under fruit vegetable crops and their production is not available in Bangladesh. However, fruit vegetables occupy notable areas and production in the country.

Prospects of Fruit Vegetable Improvement

Fruit vegetable production in Bangladesh has not yet been given priority in research and development. Yet, its supply in the market contributed much specially during lean months of other vegetables. The following are descriptions of some fruit vegetables:

Plantain (cooking banana)

Plantain (*Musa* spp.) is an important vegetable which is available year-round. It has medicinal properties and possesses high nutritive value. Thus, it should be given more attention for improvement. The annual production of banana in the country is 179,000 t of which some cultivars are being used as vegetables. Research information on plantain in the country is very few. Its physiomorphological characters, bunch characters, and fruit characteristics are shown in tables 2, 3 and 4 respectively based on the findings of Biswas et al. (1992). It can be inferred that Anazi can be cultivated commercially and profitably as compared with the rest of the cultivars.

Table 2. Physiomorphological characters of six plantain varieties

Variety	Pseudo-stem height (m)	Base girth (cm)	No. of sucker/plant at shooting	Total no. of green leaves	No. of of leaves
Anazi	2.43 bc	60.80 b	9.27	30.20	14.11
Borobhagne	2.32 c	60.23 b	9.71	29.98	11.85
Dhalpoush	2.58 ab	63.27 b	10.28	31.16	12.87
Hazari	2.32 c	58.87 b	9.35	29.90	13.57
Kanthali	2.67 a	67.87 a	9.55	30.31	12.37
Kapasi	2.30 c	58.83 b	10.21	31.95	12.54

Table 3. Bunch characteristics of six plantain varieties

Variety	Bunch wt. (kg)	Hands/bunch	Finger/bunch	Length of finger (cm)
Anazi	8.70 a	5.05 bc	53.12 bc	18.25 a
Borobhagne	7.30 b	4.89 bc	48.81 c	18.09 a
Dhalpoush	6.31 b	4.99 bc	48.27 c	17.81 a
Hazari	7.28 b	4.63 c	47.53 c	17.81 a
Kanthali	6.98 b	7.04 a	89.33 a	14.89 b
Kapasi	6.93 b	5.41 b	58.78 b	17.22 a

Table 4. Fruit characteristics of six plantain varieties

Variety	Skin color	Pulp color	Blossom-end	No. of ridge	Texture after boiling	Shelf-life (days)
Anazi	Green	Cream	Semi-pointed	4—5	Semi-soggy	8
Borobhagne	Green	Cream	Swollen brown and rough at maturity	4—5	Semi-soggy	12
Dhalpoush	Green covered with white powdery substances	Light yellow to reddish	Semi-pointed	4—5	Cloddy	18
Hazari	Green to reddish	Light yellow	Semi-pointed	3—5	Cloddy	10
Kanthali	Deep green	Whitish	Semi-pointed	3—5	Firm	16
Kapasi	Light green	Light yellow to reddish	Pointed	3—5	Soggy	13

Papaya (Green)

Green papaya which is available year-round is commonly used as vegetable for cooking. The annual production of papaya is 28,000 t (Anon. 1993) of which less than 20% is used as fruit and the remaining 80% or more is used as vegetables. So, it can supplement vegetables during lean seasons. It has both nutritive and medicinal values. Carpaine, an alkaloid present in papaya, can be used as heart depressant, amoebicide and diuretic (Verheij and Coronel 1992). In some countries papaya is grown in sizeable plantations for the extraction of papain, a proteolytic

enzyme present in the latex, collected mainly from the green fruit. Papain has varied uses in the beverage, food and pharmaceutical industry: in chill-proofing beer, tenderizing meat, drug preparations for digestive ailments and treatment of gangrenous wounds. It is also used in bating hides, degumming silk and softening wool. Research findings on papaya in the country is still lacking. However, Saha et al. (1992) found that the treatment combination $N_{100} P_{200} K_{100}$ produced highest yield (12.33 kg/plant) closely followed by $N_{100} P_{100} K_{150}$, $N_{100} P_{150} K_{100}$ and $N_{150} P_{100} K_{100}$ at Joydebpur.

It was observed that yield of papaya goes beyond 60 kg/plant per year at Ishurdi. From these variabilities in yield at different places, it can be suggested that papaya has great yield potentials. But there is no recommended cultivar of papaya for vegetable purpose. However, based on observation, it can be inferred that there are some good yielders of papaya. Those with poor eating quality (as fruit) can be screened for vegetable purpose.

Other Fruit Vegetables

Tender jackfruit is delicious and nutritious. It is often called as plant meat. The country's total production of jackfruit per annum is 253,000 t (Anon. 1993). But only a small portion of it is used as vegetable. But there are deformed jackfruit in the market. It is caused mainly due to improper pollination. It can be corrected by hand pollination. Oftentimes it is observed that some ripe fruits have hard pulp. If the yield of this type is good, then it can be used for vegetable purpose only.

Green mango is also an important fruit vegetable. Annual production of mango is 179,000 t. But there is no authentic data on green mango being used as vegetables.

Satkara is a very popular fruit at Sylhet regions. It is mainly consumed as vegetable either with curry and meat or fish.

Indian olive is also a good fruit vegetable which is mainly used with cooked pulse and fish curry.

Bilimbi is a popular fruit-vegetable in Chittagong. It is eaten with pulse and curry of fish and meat.

Chalta has a sour taste which is mainly used with pulse. It is available during the rainy season when vegetable is scarce.

Otaheite apple is an important fruit-vegetable rich in vitamin C. It is available during autumn when neither rabi nor kharif vegetables are sufficient to supply vegetable demand.

Star goose berry, watermelon, karanda, fig, taikar and **muskmelon** are also found to be used as vegetable to some extent.

Recommendations

1. Collection of superior germplasm for fruit-vegetables.
2. More thrust on agronomical approach should be given to fruit-vegetables.
3. Development of suitable cultivars for fruit-vegetables such as papaya, jackfruit, etc.
4. Hand pollination of jackfruit should be developed to obtain uniform fruit shape.
5. Integrated approach should be strengthened to boost fruit-vegetable production.

6. Fruit-vegetables should be considered for research and development.
7. Package of production technology should be developed for fruit-vegetables.

References

Anonymous. 1993. Yearbook of agricultural statistics of Bangladesh 1992. Bangladesh Bureau of Statistics. Ministry of Planning, Bangladesh. p. 78-86.

Biswas, M., A. K. Azad, and Amzad Hossain, A. K. M. 1992. A study on the performance of six varieties of plantain. Bangladesh Hort. 20(1): 55-58.

Chauhan, D. V. S. 1989. Vegetable production in India. Ram Prasad and Sons, Hospital Road, Agra-3, India. p. 275-333.

Guillemot, J. 1976. The plantain in the Ivory Coast. Fruits. 31(11): 684-687.

Kale, P. B., Dod, V. N., and Gonge, V. S. 1986. Importance of vegetable and its prospects for improvement in India. In : Vegetable crops in India. T. K. Bose and M. G. Som (ed). Naya Prokash, Calcutta - six, India. p.1-28.

Lahav, E. and D. W. Turner. 1983. Banana nutrition. Int. Potash Instit., Bull., 7.

Saha, S. K., Ahmed, A., and Amzad Hossain, A.K. M. 1992. Growth and yield of papaya as affected by NPK fertilizers. Bangladesh Hort. 20(1): 73-79.

Simmonds, N. M. 1960. Bananas. Longmans Green and Co. Ltd. 6 and 7 Cliggord Street, London.

Tchoungui, G. 1972. The problems of plantain estate in South Cameroun Agricole, Pastoral et Forestier. 131: 28-32.

Verheij, E. W. M. and Coronel, R. E. (ed). 1992. Plant resources of Southeast Asia No. 2: Edible fruits and nuts. Bogor Indonesia. p. 225-233.

Peri-urban and Urban Vegetable Production

S. M. Monowar Hossain

Chief Scientific Officer and Head, Olericulture Division, HRC, BARI, Joydebpur, Gazipur

Abstract

The towns and cities had expanded tremendously during the last decade due to economic development and new settlements. More than 20% of the total population (144 mill.) live in the urban areas. It is essential therefore to increase the production of vegetables for better nutrition in both rural and urban areas. Methods of growing vegetables in urban as well as the present system of intensive vegetable cultivation in peri-urban areas have been highlighted. The opportunity of integrating vegetables, fish, poultry, dairy farming, and the role of vegetable in promoting agribusiness particularly in peri-urban and urban areas have been discussed.

Introduction

The urban areas are generally nonagriculture where the community is well developed (Anon. 1992). The cities and towns expanded and there was a significant increase in number of urban centers over the last decade due to industrialization and other economic activities. The total number of cities and towns in Bangladesh is 522 including four metropolitan cities namely Dhaka, Chittagong, Khulna, and Rajshahi (Rahman 1995). On the other hand, the peri-urban denoted the adjoining areas of the cities and towns but without any municipality may extend to the radius of 20-25 km.

Urban Population and Vegetable Requirement

More than 20 percent of the total population (114 million) live in the urban areas. The number of population in all the cities increased significantly because of large scale migration from rural to urban areas. The population of Dhaka City for example increased from 0.90 million to 4.56 million in 1901 to 1991 (Anon. 1992).

Unprecedented heavy flood, drought, massive soil erosion, acute rural poverty, lack of employment opportunity are some of the factors prompting the rural people to migrate to cities and towns for better living. These people are occupying the fallow public and private lands causing the mushroom growth of illegal settlements. These slum dwellers are living in poor hygienic condition, practically without any sanitation and drainage facilities under the polythene or thatched bamboo roof house. Unless there is a pragmatic program to stop migration of rural people to cities and towns, the environment and public utilities will be very much affected.

The urban people need various food supplies including vegetables. Vegetables are good sources of vitamins and minerals. The poor segment of the urban population in particular are the victims of various malnutrition disorders like, scurvy, night blindness, etc. Vegetable production has to be increased in order to keep pace with the growth rate of population in urban areas. In 1995 to 2015, the projected urban population growth along with the estimated vegetable requirement is shown in table 1.

Table 1. Estimated vegetable requirement against projected urban population

Year	Total population[a] (Million)	Urban population[b] (Million)[b]	Vegetable requirement for the urban population[c] (Million t)
1995	126.8	29.4	2.15
2000	141.1	37.3	2.72
2005	155.8	46.4	3.39
2010	170.5	56.8	4.15
2015	184.6	67.9	4.96

[a]BSS, Govt. of Bangladesh, Bangladesh Population Census. 1981, [b]BSS, Report of Urban Areas. 1987, [c]Estimated by the author.

Present Vegetable Production System

Vegetable production is only one-eighth of the total requirement. It is therefore, necessary to grow vegetables in peri-urban and urban areas in addition to large-scale production in the remote rural areas.

Urban vegetable production

Urban cultivation is not a new concept, rather, it has become a permanent part of landscape in many cities of the world (Sanyal 1985). Urban dwellers grow different types of horticultural plants along with vegetables within the space available in their houses. In fact, urban gardening is a food production strategy to supplement food supply (Ninez 1984).

In Bangladesh, urban gardening is becoming popular particularly in big cities and towns. The front yard, backyard, balcony, roof are generally utilized for urban gardening. Some of the methods of urban gardening are:

1. **Box gardening**. Wooden boxes of different sizes depending on the available space are built where shallow rooted and quick growing vegetables are grown.

2. **Pot gardening**. Earthen or plastic pots of different sizes are used for growing single plant of some vegetables like tomato, brinjal, chili etc. This type of gardening is getting popularity in big cities where the space is limited.

3. **Roof gardening**. The rooftops of buildings are being used in growing different types of flowers and vegetables. Tomato, eggplant, chili, bottle gourd, Indian spinach, coriander, mint are some of the common vegetables found on the roof garden.

4. **Frontyard and backyard gardening**. Many urban houses have fallow front and backyards. These vacant lots are utilized to grow different types of year-round vegetables, flowers, and ornamental plants. The selection of the vegetables and their extent of cultivation depends on the space and taste of the gardeners. This type of gardening is practiced by the affluent segment of the urban population. The affluent people normally grow high value exotic

vegetables like, beet, bell pepper, lettuce, parsley, bunching onion, cauliflower, broccoli, etc.

In all the above types of gardening, plants are grown with or without fertilizers and gardeners are discouraged to spray any insecticide. Pests are eradicated by mechanical means.

However, some of the constraints of urban gardening are limited space, tenurial conflict between landlord and tenant, pollution, and lack of appropriate technology for urban gardening.

Vegetable production in peri-urban areas

Vegetable farming in peri-urban is diverse and complex. Most of the intensive vegetable-growing areas are nearer to cities and towns because of their easy marketing and high profitability. A wide variety of vegetables are grown during kharif (summer months from April-September) and rabi (winter months from October-March) seasons both at homesteads and fields. Vegetables like bitter gourd, pumpkin, cucumber, stem amaranth, yard-long bean, okra, Indian spinach, and brinjal during summer, while cabbage, cauliflower, tomato, brinjal, bottle gourd, hyacinth bean, radish in winter season are generally common in all the peri-urban areas. However, the diversity of vegetables and their intensity of cultivation may vary from one peri-urban to another due to variation of agroecological conditions, local adaptability and market potential of the vegetables.

Different cropping systems namely, sequential, relay, row intercropping and mixed cropping are practiced in peri-urban areas for the production of vegetables. Further, it is observed that the vegetable production plan is designed in such a way that the farmers can get a good income by marketing vegetables in the early season and thereafter continuous supply to the nearby cities and towns.

In some cases, a group of peri-urban farmers for example grow cauliflower, cabbage, string bean twice in the same plot of the year. Kartika, a variety of cauliflower is transplanted in July-August and after harvesting in October, early snow variety is planted in the same field. This is practiced in Jessore. Likewise, cabbage is grown twice at Kashiadanga village near Rajshahi City. The first cropping of cabbage variety K-K cross / K-Y cross is transplanted in August and in December for second cropping in the same piece of high land under irrigated condition. String bean is grown twice in summer season at Pubail and Ulukhola of Gazipur district. The seeds are sown in February for the first cropping in April-May and then in May for the second cropping in July to September (Aditya 1993).

Some of the vegetables are intercropped with other plants. For instance, ash gourd is intercropped with potato and brinjal, cauliflower with knolkhol, and cabbage with onion. The common mixed cropping practices are red amaranth with potato, stem amaranth with jute (for vegetables) or chili, and pumpkin with potato.

In Khulna, Jessore, seedlings of tomato variety patharkuchi are transplanted as relay crop 2-3 weeks before harvesting cauliflower. Similarly, hyacinth bean seeds are sown in the pits of teasle gourd in August which is one month ahead of complete harvesting of the gourd.

Many peri-urban farmers prefer to grow one vegetable after another instead of cereals in irrigated high land for higher income. The cropping pattern varies from one peri-urban area to another as evident from the comparison between Monsashan Village near Comilla Town and Kashimpur village near Gazipur Town. The common cropping patterns are shown in table 2.

Table 2. Common cropping patterns

Kashimpur			Monsashan		
Kharif[a]		Rabi[b]	Kharif[a]		Rabi[b]
I	II		I	II	
Aus	T. Aman	Tomato	Bitter gourd	Radish	Potato
Aus	Radish cabbage	Chinese	Bitter gourd	Country bean	Country bean
Indian spinach	Cucumber	Onion or Cabbage	Ashgourd	Cauliflower	Potato+Ash gourd
Green pepper	Red amaranth	Broccoli	Brinjal	Stem amaranth	Potato+Brinjal
Fallow	Radish	Tomato	Teasle gourd	Bitter gourd	Cauliflower
Fallow	T. Aman	Potato+Red amaranth	Snake gourd	String bean	Tomato
-	-	-	Bottle gourd	T. Aman	Potato
-	-	-	Snake gourd	T. Aman	Potato

[a]*Summer months from April-September;* [b]*Winter months from October-March*

Farmers usually use their own seeds for indigenous vegetable but they buy exotic varieties from local market or known seed companies.

Vegetable growers apply cowdung, ash, and chemical fertilizers (Urea, TSP, MP) to the vegetables at variable doses for the same vegetable. Vegetable fields are normally irrigated. Farmers are heavily dependent on the application of pesticides to control insects and diseases. Insecticides like Ripcord, Cymbush, Nogos, etc. are applied to control shoot and fruit borers of brinjal by spraying 15-20 times from pre-flowering to the last harvest. Thus the application of insecticide in vegetables seems to be more than the required amount.

Lack of location specific variety, higher rate of disease and insects attack, inadequate irrigation facility, lack of incentives are some of the problems of peri-urban vegetable cultivation.

Linkages with other farming system components

Olericulture, aquaculture, poultry, and dairy farming are the important components of farming system in Bangladesh. These components are found in different cities, towns and their adjacent areas. Because of high priority given by the present government to the livestock and fisheries sector, the number of poultry and dairy farms as well as fish ponds have increased significantly. At present, Dhaka City alone has 1,000 poultry farms of which 40% have 50-100 birds (Paul et al. 1994). There are 2,973 dairy farms of which 2,685 farms have 1-4 cross breeds (Shahjahan et al. 1994). Further, Dhaka City has fishery resources of 134 ha in the form of beels, dighis, ponds and seasonal water (Hossain 1994).

The linkages among these components can be established through integrated farming. The poultry litters and cowdung from the farms can be utilized for growing horticultural crops including vegetables without or minimum use of chemical fertilizers. Mini- poultry farm sheds can be built over the pond, so that droppings are available to fish. Vegetables can be grown around the ponds and lakes for better nutrition and environment of the people. Some leafy vegetables grown around different waterbodies can be fed to poultry birds

Role of Vegetables in Agribusiness

Vegetable farming is profitable in terms of land, time and investment. It requires the supply of various inputs and disposal of output in proper time. Increased production of vegetables per unit area and time is possible through intensive farming. Large-scale production of vegetables can promote new business, and expand ongoing business in the following areas:

Business related to inputs

1. **Small implements.** Spade, khurpi, mini hand sprayer, watering cane, weeder, pruning knife or shears, etc. of improved types are needed by homestead gardeners. Manufacturing and marketing of these implements locally look promising as a business enterprise.

2. **Seeds and seedlings.** At present more than 1,500 t of vegetable seeds are required. Only 20% seeds are imported and the rest are locally produced and traded by the seed business companies and farmers. Tremendous opportunity exists for the production, processing and marketing of open pollinated as well hybrid varieties of important vegetables. Cool and dry weather in northern part of Bangladesh during winter season are congenial for good quality vegetables seed production. The present seed policy encourages the establishment of seed enterprise under joint venture for the production and marketing of vegetable seeds. Production and sale of improved varieties of different transplanted vegetable crops could be a good business in rural, peri-urban and urban areas. The control of bacterial wilt in tomato and fusarium wilt in watermelon is possible by grafting tomato seedlings on wild brinjal (*Solanum torvum*) and water melon on bottle gourd. One can earn good income by producing and selling such type of seedling on commercial scale.

3. **Micronutrients.** Micronutrients deficiency especially zinc, boron, molybdenum are problems in producing some fresh vegetables and their seed. Marketing of the micronutrients to meet the future demand of vegetable growers could be a good business.

4. **Pesticides.** Vegetables are subject to attack by different insects and diseases. Business dealing with pesticides having no residual toxicity on vegetables and thereby friendly to environment could be promising.

5. **Phytohormones.** The application of plant hormones in horticultural crops in promoting roots, inducing flowers, improving fruit set and size etc. started recently on a small scale in Bangladesh. Marketing of plant hormones as commercial formulations like tomatotone (Para chloro phenoxy acetic acid), planofix (Naphthalene acetic acid), Etherel (Ethylene), etc. looks promising as an agribusiness.

Business related to output

1. **Vegetable production on commercial scale.** Generally, vegetable cultivation is more profitable than other crops. So, some people prefer vegetable farming as a business enterprise to supply vegetables for local and export market. Production of tomato, cauliflower, cabbage, bell pepper during off-season even under intensive management could be highly profitable . However, the commercial vegetable growers should focus attention to improve both yield and quality of high value vegetables.

2. **Marketing and storage of fresh vegetables.** Vegetables after harvesting need to be cleaned, graded, packed and transported from production areas to different distribution centers. Many people are involved in marketing channels of vegetables as *Beparies, Farias, Arathdars*, Retailers and Brokers. The production of more vegetables will create more business

opportunities to the above groups of people. Further, some people can generate income from storing surplus vegetables under controlled atmosphere to extend the availability of vegetables beyond growing season.

3. **Export of fresh and processed vegetables.** Vegetables constitute 3.5% of the total export (Anon. 1993). The potential of vegetables for export has not yet been fully assessed. Opportunity prevails to export not only indigenous vegetables but some other types like baby corn, mushroom, peas and processed products such as dehydrated ginger, concentrated tomato juice, garlic paste, frozen peas, broccoli, and pickled cucumber etc. Exporters may explore the markets of these vegetables and processed products in different countries.

4. **Processing of vegetables.** Because of urbanization, the demand for processed vegetables will increase. The existing food processing industries can expand their business by increasing production of dehydrated and frozen vegetables, tomato juice, pickles of chili, garlic, cucumber, etc.

Conclusion

There is a wide scope to grow different types of year-round vegetables in homesteads and fields through technological advancement. Intensive vegetable production program needs high priority in national planning for better nutrition, strengthening economy, creating more business and employment opportunities. Integrated farming of vegetables, fish, and poultry as a strategy of efficient utilization of local resources for improving livelihood and environment of the people both in peri-urban and urban areas should be encouraged.

References

Anon. 1992. Dhaka City emergency water supply project. Feasibility study (1991-92).

Anon. 1992. Statistical yearbook of Bangladesh. Bangladesh Bureau of Statistics.

Anon. 1993. Final report. Project formulation survey on export possibility of agricultural products in Bangladesh. Funded by JICA. Engineering and planning consultants Ltd., 43, Dilkusha Commercial Area, Dhaka 1000.

Aditya, D.K., 1993. Vegetable production and development in Bangladesh. A consultancy report. Agricultural research project phase II (Supplement), BARC/BARI/AVRDC/USAID Project, No. 388-0051, May 1993.

Bangladesh Bureau of Statistics. Govt. of Bangladesh. Bangladesh Population Census 1981.

Bangladesh Bureau of Statistics. 1987. Report on Urban Areas.

Hossain, M.A. 1994. Aquaculture in city houses and water bodies in and around the city for better environment, nutrition, employment and income generation. Proceedings of the workshop on "Role of Agriculture in Improving City Environment and Self Employment Generation. 22 June 1994, BARC, Dhaka.

Ninez, V. 1984. Household Gardens. Theoretical considerations as an old survival strategy. Food Systems Research Series, No. 1 (International Potato Center, Lima).

Paul, D.C., Salah Uddin, M., Huque, Q.M.E. 1994. Self employment and income generation by city dwellers through poultry farming. Proceedings of the workshop on role of agriculture in improving city environment and self employment generation. 22 June 1994.

Rahman, M. Rezaur. 1995. Soil and land use issues. Urban and City Development.

Sanyal, B. 1985. Urban Agriculture. Who cultivates and why? A case study of Lusaka, Zambia A paper published in the Household Food Production. Comparative perspectives, CIP., 15 p.

Shahjahan, G. M., Siddique, A. B., and Pandit, K. 1994. Contribution of Crossbred dairy in Dhaka Metropolitan City in attaining milk self sufficiency . Proceedings of the workshop on role of agriculture in improving city environment and self employment generation. 22 June 1994, BARC, Dhaka.

Peak and Off-Season Vegetable Production: Agribusiness Opportunities

Shahabuddin Ahmad, A. E. Hossain[1] and M.L. Chadha[2]

Horticulture Research Center, BARI; [2]Resident Senior Horticulturist, AVRDC-ARP, Bangladesh

Abstract

Peak season vegetable crops (winter peak), which is normally blessed with favorable climate having high yield and price, occasionally face risk of low price due to glut. On the contrary, off-season vegetables get good price but face risk of adverse climate causing decline in production or even crop failure. A good number of vegetables are available with package of technology for peak season production. But off-season adaptable variety and growing technique is scarce in Bangladesh. So, agribusiness with off-season vegetable is unfavorable at present as compared to peak season. Price fluctuation is also very high during the off-season. Very recently, some efforts has been made to develop off-season vegetable varieties and techniques. Encouraging results include: development of viable vegetable patterns for homesteads under vulnerable situation; sorjan cropping method for rainy season in low lying coastal area; grafting of brinjal, tomato and watermelon for controlling bacterial/fungal wilt and nematode diseases particularly in off-season; hormonal manipulation for summer tomato production; raised bed; and protective cultivation techniques for some of the summer-rainy season vegetables. With the successful adoption of new off-season varieties and techniques the vegetable production in off-season can be boosted and modernization of transport and marketing channels can create a momentum in vegetable crop agribusiness as a whole.

Introduction

Vegetables are rich sources of essential vitamins and minerals which are essential for maintaining health and curing nutrition disorders. More vegetables can be produced per unit area and time compared to cereals with more food values. Production and marketing of vegetables is labor intensive and can create employment opportunities as well as generate higher income to the small and marginal farmers.

The present production of vegetables is around 1 million t per year, 70% of which is produced during the cool season. Production of summer vegetables is constrained by lack of suitable varieties and adverse climatic conditions while production in winter is favored by suitable climate. Therefore, there is a seasonal fluctuations in the availability of fresh vegetables in the market.

Production

Climate and soil favors the production of more than 60 different subtropical kinds of vegetables in Bangladesh. The popular summer vegetables are teasle gourd, pointed gourd, bitter gourd, string beans, stem amaranth, lady's finger, sweet gourd, ash gourd, ribbed gourd, Indian spinach, plantain, green papaya, and brinjal. They are mostly indigenous in origin. The popular winter vegetables are mostly of European origin. They are tomato, cabbage, cauliflower, radish, broccoli, carrot, beet, spinach, brinjal, hyacinth bean, bottle gourd, and pumpkin.

Vegetables, when grown in their normal season is called peak season vegetables and when they are grown out of the season is called off-season vegetables.

Constraints of growing vegetables

The following are several constraints which hamper the normal production of summer and off-season vegetables in the country :

1. **Seasonality**. There is adequate supply of vegetables in winter because of favorable climate but short supply in summer and rainy season for unfavorable climate. Further, the vegetable shortage is acute during the two slack seasons (mid-March to April and October to mid-November).
2. Humidity plays an important role in the occurrence of pests and diseases in the production phase.
3. In many cases, vegetables grown in summer are seriously affected by drought or heavy rainfall.
4. Flood water can partially or totally submerge the crop and cause total damage.
5. Unavailability of short duration, thermo and photo-insensitive, widely adapted high yielding varieties suited to off-season and summer season vegetable cultivation.
6. Inadequate production technology packages for year-round supply of vegetables with special emphasis on off-season and summer season vegetable cultivation.
7. Lack of suitable high-yielding varieties that can resist biotic, (insect pests and diseases) and abiotic (heat drought, humidity etc.) stresses.

Coping with risk factors

Since the major agricultural activities of the country are dependent on weather, any deviation from normal can greatly affect the yield potential of the crop. Farmers follow certain risk avoiding or adjusting practices to get a reasonable harvest.

Some agronomic practices suggested by different researchers to cope with the flood, drought and other associated off-season risks and some promising strategies that can alleviate the consequences of different effects of risk factors in vegetable production are listed in table 1.

Sorjan cropping

Delayed harvest of T. Aman and tidal inundation are two major constraints to vegetable production in the coastal areas of southern Bangladesh (Patuakhali). In such areas, an innovative method developed in Indonesia, called sorjan cropping, was found suitable for successful production of annual and perennial vegetables.

Alternate ridges (beds) and furrows were made on a piece of selected land. Three meter wide by 10 m long raised beds were prepared using soil taken from the 1.6 m wide furrows. The height of the bed was 1 m from the ground so that at least the upper 30 cm portion remained above flood level. The furrows served three purposes (1) drainage of excess water during rainy season; (2) reservoir of water for irrigation during dry season; and (3) provision of space for trailing of creeper vegetables.

Grafting

Brinjal and tomato grafted on the wild species of *solanum* and watermelon on bottle gourd stock showed on bacterial wilt or nematode disease during off-season production. In grafted tomato, crop duration is prolonged and by that way season can be extended.

Hormonal manipulation

It was observed that 0.2% tomatotone (Chloro-phenoxy acetic acid) sprayed at pre-anthesis stage on tomato cultivated during off-season (summer) gave satisfactory yield (1.5-2.0 kg/plants).

Raised bed techniques

Under high rainfall condition, raised bed (30-40 cm) techniques can give better yield compared to normal bed system.

Protective cultivation

Polythene tunnel techniques in high rainfall condition, summer tomato, cauliflower, etc. can be grown successfully.

Table 1. System-based technology options for cyclone and flood-vulnerable areas

Vegetable patterns in homestead	Creeper vegetables
Radish/tomato—red amaranths—Red amaranths—kangkong	Creeper vegetables on trellis bitter gourd, ash gourd and country bean as three—tier system
Red amaranths + eggplant-Red amaranths-okra	Pumpkin, bitter gourd and other vegetables on gourd
Red amaranths—eggplant—Red amaranths—stem amaranths—Red amaranths	Creeper vegetables on trees—bottle gourd, sweet gourd sponge gourd, ribbed gourd, yard—long bean, country bean, teasle gourd, yam, colocassia, French bean.
Pai-tsai batisak (*B. chinensis*)—kangkong—red amaranths , Cabbage—red amaranths—bitter gourd—red amaranths	Watermelon and melon

Agribusiness

Vegetable crops agribusiness opportunities

With the promotion of vegetable crops as a whole, there will be a vast scope of agribusiness creating a lot of employment opportunities. This will have positive impact on our national economy. The possible fields relating to vegetable crop-based agribusiness are the following:

1. Growing and handling of vegetables as a cash crop;
2. Transportation with refrigeration facility;
3. Cold storage facility;
4. Processing and preserving industry;
5. Vegetable (fresh and processed) export business;
6. Export oriented special vegetable growing farm;
7. Marketing channel intermediaries;
8. Vegetable seed production farms;
9. Vegetable seed merchants;
10. Vegetable seedling nursery (e. g. grafted and potted seedling); and
11. Special-type vegetable grower (e. g. sprout vegetable and mushroom).

Marketing problems

High perishability, glut during peak season, and lack of storage and proper transportation cause serious problems in vegetables marketing . Middle men exploit both farmers and consumers by getting high profit. At present, there is no organized channel of marketing and price protection which benefits both farmers and consumers.

Price

Prices of vegetables differ from season to season depending on their volume of production and availability. To give an overview of the seasonal fluctuations of vegetable prices, a comparative statement of average monthwise price of different kinds of vegetables in the country is shown in table 2.

A wide seasonal fluctuation exists in the price of vegetables. Such wide fluctuations are mainly due to the seasonal character of production and supply. The table shows that the vegetable grown in its peak or normal season have comparatively lower price but in off-season it is relatively higher. The peak and off-season price variation depends on consumers' choice. Other reasons of high price in off-season vegetables include low-yield and high cost of production. In peak season price is sometimes very low due to glut.

Table 2. Monthly average wholesale price of some important vegetables

	Tk/Quintal[a]												
Commodity	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Brinjal	415	398	463	385	398	658	635	686	661	954	758	625	586
Lady's finger	700	722	709	495	400	425	539	868	1,005	1,278	1,118	790	754
Pumpkin	275	225	195	220	225	188	175	244	275	388	606	688	309
Green papaya	310	250	225	345	323	303	321	366	290	386	410	365	324
Beans	400	337	591	433	-	-	-	-	-	-	-	926	537
Tomato	656	481	430	641	-	-	-	-	-	-	-	1421	726
Radish	128	93	-	-	-	-	-	-	-	-	-	320	180
Cauliflower	328	261	350	-	-	-	-	-	-	-	510	469	384
Cabbage	293	216	150	-	-	-	-	-	-	-	458	385	300
Patal	-	-	-	992	593	447	619	692	727	1,016	994	358	771
Jhinga	-	-	901	645	575	497	540	650	634	748	-	-	649
Chichinga	-	-	817	548	317	253	245	424	600	817	-	-	503

[a]*1 Quintal = 100 kilograms, US$1=40 Taka*

Recommendations

Although Bangladesh produces only 1 million t of vegetables per year as against the requirement of nearly 5-6 million t, several of these commodities are available as seasonal surplus during peak period of the year and go to waste due to improper packaging, handling, distribution and marketing.

Therefore, if losses can be prevented and large seasonal surpluses made available for consumption, every effort should be made by the producers and the consumers to preserve part of these surpluses for their own consumption in any form. This would stimulate production and bring better returns to the farmer. By extending the planting/showing time, i. e. growing early and late varieties, harvesting time can be extended to ensure the supply of fresh and good quality produce throughout the year.

With the present and would be available varieties and techniques, crop sequence can be adjusted in such a way that an increased and steady production of vegetables with minimum seasonal fluctuation is ensured. The per capita consumption of vegetables in Bangladesh is low by any standard. To improve the tragic extent of malnutrition, availability, increased and steady production of vegetables are required. Moreover, consumption needs to be increased by making vegetable available in different forms and slowly changing food habits.

Vegetables are cash crops and perishable products. Production cannot be increased unless organized marketing is developed. One of the crucial factors involved in delivering vegetables to the consumer is the marketing process. As a result, the consumers pay more but the farmers get relatively lower prices for their produce. Inadequate and improper transportation system and preservation facilities hamper the supply of products from surplus season and areas to the deficit season and areas.

Most of the NGOs involved in rural development aim to promote homestead vegetable gardens managed by female family members for nutritional aspect. But today, the thrust has been changed to promote vegetable production based on profitability and marketability.

To make the vegetables available from the primary market to the wholesale and retail markets, a number of intermediaries like the *farias, beparis, arathdar* and retailers are involved in vegetable-

based agribusiness. If this intermediaries can be trained and organized they can play a vital role in stabilizing peak season and off-season price benefiting farmers, intermediaries, and consumers.

Exporters of fresh, processed, and preserved vegetables are also big partners of vegetable-based agribusiness and earning valuable foreign exchange for the country. The vegetables which have higher yield and export potential both in peak-season and off-season need to be identified.

Chapter 3

Postharvest Handling and Processing

Session V : Postharvest Handling and Processing

Chairman : Dr. M. A. Hamid Miah

Rapporteurs : Dr. A. Quader
Mr. J. C. Shaha Chaudhury

Reducing Postharvest Losses in Vegetables

Abdul Karim

Chief Scientific Officer, Bangladesh Atomic Energy Commission

Abstract

Postharvest is very crucial in vegetable production. A well-managed postharvest activities will lead to higher yield and profit to the producers. In order to avoid postharvest losses, vegetables should be harvested at the right maturity stage. Proper packing materials and cooling facilities should be provided during transportation. Storage facilities should be established for short and long-term storage of vegetables.

Introduction

Vegetables represent a broad category of plant products. They include: leaves, stems, buds, flowers, seeds, fruits, bulbs, roots and tubers of plants. In general, vegetables are highly perishable. But some vegetables are more perishable than the others. Perishability of vegetables is due to physiological process, high moisture content, susceptibility to mechanical injury and susceptibility to insect, mold and microbial attack.

Different vegetables are affected in different degrees by these factors. To reduce postharvest losses of a specific vegetable, relevant contribution factors should be addressed.

Nature of losses

Post harvest losses may occur in terms of economic loss which refers to the reduction in monetary value as a result of physical loss; quantitative loss which includes reduction in weight by water loss and loss of dry matter by respiration, pilferage and other incidental losses in quantity of food; qualitative loss which is frequently described by comparison with locally accepted standards of quality leading to loss of consumer appeal; and nutritive loss which includes losses in nutrients like vitamins, minerals, sugar, etc. There is no accurate data on the extent of postharvest losses in the country. However, the National Academy of Sciences, USA, (1978) published data on estimates of postharvest losses of fruits and vegetables as shown in table 1.

The table shows that one-fifth to nearly half of the fruits and vegetables go to waste. Expressed in monetary terms, this is equivalent to millions of dollars in countries that can not afford to decrease the available food for their increasing population.

On a daily basis, postharvest losses of vegetables may range from three to 11% which may be due to rot, over ripening, mechanical injury, weight loss, trimming, sprouting, browning, and culls.

Table 1. Estimated postharvest losses of fruits and vegetables in Asia

Country	Reported % Loss
Asia/Far East	20 -42
Philippines	28 -42
Malaysia	20 -25
India	20 -30
Thailand	23 -28
Sri Lanka	20 -40

Mechanism of postharvest losses in vegetables

Losses due to physiological changes. Even after harvest, a vegetable crop is alive; metabolism continues until the crop deteriorates. The objective of proper postharvest handling is to keep the cells and tissues alive and intact for as long as necessary. In order to maintain this organization and sustain metabolism, energy is necessary. The energy is made available through respiration using the products of photosynthesis accumulated before harvest.

Therefore, the greater the energy source at the time of harvest, the longer the postharvest life. The faster the respiration, the faster is the deterioration. Extending of postharvest life therefore calls for good production practices in order to have greater energy sources at harvest and respiration should be slowed down after harvest to enable the source of energy to last for a long period of time. Harvesting at the proper stage of maturity ensures adequate source of energy to start with. Low temperature or controlled atmosphere storage reduces the rate of respiration.

Continuous state of change. Being live tissues, vegetable commodities continuously change after harvest until completely deteriorated. These changes influence color, flavor, appearance, texture, and nutritive value. Some of the changes may be desirable initially such as the changes associated with ripening, but most of the changes are deteriorative. In general, leaves will wilt, buds will open, stems will elongate, bulbs and tubers will sprout, legumes will harden and mature fruits will ripen and their seeds will germinate. There are also associated undesirable chemical changes. The slower the undesirable changes are, the longer the postharvest life of a commodity. These changes are influenced by temperature, relative humidity, light, gases and gravity. High temperature and low relative humidity hasten undesirable changes in all commodities.

High water content. Fresh fruits, vegetables and flower crops consist mainly of water. It could be as high as 98% by weight in fully succulent leaves. Milk contains only 87% water. Loss of water can dry up a commodity. A 10% loss in weight may result in 100% commercial loss. The high amount of water in commodities make them succulent and therefore susceptible to mechanical damage.

Consequences of water loss. Water loss leads to loss in weight of all commodities, softening of fruits and vegetables, wilting of leaves and flowers, shriveling of fruits and root crops, and discoloration of commodities.

The faster water is lost from the commodity, the faster it losses its freshness. Therefore, transpiration should be slowed down to keep the commodity fresh. High temperature and low humidity hastens transpiration.

Susceptibility to injury and mechanical damage. Soft tissue structures associated with high moisture content make the fresh fruits and vegetables highly susceptible to mechanical injury during harvesting, handling and transportation. Damage is caused by such physical forces as

heavy load on top of a package, sharp or pointed materials, rough surfaces, impact against a hard surface and prolonged vibration.

The effect of damage occurs immediately. Mechanical damage alters the physical appearance of the product. A ruptured cell wall provides a convenient access to rot organisms and a ready passageway of water from the cells. Disorganization of cell membrane follows. This leads to the release of enzymes which break down lipids in membranes mainly to the mitochondria membranes. The fatty acids released are used in ethylene production and wound respiration. The heat produced increases respiration further, thus inclusion of damaged products will lead to more rots, wilting and shriveling, faster ripening or over ripening. Damage therefore results to poor sales and reduction of profit.

Attack by pathogens and insects. Fresh fruits and vegetables are susceptible to the attack of microorganisms and insects. Commodities will last longer if we could keep insects and micro organisms away or slow down their growth and reproduction once they have landed or started to attack the commodity. Controlling insects and pathogenic organisms are essential to meet quarantine requirements.

Effects of stress. Stress is a potentially injurious force or pressure acting on the commodity that may lead to a reversible or irreversible strain such as injury or death. Examples are water loss, rot and insect or physical injury. Any stress can increase ethylene production in commodities. Thus minimizing or preventing such stresses can result to longer postharvest life of commodities. Conversely, any stress can hasten the ripening or shorten postharvest life. The production of ethylene by commodities under stress is the basis of some traditional practices of ripening such as a tiny cut on a papaya.

Areas of Postharvest Losses of Vegetables

The major areas of postharvest losses of vegetables are harvesting, transportation and distribution and storage.

1. Factors to be considered during harvesting are proper stage of maturity at the time of harvest, minimizing mechanical injury, avoiding high temperature at the time of harvest, rough handling and contact with soils and dirts and proper curing in case of certain crops such as potato, sweet potato, onions etc.

2. Pre-harvest care for reducing postharvest losses include selection of proper varieties and proper crop production practices such as irrigation, fertilization etc. Pre-harvest crop production measures such as detopping or dehaulming of vines in certain cases e.g. potato; and spraying the crops with suitable chemicals in specific cases e.g. spraying pineapples and tomatoes with ethephon before harvest for uniform ripening and color development.

3. During transportation and distribution care should be taken for quick transportation, use of proper packaging such as perforated rigid containers of uniform capacity, avoidance of rough handling and cooling if possible, etc.

4. During storage which may be temporary or for a long time, proper environment such as temperature, humidity, oxygen concentration, etc., should be maintained. Ideal storage depends on the nature of the commodity and purpose of storage.

Recommendations

1. Loss-reduction efforts should be concentrated on the commercial production of vegetables in the main vegetable-growing areas or centers of the country.

2. Farmers should be trained on proper pre harvest and postharvest care and handling of vegetables.

3. Production of information materials, training of extension workers and creating awareness and spreading the knowledge on postharvest technology of perishable commodities including vegetables.

4. Establishment of collection points with shades and temporary storage facilities and development of internal road network in the main vegetable-growing areas will facilitate quick transportation of vegetables.

5. Appropriate packaging materials and techniques can greatly reduce losses of perishables during handling. There is an urgent need for developing codes of practice for handling and packaging of perishable commodities.

6. To avoid injury and damage during transport, trucks carrying vegetables should be properly designed and equipped. They may be required to use covers, horizontal dividers or platforms, cooling arrangement, etc.

7. Wholesale markets of vegetables should be properly designed and equipped to handle these commodities and to provide necessary storage facilities.

8. There is an urgent need to develop an effective system for monitoring insecticide and pesticide residues and ensuring quarantine requirements.

9. Introduction and development of vegetable-varieties and cultivars with desirable postharvest characteristics and processing properties will solve most postharvest problems.

10. There is an urgent need for the development of institutional mechanism for the management of postharvest problems. Formation of Producers' Cooperatives Marketing Board and introduction of contract growing system will ensure fair price to the growers, facilitate introduction and adoption of appropriate postharvest technology and promote establishment of processing industries and export of fresh and processed vegetables. Contract growing system can be developed by the wholesalers, exporters and processors of vegetables. These arrangements will facilitate the channeling of institutional credit facilities to agribusiness.

11. Storage facilities should be developed for both short and long-term storage of vegetables. Detailed cost-benefit studies should be required for the storage of specific vegetables. Experience of SOGORIP will be useful although it deals with cereals and relatively more durable commodities than vegetables. These storage facilities may be owned and managed by private investors or producers and cooperatives.

12. Postharvest problems of different vegetables are different. It is easier to address the postharvest problems of a single crop in a particular locality. Considering the agroecological potential and infrastructures available in a locality, new centers of production in the concept of a Papaya Village or Kakrol Village may be developed.

13. There are differences in measuring the cost and benefit for a private entrepreneur and the public sector for an investment in postharvest loss-reduction program. The public sector investment in this area must be considered in terms of increased food supply, employment

generation, income distribution, improved nutrition, social stability and a favorable balance of payments. Therefore, public sector investment in postharvest loss reduction program has a very important socioeconomic and sociocultural implications.

References

Ahmad, K. U. and Karim, A. 1977. Technological approaches for horticultural development. Presented at the seminar on science and technology in agriculture held in Dhaka under the auspices of NCST and BARC, Oct. 1-3, 1977.

Bautista, O. K. 1990. Postharvest technology for Southeast Asian perishable crops. Technology and Livelihood Resource Center (TLRC), Manila, The Philippines.

Karim, A. 1979. Export of processed agricultural products to Western Europe. Bangladesh Sugar and Food Industries Corporation, Dhaka.

National Academy of Sciences. 1978. Postharvest food losses in developing countries. National Research Council. National Academy of Sciences. Washington, DC, USA.

Salunkhe, D. K. and Desai, B. B. 1984. Postharvest biotechnology of vegetables. CRC Press, Inc. Boca , Raton, Florida, USA.

Processing of Vegetables as an Agribusiness Enterprise

Md. Amiruzzaman and J. C. Shaha Chaudhury

Postharvest Technology Division , BARI, Joydebpur, Gazipur, Bangladesh

Abstract

Vegetables are perishable and have extremely short shelf lives. Hence, processing is a viable alternative to answer problems on surplus of production particularly during peak season. Processing imparts preservability of the vegetables. It can also generate new products of specific taste and appeal. In Bangladesh, the demand for processed vegetables is low because fresh vegetables are available throughout the year. Presently, processing of vegetables as an agribusiness enterprise has a little prospect. New products developed from processed vegetables, have, however, created a demand among the urban and semi-urban population. These products are mainly concentrates like tomato ketchup and pastes, dehydrated and deep fat fried products like potato chips, crun chips, ring chips, etc., and salted, fermented products like pickles, and chutney. These products are generally produced in traditional cottage-industry type factories. Canning, the biggest outlet for processing of vegetables, is yet to strike roots in Bangladesh since sanitary cans of acceptable international quality are not available. Some processed vegetable products are in demand in foreign markets, like canned mushroom, babycorn, peas, carrots, etc., exist along with semi processed products like salt stocks of cucumbers, cabbage, and other vegetables.

Introduction

In Bangladesh, rice is grown in nearly 78% of the area. All other crops compete for the remaining 22%. Vegetables are produced in nearly 1.08% of the total cropped area with roots and tubers covering about 2.39%. (Siddique and Aditya. 1992). The production and availability of vegetable is not continuous throughout the year. Although winter is short, about two-thirds of the total vegetables are produced during the season. Over the years, there has been a steady increase in both area and production of vegetables as shown in table 1.

Table 1. Area and production of vegetables in Bangladesh

Year	Winter vegetables		Summer vegetables	
	Area ('000 ha)	Production ('000 t)	Area ('000 ha)	Production ('000 t)
1978-79	77.3	515	42.5	249
1980-81	79.8	538	44.5	252
1982-83	86.2	580	49.4	277
1988-89	98.0	673	60.3	292
1989-90	100.0	707	62.8	299

Source: Siddique and Aditya. 1992.

Large-scale vegetable production in Bangladesh

Vegetable growing is becoming a commercial venture in Bangladesh in the following areas:

Jessore	- Chuadarya, Jhikargaclha, Sharsha, Manipur, Gatkhali, Novarone
Khulna	- Phultala, Dumuria, Chuknagar, Tala, Paikgacha
Comilla	- Chandina, Sadar, Devidwar, Burichang, Daudkandi
Gazipur	- Kashimpur, Pubail, Tongi, Kaliakair
Rangpur	- Sadar, Mithapukur, Jaigirhat, Pirganj
Pabna	- Sadar, Ishurdi, Atgharia, Santhia, Shujanagar, Chatmohar
Natore	- Sadar, Banpara
Chapai	- Sadar, Shivganj, Gomastapur (tomato only)
Nawabganj Rajshahi	- Pabna, Boyaliya, Mahanpur, Bagmara, Punthia
Chittagong	- Sitakunda, Mirersarai, Hathazari, Satkania, Rauzan, Patiya, Rangunia, Dohazari
Noakhali	- Vinodpur, Mandar, Sadar
Feni	- Baligaon, Panchgachhia, Sarshadi in Sadar, Panthannager (Chhagalnaiya), Sonagazi

Bangladesh has considerable potential to increase the production of conventional and non conventional vegetables through contract growers. Exploitation of huge vegetables envisaged to be produced in the future needs development of agro-processing industries and systematic export promotion programs of processed vegetables. Development of vegetable processing industries will reduce postharvest losses, make more raw materials for processing and more food to meet the nutritional requirement of the population. It will take care of seasonal surplus and extend availabilities of different vegetables for a longer period and ensure better return to farmers / producers. Vegetable processing will generate employment opportunities and increase foreign exchange earning by exporting processed products along with fresh vegetables.

Status of vegetable processing

Processing of vegetable is not so popular in Bangladesh because of limited market. Consumers prefer fresh vegetables because processed vegetables command higher price. However, some vegetables have processing values and are being processed in traditional cottage-type industries in Bangladesh. At present proper industrial base for these commodities is yet to be developed.

Constraints to vegetable processing

1. Lack of sufficient raw materials for specific variety and quality;
2. Lack of infrastructure for handling, transport and storage;
3. Lack of technical know-how and skilled manpower for handling, storage and processing of vegetables;
4. Absence of entrepreneurs in the private sector; and
5. Lack of financial assistance.

However, export of certain kinds of semiprocessed and processed vegetables seemed to be promising in Bangladesh provided, technologies and inputs are available.

Industries for processing vegetables

There are very few processing companies in Bangladesh. The major companies are mentioned below. Other processing companies and their products are listed in table 2.

Multiple Juice Concentrate Plant, Kalurghat, Chittagong. Annual production capacity of tomato paste is 1,800 mt.

Rangamati Food products. Among vegetables, green peas are canned in brine. Cans are imported from India with soldered side seam which is banned in the international market.

Pran Food Factory Ghorasal. This industry has three production lines; canning line, bottling line, and jam, jelly and pickle lines. Mainly baby corn, gherkins and mushroom are produced and processed. The indigenous variety of tomatoes are processed into ketchup. Cans are imported from Thailand, returnable bottles from India, and crown caps from Sri Lanka. For jams, jellies and pickles, local glass bottles are used. Lug caps for bottles and jars are imported from Thailand. Salt and sugar, being used in processing are also imported. Bangladesh Sugar and Food Industries Corporation has the facilities for producing refined sugar in one of their mills.

Table 2. Some fruit and vegetable processing industries in Bangladesh and their products

Processing industries	Products
Pran food/Ghorasal, Palash Narsingdi	Fermented gherkin in brine, canned babycorn, jams, pickles, bottled fruit juices, canned fruits and vegetables in syrup and brine.
Ahmed Food Products (PVT) Ltd. B-12, 4/67, Mirpur, Dhaka	Jam, Jelly, Ketchup, Pickles, Squash
Iqtedar Food Industries Ltd. 185, Tejgaon Industrial Area, Dhaka	Fruit juices
Sumi Food Products Bhuboner Chala, Kapashia, Gazipur	Jam, Jelly
Mary Gold Food Hali Sahar Road, Chittagong	Squash, Jam, Jelly
The Health Pharma Food Professorpara, Comilla.	Soft drinks
Daisy Food and Chemical Industries, Mugoltuli, Comilla	Jam, Jelly
Chittagong Food 1785, West Nashirabad, Chittagong	Jam, Jelly
Universal Laboratories 25/2, Munshipara, Sylhet	Jam, Jelly
Progressive Food Industries Ltd. Mowchak, Shibganj Badarlatka, Sylhet	Jam, Jelly
Bhai Bhai Chemical and Food Products, Mugoltali, Paschim Bazar, Sylhet	Jam, Jelly
Allied Food and Industries Uttarpara, Srimangal	Jam, Jelly
Mono Chemical Works Main Road, Bagerhat	Lemon juice, Fruit juice, Squash
Globe Chemical and Logence Industries	Syrup, Logence, Squash
Max Food and Chemical Industries. C & Road, Barisal	Jam, Jelly, Squash, Sherhat
Multiple Juice Concentrate Plant (MJCP) Mohra, Kalurghat, Chittagong	Tomato and Pineapple juice concentrate

Status of Materials Used

Food color flavors and chemicals. Food flavors and colors are being imported by few local agencies from countries like, UK, Germany, and USA. Chemicals like citric acid, pectin, carboxymethyl cellulose sodium benjoate, sodium/potassium metabi sulphite are being imported. But the chemicals are not often of food grade quality.

Sanitary cans. The BSFIC Can Making Plant in Chittagong produces plain sanitary cans. But there is no lacquering unit. The plant has a unit for welding of side seams to meet the international standard. Bangladesh Can Company of Bangladesh Steel and Engineering Corporation makes cans for general purpose. No sanitary good quality cans are produced in this industry.

Glass bottles and jars. The pharmaceutical bottles which are made of neutral glass are manufactured by the Bengal Glass Company of Dhaka. There are small firms in Dhaka City who makes moulds for glass bottles.

Plastic containers. MS. Ghorasal Containers Ltd. and Ghorasal Multilayer Plastic Packaging are equipped with facilities for making plastic bottles and flexible pouches from food grade plastic materials. Similarly, some engineering firms exist in Dhaka to make moulds for plastic containers.

Cap manufacture. Metal caps with printing facilities are also available in Dhaka. Two leading industries are Standard Manufacturing Co. Ltd. and Dias Metallic Industries both in Dhaka.

Food plant and machinery fabrication. There are a quite number of big and small engineering firms which have good facilities and manpower to fabricate food plant machines as per designs supplied.

Processed vegetable products for export

Canned and dehydrated vegetable products gained promising results in the export market. Canned products include tomato juice, snake bean, baby corn, mushroom, bamboo shoots, and peas. Dehydrated products include white ash gourd, bitter gourd, plantain chips and mushroom. Brinjal, radish, turnips, palwal and bitter gourd have pickling qualities and they are likely to have good demand in the UK, Middle East and other parts of the globe. List of export potential products and their packages is shown in table 3.

Table 3. List of export potential products and their packages

Vegetables	Cost of material	Processed into	Packaging material	Storage condition	Reprocessed into
Tomato	Low	Puree	Plastic container	Frozen	Ketchup
		Chili	Bottle	Cool	
		Juice	Can		
		Paste	Plastic bottle	Frozen	
		Ketchup	Bottle		
		Soup	Flexible can	Normal	
White gourd	Low	Dehydrated	Plastic container	Dry	
Baby corn	Low	Canned	Can/glass jar	Normal	
Gherkin	Low	Pickled	Glass jar	Cool	
Plantain	Low	Chips	Polyethylene	Cool	
Cucumber	Low	Salted	Plastic box	Cool	Pickles
Mushroom		Dried	Polyethylene	Cool	

Quality Control of Vegetable-Based Processed Products

To encourage vegetable preservation and processing for export and local market development of good manufacturing practices in the processed plant with maintenance of proper hygiene and sanitation at all levels and introduction of strict inspection and quality control is essential. Bangladesh has not yet been able to develop and organize export oriented vegetable processing industries. Inspection on quality control system has not also been developed to meet the requirement for exportable processed vegetables. The Bangladesh Standard and Testing Institution is primarily responsible to prepare standard specifications and promote standardization and quality control. BSTI can certify products for local consumption. For lack of infrastructure facilities and adequate manpower BSTI can not execute its authority properly.

Conclusion

Vegetable processing has not yet gained popularity in Bangladesh. Thus, processed vegetables have limited domestic market except for special types of products like potato, ketchup, pickles from chili, tomato and garlic. Processed products that are in demand abroad should be further developed.

Recommendations

1. Development of good vegetable varieties particularly those in demand in the international market.
2. Development of processing methods for various vegetables, optimize and standardize the same to meet the demand of the both local and international markets.
3. Introduction of simple and low cost storage facilities in major vegetable growing areas and transit point during transportation.
4. Establishment of semi-processing industries in major vegetable growing areas.
5. Establishment of cold storage facilities near vegetable growing areas and processing factories for short and long-term preservation of vegetables.
6. Development of high quality and attractive package and packaging materials for processed vegetable within the country.
7. Private sector should be encouraged to produce processed and semiprocessed vegetable product of export quality by adopting cost-effective modern technology with support from public sector and joint venture programs.
8. Processing of selected vegetables into pulp concentrate or paste for export.
9. Encourage dehydration of vegetables for both local and export markets.
10. DAM and EPB should be entrusted with specific responsibilities of disseminating market and price information of vegetables to the growers, middlemen and processing entrepreneurs, researchers, and exporters.
11. Organize and participate in international trade fair, sending trade mission consisting of horticulturists, processing scientists, representatives from processing industries to gain ideas about preferred varietal quality and type of processing and packaging of vegetables

so that buyers preference is taken cared of while developing varieties, processing and packaging vegetables.

12. Introduction of subsidy on electricity, gas, and lower interest rate to credit for vegetable processing industry should be considered.

13. Strengthen BSTI which is primarily responsible for quality control of processed vegetables. Their services to determine nutritional status of the processed vegetables should be ensured to facilitate product development and marketing.

14. Present duty imports of tin cans, preserving jars, glass bottles, crown cork, lug caps should be reduced from 15%-30% to 7.5%.

15. Air freight cost of Biman should be reduced, cargo space should be increased, and air post formalities should be simplified to facilitate export of processed vegetable products. Export of processed vegetables by ship should be encouraged to reduce transport cost.

16. Training on manpower development program in the field of vegetable processing for scientists and industry personnel.

17. Periodical meeting/convention should be arranged for the policymakers, political leaders, researchers on vegetable processing and owners of vegetable processing enterprises.

References

Siddique, M. A. and Aditya, D. K. 1992. Vegetable consumption and nutritional status in Bangladesh. Proceeding of a national review and planning workshop on vegetables production and marketing, BARI, Joydebpur.

Amiruzzaman, M. 1993. Postharvest management of vegetables in Bangladesh. A consultancy report. AVRDC/BARC/BARI, USAID Project.

JICA. 1994. Project formulation survey on export possibility of agricultural product in Bangladesh. Final Report. Japan International Cooperation Agency. Dhaka, Bangladesh.

ITC/IBA/EPB commodity supply studies (RAS/78/020). Report on canned fruits and vegetables in Bangladesh IBA-Jan, 1981.

Bangladesh Export Statistics, EPB.

Khan, C. A. 1995. A report on Pran Food Processing Factory.

Nelson, P. E. and Tressler, D. 1980. Fruit and vegetable juice processing technology. AVI 436-494.

Srivestava, R. P. and Ranjan, S. 1982. Preservation of fruits and vegetables products. Siva Pri Dehra Dun, India.

Eddy C. W. and Veldhuis M. K. New nectar made from fresh purees. Food Indus. 14. No. 3.

Biswas, B. K. 1988. A study on the preparation of nectar from sweet gourd. A project report. Department of Food Technology and Rural Sociology, BAU.

Closing the Agri-Agribased Industry Loop

Roy E. Bosley

Chief of Party, Agro-based Industries and Technology Development Project, FDC, Dhaka, Bangladesh

Introduction

Fruits and vegetables are very important because they contain vitamins and minerals needed in the human diet. While production of vegetables is quite high, distribution is low due to postharvest malpractices. Besides, there are limited vegetable and fruit processing factories in Bangladesh to maximize preservation of these crops. Some agroprocessing activities should then be integrated to crop production to augment farmers' income. Collaboration between private, government, and nongovernment organizations should also be strengthened for the establishment of more projects geared towards improved agri-based industry.

Nongovernment organizations are working on different agricultural projects involving farmers to increase farm productivity. Project sites are identified for the establishment of demonstration farms to showcase improved farming techniques. Contract growers were also identified to produce potential crops.

But these projects have limited resources to supervise and monitor the growth of potential crops. Thus, enumerators in different regions in collaboration with different NGOs need to be mobilized to monitor changes and impact of these projects.

New Business

Tissue culture. Plantlets of potential crops can be derived from tissue culture, but, this technology has not yet gained popularity in Bangladesh. This technology should be strengthened to bring in quality planting materials in the country.

Processing Plants. Processing of fruits and vegetables is needed to regulate excessive supply in the market. Processed products augment farmers' income and supply year-round fruits and vegetables even if they are no longer in season. But most factories are situated in Dhaka City. Farmers transporting volumes of raw materials to the processing plants do not gain profit because the transportation cost is higher compared to the amount of products being processed caused by excessive waste during processing. Thus, there is a need to establish processing plants near the production zones in different regions to save time and transportation cost. In this way, farmers could gain higher profit from their produce.

Postharvest Techniques

Postharvest is very crucial in vegetable production. Usually, the profit of the farmers depends on good postharvest practices. Crops should be harvested at the right time and should be handled properly to minimize damage. It should be transported immediately to the collection points, where, proper grading, sorting, precooling, drying, packing, etc., takes place. Processing of farm products will regulate crop glut in the market. In this way, the farmers gain high profit from their produce.

Agroprocessing of New Crops

Pran is the only food processing factory in Bangladesh involved in fruit and vegetable processing. Other factories are into poultry and milk processing. Cognizant of the scenario, some agroprocessing activities should be integrated in crop production to augment farmers income such as seed, agrimachinery, livestock and poultry, feed mills, veterinary supplies, and animal breeding and genetics.

Key Project Activities

1. Identify appropriate technologies for farmers/entrepreneurs;
2. Organize demonstrations, seminars, training workshops, policy conferences;
3. Conduct subsectoral feasibility studies to identify sound agribusiness investment opportunities;
4. Provide demand driven TA to private sector agribusiness entities/farmers/NGOs;
5. Conduct policy studies and policy dialogue to establish enabling policy environment;
6. Develop contract grower zones; and
7. Monitor inputs and other markets, credit, environmental impacts, women's access, and analyze and publish findings and recommendations.

Chapter 4

Marketing of Vegetables

Session IV: Marketing of Vegetables

Chairman : Dr. S. M. Elias

Rapporteurs : Dr. Shahadad Hossain
Dr. Ashraf Khan

Development of an Effective System for Vegetable Marketing in Bangladesh

Md. Aminul Islam

Director, Department of Agricultural Marketing, Bangladesh

Abstract

The present market intelligence system in Bangladesh is not yet well organized. Communication systems to link wholesale and retail prices of commodities in different areas has not yet been strengthened. Credit support for vegetable growers is still unavailable except for other crops specifically potato. Likewise, transportation for domestic and foreign markets is still poor. Apparently, vegetable marketing in Bangladesh needs full support from the government and private sectors including the growers themselves to achieve highest returns of production.

Introduction

Vegetables in Bangladesh are grown in summer and winter seasons. The total volume of vegetables excluding green papaya and green banana is 1,142,000 t of which 33% grows in summer season. In winter season, about 1.6 t of potato is grown and consumed throughout the year. Green banana and green papaya are also used as vegetable in all seasons. Table 1 shows the area, production and yield/hectare of vegetables.

The BADC organized vegetable production and marketing in some selected areas of Bangladesh. Some wholesalers of metropolitan cities and district headquarter markets were organized for contract growing of vegetables by advancing money, seeds, irrigation equipments to growers through traders to supply hotels, hospitals, army, Bangladesh Rifles and others. Some exporters has also organized contract growing of vegetables for export markets mainly to the Middle Eastern countries, Germany and the United Kingdom.

These vegetables are grown near Dhaka and in some other neighboring districts. The river transportation linking to Dhaka is found to be favorable in keeping the quality of vegetables for export. Most of the vegetables are grown according to the choice of the individual growers. Price support and credit facilities may boost both production and quality of vegetables.

Table 1. Area, production, and yield of vegetables in Bangladesh, 1993-94

Vegetable	Area ('000 ha)	Production ('000 t)	Yield (t/ha)
Summer			
Pumpkin	5.26	32	5.93
Brinjal	9.72	56	5.83
Patal	4.05	22	5.31
Lady's finger	4.45	14	3.01
Jhinga	5.67	22	4.08
Karala	5.26	20	3.88
Arum (all)	13.96	97	7.14
Puisak	3.24	16	5.06
Chichinga	2.43	10	4.08
Barbati	2.83	7	2.47
Cucumber	3.64	16	5.98
Chalkumra	4.86	28	5.98
Stem amaranth	4.05	19	4.69
Other Vegetables	2.43	10	3.85
Lalsak	—	—	—
Kakrol	—	—	—
Dhundol	—	—	—
Datasak	—	—	—
Green banana	7.77	12.62	16.20
Green papaya (etc.)	4.62	33.25	7.43
Winter			
Potato	131.17	1,438	10.94
Brinjal	19.43	132	5.61
Cauliflower	9.31	72	7.78
Cabbage	9.31	81	8.87
Spinach	4.45	21	4.74
Water gourd	8.50	72	8.42
Rabi pumpkin	7.69	58	7.48
Tomato	11.74	86	7.34
Radish	20.24	180	8.82
Beans	8.91	41	4.59
Carrot	10.12	52	5.16

Source: Monthly Statistics Bulletin of BBS.

Note : 2% of banana (area and production) and 90% of papaya (area and production) are taken as green vegetables.

Vegetable marketing channels in Bangladesh

Vegetables are sold fresh or processed to the domestic and foreign markets. In Bangladesh, these are sold to wholesalers and retailers before reaching to the consumers. Thus, there is a tendency for prices to balloon tenfold. Figure 1 shows channels for vegetable marketing in Bangladesh.

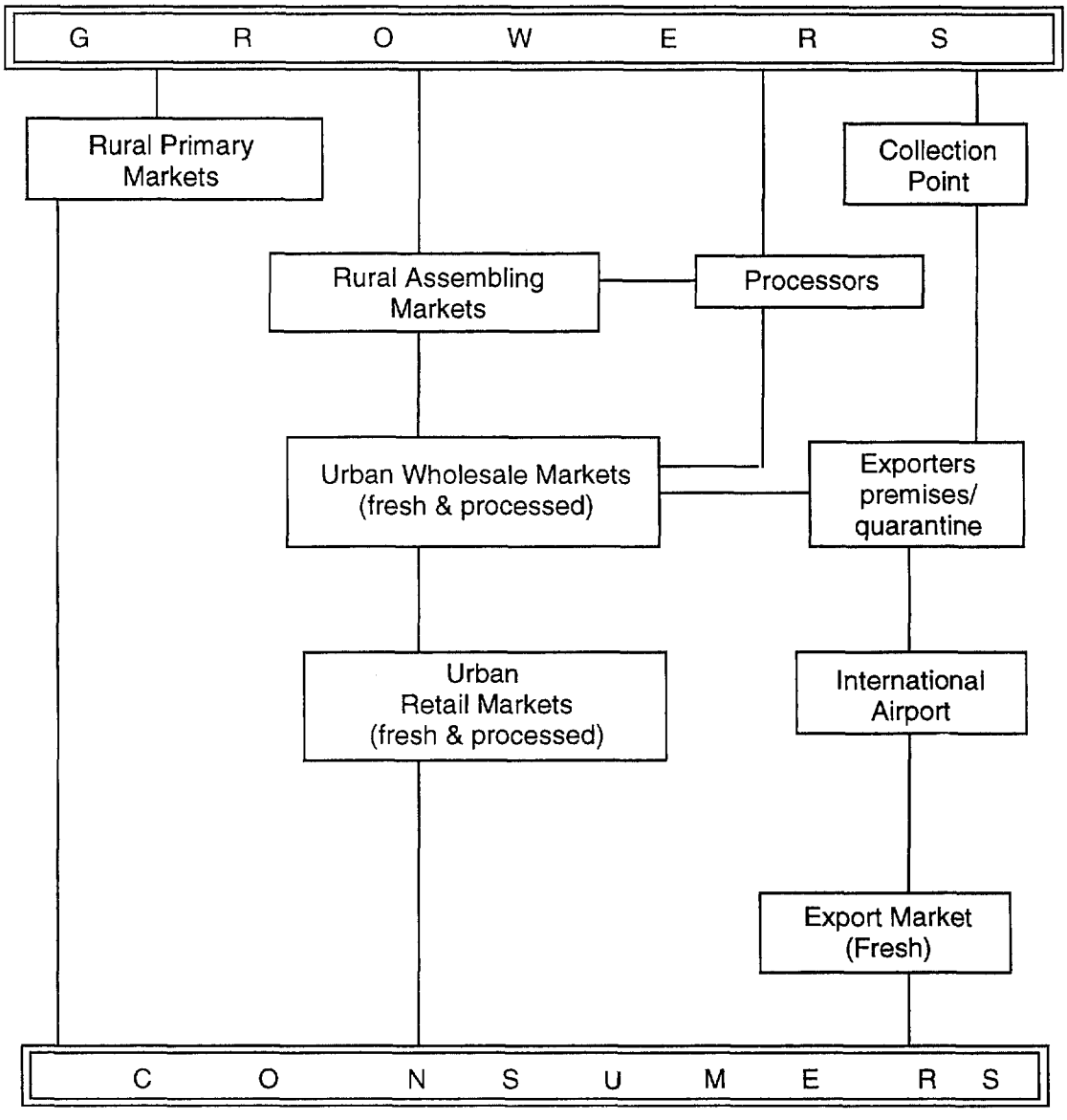

Fig. 1. Vegetable marketing channels in Bangladesh

Improved techniques for market intelligence

The present market intelligence system is not well organized. Out of 64 field offices of the Department of Agricultural Marketing, only 24 (field offices) have telephone lines thus market information is mostly sent by mails. Field offices collect information from 70 wholesale markets in semi urban/urban areas. Farm level prices are broadcasted over the radio once a week. The weekly wholesale prices are published in weekly bulletin. Retail prices in 64 district markets are collected and supplied to radio and government offices. Both wholesale and retail prices of farm and animal products of Dhaka wholesale markets are collected and supplied daily to newspapers, radios, banks and government offices. But very few items are broadcasted. The "Bangladesh Observer" publishes retail prices of selected items daily. The following are suggestions for improved market intelligence:

1. In the interest of the national broadcasting of vegetables, market information through radio and television should be introduced.
2. Prices and gathering of different vegetables of important markets should be published in separate bulletins.
3. Vegetable growers, traders/exporters associations should get the vegetables information bulletin of important markets.
4. Grade and standardization of vegetables, knowledge of packing and quality control should be given to growers and traders both for local and export markets to increase the status of vegetables by organizing training programs to farmers, traders and exporters.
5. Farmers need market information demand of different vegetables for each season so that regular supply can be ensured by production planning.
6. The prices and demand of export markets for different vegetables should be collected by the Department of Agricultural Marketing for distribution to exporters.
6. The capacity of DAM should be increased.

Price support

Imported vegetable seeds are available in the market in adulterated condition and some portion are smuggled out of the country. Farmers do not get good vegetable seeds at the right time at a reasonable price. The following actions may be taken :

1. Vegetable farmers association should be formed and encouraged to import vegetable seeds for the production of quality products. They may be given price support to import seed.
2. Exporters need price support on air freight in order to compete with the exporters of neighboring countries.
3. Manufacturer of packaging materials should get price support to boost the production of local packaging materials.

Credit

The farmers, traders, and exporters need credit for production and marketing. Necessary banking procedure should be developed and letter of credit (LC) should be introduced to parties of importing countries to increase export. At present exporters export vegetables to parties of the importing countries and get their money back after about four weeks which is unfavorable for vegetable business. The exporters repay cash to farmers through traders after five to six weeks.

Loans are almost unavailable to vegetable farmers. Traders are also hesitant to avail of loans in the banks because of uncertainty in vegetable marketing. The following steps may be considered:

1. Farmers, traders, exporters and processors should be provided with marketing institutional credit.
2. Provision of credit facilities for the construction of special types of wholesale market for vegetables, refrigerated van, coolroom and production of packaging materials.

Transportation

The most neglected area of vegetable marketing in this country is transportation both for local and foreign markets. Modes of transport and equipment, management of produce during transit, temperature control, road, vehicles and vehicle conditions, packages, loading patterns and load sizes, and product compatibility (temperature, ethylene, moisture and odor), for fresh produce during transportation or store as mixed loads are not maintained / considered properly. The road transport needs good facilities to keep the quality of the vegetables in good condition. There are no special facilities for transportation of vegetables for which 20-50% of different vegetables are damaged during handling from farmers field to retailers shop. Foreign carriers do not admit vegetables for export of inferior packaging. The national carrier (Bangladesh Biman) is connected to limited numbers of cities for foreign markets. The following steps need to be considered:

1. Buses which carry vegetables on its rooftop at night should be allowed to deliver vegetables to wholesale markets without unloading at the bus terminal.
2. Buses must use raised cover to protect vegetables from rain and heat of the sun.
3. Transport carrying vegetables should get space in covered sheds at the entry point of metropolitan cities during restricted hours. A few sheds need to be constructed.
4. Precooling and coolroom facilities should be constructed in vegetable wholesale markets in urban areas to reduce damage of vegetables.
5. Special type of vegetable wholesale markets should be constructed in metropolitan cities.
6. Refrigerated vegetable van should be used to transport vegetables from farms to wholesale markets.
7. To protect the vegetables during transportation, proper packing and packages should be used according to type of vegetables and distance covered by the transport and mode of transportation.
8. All weather river transport is the best carrier for vegetables from farms to wholesale markets or rural assembly market to wholesale market both for local and foreign shipments. Special programs should be taken for river transportation and waterways.
9. Efficient packing and packaging should be used so that foreign carriers agree to transport Bangladesh vegetables to different foreign destinations.
10. Vegetable van in rail should be reintroduced for metropolitan cities like Dhaka, Chittagong, and Khulna.
11. Arrangement of air cargo should be made for vegetable export.

Recommendations

Local and foreign information on market demand of different vegetables should be provided to vegetable growers and growers associations. Prices of important vegetables for wholesale markets should be broadcasted over the radio and television for farmers, traders, processors, and exporters. Retail prices should be broadcasted for consumers. Traders associations and exporters' association should get data of expected production of vegetables of different growing areas.

Vegetable farmers associations should be given price support for importing vegetable seeds. Exporters should be allowed price support for air freight to compete with India in boosting vegetable export. Vegetable farmer's association traders for contact marketing of vegetables, exporters for exporting vegetables should get facilities under letter of credit (LC) and processors of vegetables like tomato, potato, cauliflowers and others should be provided with institutional credit facilities.

Refrigerated vans for transportation of vegetables at private level should be encouraged by providing institutional credit facilities. Refrigerated van in railway should be reintroduced for increasing supply of vegetables to metropolitan cities. Bangladesh Road Transport Authority (BRTA) should issue order to truckers for using cover-in trucks for transportation of vegetables and commodities like foodgrains, salt, sugar, fruits in order to save national losses. The Ministry of Agriculture and the Ministry of Local Governments should take steps for the construction of special vegetable wholesale markets with modern facilities like coolroom, truck shed, and storage facilities for vegetables, etc.

Export of Fresh and Processed Vegetables from Bangladesh

M. Ahsan Ullah

Former National Consultant, Fresh Fruits, Vegetables and Flowers, UNDP/ITC Project of Export Promotion Bureau, Bangladesh

Abstract

Bangladesh produces around 3 million t of vegetables (including potato and sweet potato). There are 45 listed items of vegetables being exported to the United Kingdom, Middle East, Germany, Italy, New York, Amsterdam, etc. There are 500 exporters out of which 96 are regular exporters and 24 are leading exporters to the UK and the Middle East. The operations of Bangladesh Biman to various routes and the air freight charged are more or less within acceptable limit. The total quantity of fruits and vegetables exported was around 11,000 t at 20 million taka in foreign exchange. The export to the UK accounts for 100-25 t while in the Middle East (KSA, UAE, Kuwait, Qatar, and Oman) is 100-50 t per week i.e. a total of 200-275 t of vegetables exported depending on demand. The total vegetable production approximates around 7,500 t per year. The Bangladesh Biman carries the major quanta through five flights to the UK and as many as 13 flights to the Middle East, two flights to Amsterdam and New York per week. Apart from Bangladesh Biman the KLM, Thai, Saudia, Gulf, Emirates and British Airways carry almost 40% of the total vegetables and fruits. At present, air freights are cost effective. The main traditional items like aubergines, taro and yam, long beans, bamboo shoots, edoes, pumpkins, green papayas, and green bananas are the items we may offer in huge quantity. As a long drawn policy, we may go for the production of French bean, long bean, mushroom, courjettes, bamboo shoots, asparagus, specific types of aubergines etc., as preferred by the importers of Europe, America, Japan, Malaysia, Hong Kong, Singapore, and Thailand, etc. The improvement of packaging and cool chain management are the first two prerequisites for export and special emphasis is required. The crop like asparagus must be supported with cool chain management because of its high perishable nature. There is a big market for processed vegetables or even dehydrated vegetables thus special training should be organized for enterprises and the industries need be established. Linkage among the researchers, producers, exporters, Export Promotion Council, Export Promotion Bureau, Ministries of Agriculture and Commerce and other concerned agencies should be strengthened to improve the export industry of Bangladesh.

Introduction

Bangladesh is situated between 88-93^0 E Longitude and 20-26.5^0 N Latitude. As a tropical country its vast natural resources for the production of year-round vegetables have a good scope for traditional as well as exotic items. The winter from November in the south and October to March in northwest allows it to grow all temperate crops. The introduction of F_1 hybrids with high management are some of the items ahead of us which needs proper attention to boost quality production of vegetables for export market. Moreover, the operations of airlines, operation of cargo planes chartering of flights at peak season, improved packaging, supply pallet load of vegetables are some of the major problems which need attention.

Production of Vegetables

The country produces 3.63 lakh t (1 lakh = 100,000) of various items of summer vegetables in 0.71 lakh ha, while 7.76 lakh t of winter vegetables in 1.08 lakh ha. The production of potato amounts to 13.84 lakh t in 1.27 ha while sweet potato was 4.34 lakh t in 0.45 lakh ha (year 1992-93) as per BBS. Total production of summer and winter vegetables except 13.84 lakh t of potatoes and 4.34 lakh t of sweet potatoes was 29.57 lakh t. The betel leaf accounts for 0.69 lakh t in 0.13 lakh ha.

Exports

The national average per capita consumption of vegetable and fruits is quite low as per studies conducted by the National Institute of Nutrition. The export market in the Middle East and the United Kingdom has increased. But efforts for other items to supply the European and other markets need be explored. Out of the total vegetables produced except spices (3.02 lakh t) only 7,500 t are exported. All shipments are directly proportional to the operation of flights. These are lifted by the national flag carrier (Bangladesh Biman) which allocates 16 t for fresh produce in DC-10 per trip while the other airlines like Gulf, Emirates, Saudia, KLM, BA, Thai, etc. are the major fresh produce carrier allocating around 10-15 t per shipment. They prefer dry cargoes compared to fresh produce. The freight per kilogram ranges from 0.60 to 1.5 US dollars in the Middle East and Europe if the booking space is above 500 kilograms. As per existing facility extended by Bangladesh Biman Airlines 500 Kilograms is allocated to each firm. But there are companies who owns 4-5 companies and is registered with Biman and obtained space allocation in the UK or the Middle East.

Gulf Emirates, BA, Kuwait Airlines, KLM, Thai, Saudia, is normally on a case to case basis. No space is allocated in Dhaka office by Saudia as it is always the head office giving the space allocations. Anybody exporting through Saudia needs to have prior space allocation. But allocation of space in Bangladesh Biman for the UK is quite impossible for new entrants. Moreover, other airlines prefer dry cargo compared to fresh products. Biman is operating its fifth flight to London but agreed to take only 50% of the fresh products while the remaining 50% will be reserved for dry cargo.

There is a possibility that cargo flights by federal express or others which is expected to operate during this year may open up new chapter for Bangladesh.

Exporters and their ways of export

There are about 500 registered exporters of which 96 are regular exporters and 24 are big exporters of fruits and vegetables. The exporters have their own established buyers who are their relatives or friends who send daily orders for shipment on consignment basis. There were cases of unloading the vegetables which were either kept for a day in the airport and shipped on the following day or sold out incurring losses.

Previously 100% were sent in bamboo baskets but for one year now a major portion is being sent in perforated paper board cartons. About 15-20% are shrinkage losses which is supplemented by the excess supply of all exporters.

The meetings with Bangladesh Biman yielded good results. Biman agreed to allow 50% of fresh produce in its fifth flight to London. Biman agreed to reschedule its flights to KSA, UAE, and Kuwait on Thursday instead of Friday. The freights for Malaysia would be 50% of the normal charges till the end of 1995. Biman with the commissioning of four more DC-10 as planned, would increase flight operations to various destinations. The assessment of the areas, the quantity produced in the country, the growers-exporters' relationship, marketing for ethnic population, and export marketing for other countries (Europe, North America, Malaysia, and Japan) are quite

Japan) are quite different. The farmers' training for general and export productions are also quite different. The latest world cultivars support to enterprises are the main aspect of the export production.

Vegetable producing areas

Areas identified as the major vegetable belt of the country are Comilla, Norshingdi, Gazipur, Dhaka, Rampal (Munshiganj) Brahmanbaria, Bogra, Patiya (Chittagong), Pabna, Rangpur, Jessore, Kushtia, and Rajshahi.

Survey of vegetable exports

A survey on the prime items exported from Bangladesh to various destinations was also conducted. The same have been analyzed in meeting with the Bangladesh Fruits, Vegetables and Allied Products Exporters Association. They have been supported with 10 kg and 5 kg packages developed by the NC, ITC project and these packages are being used by some exporters.

Export of processed vegetables

Gherkins are now being exported to Sri Lanka by Agricultural Marketing Company Ltd. They will soon find a market in Europe. Gherkins are small pickle cucumber processed in brines. The same company exported around 30 tons of the same item to Sri Lanka by using the seeds supplied by Sri Lanka exporters. The parent company sent various types and qualities of the gherkin seeds at different times and the result was poor production or loss of crop. The know-how as relayed from time to time was also misleading which caused losses. Other processed items like baby corn and pickled tomato are yet to be developed.

Conclusion

The export and domestic productions or the product development for export had attributed to the comparative advantage of climate, freight (air, ship) rate, packaging, number of sorties flown by different aircraft per week, and allocation of space by airlines for the fresh produce. The demand for traditional and exotic items in the world market has increased. The demand for 'French bean' is considered number one in Europe. There is also high demand for courjettes (squash). The yard-long bean export to the UK and the Middle East increased with the improvement of perforated paper board cartons. The price per kilo has increased by 0.25 cents in the UK last year. The demand for aubergines (brinjal or eggplant) has also increased in the European market. It is best to supply more vegetables to the European countries during winter where our cost of air freights is lower compared to their cost of heating especially on frozen food products.

Recommendations

1. Reduction of air freight royalties and increase in flight operations;
2. Implementation of the 'export village' policy;
3. Materialize the use of freezer vans from the farm house to the airport;
4. Provision of soft term credit for the growers and exporters;
5. Attract bigger cargo airlines; and
6. Development of improved cultivars, packaging practices, efficient quality control, and intensive IPM practices.

Exporting Vegetables: Problems and Solutions

S. M. S. Kamaly

Secretary General, Bangladesh Fruits, Vegetables and Allied Products Exporters Association

Abstract

Vegetables produced in Bangladesh are exported to the Middle East Countries and the United Kingdom, Germany, Canada, Italy, and France. These are carried by the Bangladesh Biman (official carrier) and some aircrafts operating in the country. Bangladesh could have exported Tk. 300 crores (1 crore =10,000,000) in foreign exchange each year. But some problems should be first addressed and solved to pave the way for a smoother and easier flow of export activities.

Introduction

Bangladesh as predominantly an agricultural country has been producing various traditional and exotic vegetables. The latest varietal improvement of vegetables in different countries are playing a pioneering role in production as well as export. But Bangladesh needs to exert more effort to boost export of various products to the Middle East and the United Kingdom.

Our export began in the 1970s (1973-74) but gained momentum in the 1980s with the increase of air flights and the introduction of bigger aircrafts (DC-10) in the fleet of Bangladesh Biman.

In 1985 the BADC established a cold storage (60 t capacity) at Zia. BADC gave initial support for the export production and also for postharvest i.e. handling, sorting, grading, packing, etc. Meanwhile, export supply zones increased in Dhaka, Mymensingh, Gazipur, Narshingdi, Comilla, Brahmanbaria, Jessore, Chittagong, Sylhet, Pabna, Rajshahi, Bogra, Rangpur, Kushtia, etc. Targeted export of fruits and vegetables totalled 11,500 t valued at 180 million takas in 1994. But this target could not be achieved. However, there is a possibility to earn 300 crore taka (1 crore = 10,000,000) easily if major problems shall be addressed properly.

Problems

1. Eighty percent of the packaging materials is imported subject to import duty;
2. High interest rate of credit;
3. Inferior quality of products;
4. No export village (as planned by the government) to give loans on soft-term basis;
5. Inability to meet world market demand for quality products;

6. Air cargo space allocation, frequent increase in air freight, absence of local and international cargo and high royalty imposed by the civil aviation authority on other airlines;
7. Poor support to Bangladesh trade missions abroad; and
8. No export performance benefit.

Recommendations

1. Development of improved/quality packaging materials.
2. Credit support to the growers/exporters from various banks/institutions on soft- term basis.
3. Full support from the government is needed especially on export products. The government and other concerned agencies should organize an Export Fair to be participated in by growers/exporters.
4. The government should establish an Export Village. The extensive service and loans given by the Export Village on a soft term basis to the growers/exporters shall improve quality of products for export.
5. Production of more quality products to meet foreign demand.
6. Aircrafts should allocate bigger space for export products. Bangladesh Biman should reduce air freights by at least 15%. Other airlines should be allowed to operate with lower royalty from the civil aviation authority. An exporter paying air freight worth Tk 10 lakhs (1 lakh = 100,000) to Biman should be given free Biman ticket to explore various markets.
7. Bangladesh trade mission abroad like the United Kingdom, Japan, Malaysia and Hong Kong should be strengthened to attract wider market for various products and achieve more foreign exchange.
8. Introduction of Performance Benefit.

Chapter 5

Socioeconomic Aspects of Vegetable Agribusiness

Session VI: Socioeconomic Aspects of Vegetable Agribusiness

Chairman : Dr. M. Ishaque

Rapporteurs : Dr. Jahanara Khan
Mr. S. R. Saha

Role of Women in Vegetable Agribusiness

Nilufer Ahmed Karim

Secretary General, Women Entrepreneurs Association, Bangladesh

Abstract

Women's involvement in agriculture has started since time immemorial. They play an important role in crop production as well as in livestock and fisheries. Women are effective managers of farming operations to a much greater degree than what is evident from national statistics because it is not socially acceptable for women to be involved in the field of agriculture. Women in very small land holding have the highest involvement in agriculture, followed by women in landless, small and medium sized holdings.

Most household fruit and vegetable gardens that supplement the family food consumption become the women's responsibility. The male members are more involved in fertilizer and insecticide applications and in selling the produce to the market. Women are more involved in seed collection, seed storage, water management, fertilizer application daily maintenance, harvesting and even in field-laced vegetable production. Women and children's participation is predominant in weeding, watering and specially, harvesting of different vegetables and spices.

In case of tribal people, vegetable growing fields are mostly cared for by the women. The tribal women of Garo, Chakma and Marma are traditionally managers and workers of their agricultural lands. Urban women are also often found to be eager to grow vègetables in the homestead.

The contribution of homestead crops to the total food production has remained largely invisible. Its contribution to the family income is even less known, although there are indications that such income could be quite significant. The performance of small, marginal and landless households in terms of average returns per decimal of homestead land is reported to be far superior from large household due to more intensive labor inputs on the part of women in poor households. Traditionally, rural and urban women are also involved in home preservation of vegetables. Women's contribution to family health and nutrition is highly important.

One-third to half of vegetables, spices, and fruits grown in the homestead are sold to supplement the family income. Among homestead activities, vegetable cultivation contributes two to six percent and tree cultivation is one to 22 % of total income varying according to location. Although, women are primarily responsible for homestead crop production, the marketing of homestead produced is not entirely under their control. In general, women in landless, marginal, and small farm households are directly involved in marketing of fruits and vegetables more often than women in medium and large households.

Women control their income in nearly all female headed households, irrespective of homestead size. In male headed households the control of income varies considerably according to who sells homestead crops. When the wife sells the crops or the children, the wife retains control to most of the income.

Because of their wide and long-standing experience with women groups and members, NGOs are promoting the participation of women in vegetable production, consumption and utilization. But the extent of their institutional support to women in vegetable production varies considerably.

Introduction

In Bangladesh, women constitute nearly half of the total population. They play an important role in rice production and horticulture as well as in livestock and fisheries. Despite evidence indicating that women make important agricultural decisions and perform most agricultural tasks alone or jointly with men, they are not yet recognized as farmers. The invisibility of women-farmers from official agricultural statistics and from agricultural policies and programs is due to sociocultural values and attitudes. Accordingly, it is not socially acceptable for women to be involved in the field of agriculture. Because women are not seen as being involved in rice production, they are not considered to be farmers along with many other marginal and small-scale farmers who are engaged in crop production as well as in livestock and fisheries. (Rothschild and Mahmud 1989).

Involvement in Agriculture

Women's involvement in agriculture had started since time immemorial. In fact they were the pioneers in plant domestication and planned agriculture. In Bangladesh, according to Ahmed (1992), women of the 55, or so, percent of the families who own land up to three acres play a major role as unpaid family labor in various agricultural operations involving rice and cash crops as well as in poultry and cattle raising and other gardening activities.

The 1984-85 Labor Force Survey reports that the labor force participation rate for men was 78 and eight for women. The rates of participation in the agricultural labor force for men and women are 55.4 and 0.8 percent respectively. Data, however, collected by Agriculture Sector Review (ASR) showed that women in agriculture census (of randomly selected 3,949 households in 20 districts in different agroecological zones) showed that women's involvement in agriculture was much greater than that reflected in the Bangladesh Census. Women are effective managers of farming operations to a much greater degree than what is evident from national statistics (Chowdhury and Hossain 1992). Women in very small land holdings (0.06-0.49 acres) have the highest involvement in agriculture, followed by women in landless, small and medium sized holdings.

Participation in Vegetable Production Process

Vegetables form an integral part of the diet. Some vegetables and fruits are produced in almost all rural households within the homestead. The area of food preparation and consumption which includes the proper use of vegetables retaining their nutritional values is almost an exclusive women domain. Salma Khan (1988) said that most household fruit and vegetable gardens that supplement the family food consumption become the women's responsibility.

In fact, women play a dominant role in food production process in the homestead. In general, husband, children, and other family members are less involved in making decisions on growing vegetables (Chowdhury et al. 1992). It was also found by Hossain et al. (1988) that the wives of landless farmers (51%) dominate in decision making for vegetable production, while both wife and husband jointly make the decisions in the case of medium (52%) and large (52%) farms. The male members are involved more in application of fertilizers and insecticides and in selling the produce to the market. Women are more involved in seed collection, seed storage, water management, fertilizer application, and daily maintenance (Chowdhury et al. 1992).

Even in the field-based vegetable production system, women's involvement is substantial. Women and children's participation is prominent in weeding, watering, and especially, harvesting of different vegetables and spices.

In some areas of Chittagong Hill Tracts, Dinajpur and Mymensingh, where tribal people live in clusters, vegetable growing areas are mostly cared for by the women. The tribal women of Garo, Chakma and Marma are traditionally managers and workers of their agricultural lands (Chowdhury and Hossain 1992). Urban women are often found to be eager to grow vegetables in whatever small piece of land is available in any corner of their compound. In the cities, roof gardens are becoming a common scene.

Contribution in Addition to Family Food and Income

Although, the homestead has been a regular source of both family food production and consumption, the contribution of homestead crops to total food produced has remained largely invisible. Thus not much effort has been made in estimating the income from the cultivation of homestead vegetables, fruits, and spices, although there are indications that such incomes, underrated by the women themselves could be quite significant, particularly in small and medium farm households (Islam and Ahmed 1987; BRAC 1983). It is not also recognized that women perform the major roles in homestead farming system, and that they control homestead production and income.

About two-thirds of homestead horticulture products are used for family consumption. One study reports that as much as 29-46 % of vegetable and 68-97 % of fruit consumption came from existing homestead production (World Bank 1988). The study on women's contribution to the homestead system (Husain et al. 1988) on the other hand, reports that 18 % of farm households can meet family vegetable and fruit requirement adequately from household production while 19% of households are able to meet family vegetable requirements (Husain et al. 1988).

Average returns from vegetable production are difficult to estimate. According to BARI's estimates of "average returns" from homestead vegetable production from one FSR site at Ishurdi, the performance of small, marginal and landless households in terms of "average returns per decimal of homestead land" is far superior than that of large farm households, possibly due to the more intensive labor inputs on the part of women in poor households (Islam and Ahmed 1987). It has also been found that while landless, marginal, and small farm-households concentrate primarily on vegetable and spice cultivation, large and medium farm households cultivate more often fruit and timber trees. This explains why men rather than women are the major decision makers regarding homestead agriculture since men, more often than women, control the management of timber and fruit trees (Rothschild and Mahmud 1989).

Some rural and urban women practice dry preservation of different vegetables such as cabbage, leafy vegetables, and bitter gourd. Tomatoes are preserved as jams, jellies and ketchups by urban women. Potatoes are processed as potato chips. Vegetables provide critical sources of energy and protein, specially for weaning age children. Women are frequently the principal providers for family diets thus their purchasing power and food production capability has a direct impact on household nutrition and health.

Involvement in Vegetable Crops Agribusiness

Although most rural households are unable to meet family requirements of vegetables and fruits, one-third to half of vegetables, spices, and fruits grown in the homestead are sold to supplement family income (BRAC 1983; Islam and Ahmed 1987; Chaffer. 1986). The contribution of homestead-based activities to total family income can be quite substantial, ranging from 32 to 49%. Among homestead activities, vegetable cultivation contributes 2 to 6% and tree cultivation is 9 to 22% of

the total income varying according to location (World Bank 1988). The share of the sale proceeds to total household income is low since proportionately, more is consumed than sold.

Presently, production of vegetables are sold immediately after harvesting (except for spices) and in small quantities. Prices during the early harvest period are significantly higher (by 100 to 250 %) than prices at peak harvest season when markets are glutted (Khaleque 1987). Prices also vary by region due to inefficient marketing channels and the lack of immediate transport services.

Although women are primarily responsible for homestead crop production, they do not entirely control the marketing of homestead produce. In general, women in landless, marginal, and small farm households are directly involved in marketing vegetables and fruits more often than women in medium and large farm households. BARD study reports that about 10% of the women from all farm categories sell vegetables and fruit themselves, while children sell vegetables and fruits at 22 and 17% respectively. Among the landless, the wife sells vegetables and fruits at 15 and 22% respectively. Small and marginal farm households showed similar patterns. In contrast, the proportions of women selling homestead produce is 4-5% for large farm households (Husain et al. 1988).

Agriculture Sector Review

Survey of women's role in agriculture showed that a higher proportion (90.3%) of female-headed households who grow vegetables sell part of their produce than women in male-headed households (80.5%). Homestead produce are usually sold either directly to the dealers or at the village market. Sixty-three percent of the produce is sold at the village market, 23 % to the dealer and at the village market, 8.9% to the dealers and only 5 % outside the village. The proportion for female-headed and married women are similar. Since majority of rural households sell small amounts of homestead crops and fruits immediately after harvesting, it is logical that most are sold to the dealers who personally collect the produce or at the local markets.

In 1985, a project at the Bangladesh Agricultural Research Institute (BARI) FSR site at Kalikapur in Ishurdi, under the National Farming System Research Program of BARC, was undertaken to develop a technology that would boost vegetable production in homesteads (FSR November, 1990). The program had a threefold thrust : (i) to encourage homestead owners to grow year-round vegetables and thereby increasing their nutritional intake; (ii) to generate additional income for farmers by selling excess vegetables; and (iii) to involve women and children in active homestead labor. The grand success of this program was attributed to the involvement of women.

Participation in NGO's Vegetable Development

The beneficiaries of the NGOs are poor but enterprising women. One of the major objectives of the NGOs performing in Bangladesh is to assist rural people in proper marketing of their produce. (Husain et al. 1984). Among the various commodities produced, vegetables are the most perishable that need to be handled properly at their postharvest stage. During the peak season, when glutting occurs due to assemblage of large quantity of different vegetables at a time, the producers incur losses from slumps in the price. A large portion of vegetables go to waste due to microbial infestation and inefficient handling, transportation, storage, and marketing (Rahman et al. 1992).

Since the inception of Grameen Bank, the largest number of loans were disbursed to women who were engaged in livestock, fisheries, and crops particularly fruits and vegetables. As much as two-fifths of the total number of loans were given to women (Grameen Bank 1985). Proshika's women program is exclusively directed towards women from households of landless agricultural laborer, poor, small and marginal farmers, and different occupational distributions of the rural poor (Shormin 1990).

Other NGOs notably BRAC, Proshika, RDRS, and Nijera Kari, have also been active in organizing the rural poor and in assisting them to engage in gainful self employment. They were able to provide various institutional support to rural women in vegetable production.

Because of their wide experience with women groups and members, NGOs were able to bring about effective participation of women in vegetable production, consumption, and utilization. The planners and policymakers, as well as concerned NGOs made adequate provision of vegetable programs involving women.

Conclusion

Women play a very important role in the production of vegetables. As this subsector will increasingly play an important role in food security and improved nutrition, the production in this area needs to be intensified and expanded through development programs and projects which fall within the mainstream of agricultural investments. Women's homestead production should be increased to satisfy local and regional vegetable production to generate more employment.

References

Agriculture Sector Review Survey. 1988.

Ahmad, K.U. 1992. NGOs: Promoting vegetable production in Bangladesh. In: Vegetable production and marketing. AVRDC, Taiwan. p. 235-44.

Chowdhury, D.N. and Hossain, S.M.M. 1992. Role of women in vegetable production and consumption. In: Vegetable production and marketing. AVRDC, Taiwan. p. 210-18.

Anonymous. 1990. Homestead vegetable production programme-a boon to marginal and landless farmers. Farming Systems Agribusiness, newsletter, Vol. 1, No. 2, April-June 1990.

Grameen Bank Annual Report. 1985. 26 p.

Husain, et al. 1988. Women's contribution to homestead agricultural production systems in Bangladesh. Kotbari, Comilla, Bangladesh Academy for Rural Development.

Khaleque, V. and Chowdhury, F. 1987. Vegetable development in Bangladesh: A Pre- feasibility report. Bangladesh - Canada agriculture sector team, Counterpart unit, Dhaka.

Labor Force Survey. 1984-85.

Rahman, M.A., Nath, K.K. and Rahman, M.M. 1992. Postharvest handling and processing of vegetables. Vegetable production and marketing. AVRDC, pp. 199-203.

Rothschild, C.S. 1983. The state of statistics on women in agriculture in the third world. FAO. Rome.

Rothschild, C.S. and Mahmud, S. 1989. Women's roles in agriculture: present trends and potential for growth.

Shormin, A.H. 1990. Women in development. ADAB News, 17 (3).

World Bank. 1988. Intensified homestead production project. Draft Report, Dhaka.

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Credit and Input Supply System for Vegetable Agribusiness: Present Status and Policies

M. Sahadad Hussain, M. Elahi Baksh, and M.A.Monayam Miah

Agricultural Economics Division, BARI, Joydebpur, Gazipur, Bangladesh

Abstract

Farmers give priority to food grain production than vegetables. They are less interested towards large-scale vegetable production for its perishability and bulkiness. It requires a lot of activities in postharvest, processing, quick disposal, transportation and marketing. Besides, the growers have been facing tremendous problems such as unavailability of major-variety seeds, scarcity of fertilizers, lack of irrigation facilities, absence of institutional credit facilities, and lack of appropriate knowledge on improved management practice on vegetable production. Due to the government policy in the past, the total amount of credit available for disbursement has been increased. However, farmers have received a negligible share of increased credit for growing vegetables. Except potato, basically no special institutional credit facility for vegetable growers is available. For each financial year, Bangladesh Bank prepares an Agricultural Credit Indicative Policy (ACIP) for loan disbursement through different bank/financial institutions.

The recent crop loan distribution system in different commercial banks is comparatively easier than the past. But its interest rate is higher (10-4%) compared to the industrial loan which is only 8-12 %. Short-term credit (for 4-8 months) should be ensured to the farmers before or at the time of growing vegetables. The amount should be equal to the cultivation cost of the respective vegetables. Recovery period should be fixed during crop harvesting period (within 2-4 months) and loan repayment should be made on a weekly installment basis as followed by BRAC or Grameen Bank.

Institutional credit should be extended to private entrepreneurs to operate and establish processing and storage plants, introducing refrigerated transportation systems. It should also be extended to the marketing intermediaries especially for *Beparis, Arathders,* and retailers for promoting effective vegetable marketing systems. Retailers, *Beparis* and *Arathders* need about Taka 3 to 8,000/day, Tk. 10 to 15,000/week, and Tk. 50 to 200,000/ month, respectively. Special credit program for vegetable marketing might be helpful for improving the present marketing situation. Vegetable production and marketing corporation should be established. This corporation will be responsible to give technical and logistic (credit) support to the marketing participants, private entrepreneurs, NGOs, farmers involved in production, inputs supply, processing, and marketing of vegetables.

Introduction

Most of the vegetables are season-specific which resulted to either surplus or scarcity of vegetables in the market within a year. About 70% of the total production is produced in winter.

Among all production inputs, chemicals and fertilizers are found to be too costly for the average farmers. Higher input prices indirectly influence farmers to use low quantity of inputs thus reducing crop yield.

Although summer vegetables are mostly grown rainfed; winter vegetables require more irrigation during their growing period. Because of the over emphasis given to rice and wheat production, irrigated areas are not generally available for vegetable cultivation without some exception to commercial vegetable growing areas. As a result, the growth and quality of winter vegetables suffer from moisture stress.

Constraints

Lack of credit facilities

Compared with other crops, the production cost of vegetables is found to be comparatively higher and needs high cash investment. Vegetable growers reported the lack of credit facilities to be a serious constraint to the use of high quality inputs and introduce modern farm management practices.

Recently, due to the government policy, the total amount of credit available for disbursement has been increased. However, farmers have received a negligible share of this increased credit for vegetable production. Except potato, basically, no special institutional credit facility for vegetable growers is available.

Seed

To increase vegetable production, development and immediate release of major varieties is essential. Realizing the fact, recently, the government has liberalized regulations for releasing of new vegetable varieties through the implementation of the National Seed Policy (NSP)in the country. The NSP encourages government agencies as well as private traders to produce, process, preserve, and distribute quality seeds.

Presently, BADC, DAE, and some private traders has only met 36% of the vegetable seed requirements of the country. In this context, a Seed Development Corporation (SDC) for all crops including horticulture, in the public sector with a major responsibility of producing and distributing quality seeds of improved varieties may be established. Simultaneously, private entrepreneurs should be encouraged to produce good quality seeds of improved varieties.

Fertilizer

Fertilizer, an essential input, directly influences crops for higher yields, covering a lion share of total cash cost of crop cultivation. The use of fertilizers mostly depends on its smooth distribution system and price. Presently, due to the ineffective distribution system, the fertilizer price went exceptionally high compared to the past. The fertilizers are distributed through the channels as shown in figure 1. So, for smooth distribution, fertilizer traders should be given equal chance to receive any amount of fertilizers from the factory. They should be responsible for fertilizer distribution among the farmers. During higher price hike, government can make a buffer stock

at BADC through its personnel. During the crisis period, fertilizers can be supplied easily from the stock and sale to open markets at a reasonable price. Figure 2 shows suggested distribution channels of fertilizer.

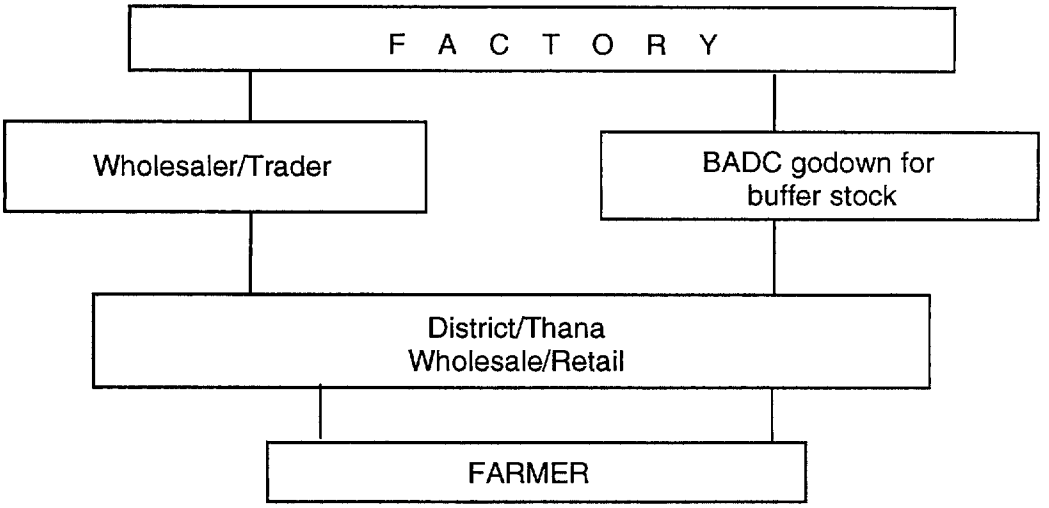

Fig. 1. Present fertilizer distribution system

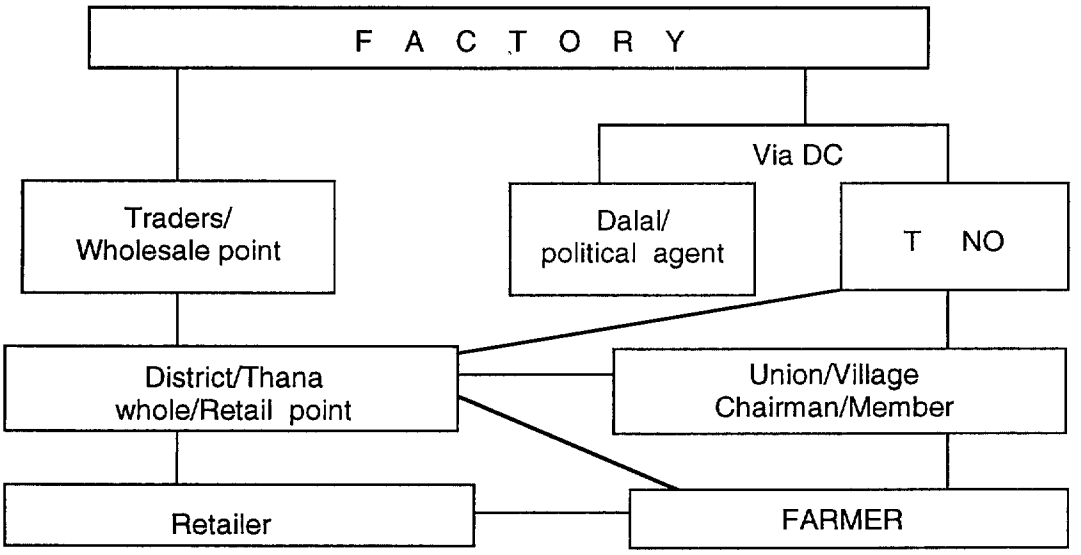

Fig. 2. Suggested fertilizer distribution system

Government Agricultural Loan Disbursement Policy

For each financial year, Bangladesh Bank prepares an Agricultural Credit Indicative Policy for loan disbursement through different banks/financial institutions. Each and every bank are supposed to follow the "Indicative Policy" which includes the following terms and conditions:

1. Each bank should fix/allot at least 50% of their total loan disbursement target, for short-term crop production loan.
2. Crop loan must be distributed at least 15 days before sowing/planting of crop.
3. A farmer may receive a 2.02 ha crop production loan except potato and sugarcane.
4. Collateral should not be required for crop loan equal or below 1 ha; collateral will be required to loans above 1 ha.
5. Anybody engaged in agricultural activities are eligible to avail of agricultural loan.
6. Repayment should be insured within four to six months after respective crop harvest.
7. The interest rate of both agricultural and rural credits should be within 10-14%. It should be counted as a simple interest rate (from the first of July, 1993). If the borrower fails to repay the loan within the next six months from the expiry date , then counting should be done as compound interest rate.

Agricultural Loan Disbursement Policy of GKF/BARI Joint Program

The GKF and BARI initiated a joint program for production and development of vegetables and their seeds at farmers level in 1993. In this program, they arranged to supply inputs like MV seeds, fertilizers, insecticides, irrigation as well as cash to meet labor expenses as a credit. In some vegetables, GKF provides credit facilities at 20% interest rate as a service charge. Usually they distribute the gross income of vegetable product at different sharing arrangement (50:50 and 33:67) for GKF and farmer. The entire production program was conducted in close supervision of GKF and BARI officials. The program reveals that vegetable production is much more renumerative than the other competing rabi crops such as wheat and tobacco (Akter 1995).

Shortcomings of government policy

1. The refinance system existed before 1990. In this system the respective banks can claim to Bangladesh bank for refinancing of certain percentage (about 50-60%) of agricultural credit for the farmers. However, only few farmers had availed of this system.
2. High interest rate for agricultural loan (10-14%) compared to industrial loan (8-10%).
3. No specific amount of loan for horticultural crops.
4. Poor repayment system. Repayment of loans extends four to six months after harvest when farmers had already spent their money out of their produce.

Distribution of agricultural credit

There are a number of financial institutions such as Bangladesh Krishi Bank (BKB), Sonali Bank, Janata Bank, Agrani Bank, Rajshahi Krishi Unnoyan Bank (RKUB), BRDB and Bangladesh Samabaya Bank Ltd. who have been distributing the entire institutional loan to the agricultural

sector (table 1). The mount of agricultural loan was increased to Tk. 595.60 crore in 1990-91 to Tk. 1100.00 crore in 1994-95 (1 crore=10,000,000). Among all other subsectors of agriculture, crop sector covered the major portion of total agricultural credit which was about more than 50%. Crop loan distributed by BKB from 1990-91 to 1993-94 is shown in table 2. Out of total loan distributed by BKB, crop loan was around 50% in 1990-91 and it has increased to about 57% in 1992-93. But, among the crop loans, a very small amount (0.01% to 0.14%) was distributed for vegetable crops. Maximum crop loan was disbursed for tea plantation (about 50% to 77%).

Table 1. Amount of agricultural loan disbursed by different commercial banks[a], 1990-95

Year	Loan distribution in tk. crore/year						
	Crops	Livestock	Fishery	Irrigation	Agril.	Others	Total
1990-91	219.93	35.38	6.28	34.20	-	299.81	595.60
	(35.93)	(5.94)	(1.05)	(5.74)		(50.34)	(100.00)
1991-92	346.39	67.38	10.01	23.58	5.85	341.38	794.59
	(43.59)	(8.48)	(1.26)	(2.97)	(0.74)	(42.96)	(100.00)
1992-1993	382.06	70.76	13.98	11.10	3.44	366.51	847.85
	(45.06)	(8.35)	(1.65)	(1.31)	(0.41)	(43.23)	(100.00)
1993-1994	515.13	96.40	15.17	1.37	2.88	469.84	1,100.79
	(46.80)	(8.76)	(1.38)	(0.12)	(0.26)	(42.68)	(100.00)
1994-95	546.74	85.58	19.21	1.71	1.52	290.47	945.23
31st March '95	(57.84)	(9.05)	(2.03)	(0.18)	(0.16)	(30.73)	(100.00)

Source: Bangladesh Bank.

[a]Commercial banks include Krishi Bank, Sonali Bank, Janta Bank, Agrani Bank, Rajshani Krishi Unnayan Bank, BRDB, and Bangladesh Samabaya Bank, Ltd.

Note: 1 crore=10,000,000; Figures in parentheses indicate percentage of the total loan disbursed.

Table 2. Loan disbursed by Bangladesh Krishi Bank for different crops, 1990-94

Crop	Loan disbursement in lakh tk./year			
	1990-91	1991-92	1992-93	1993-94
Cereals	2,493.13	7,436.42	8,795.74	12,971.64
	(15.15)	(31.24)	(33.47)	(40.39)
Tea	12,385.83	14,589.59	14,945.05	15,890.60
	(77.05)	(61.37)	(56.87)	(49.48)
Potato	756.03	860.60	1,410.82	1,821.99
	(4.70)	(3.62)	(5.37)	(5.67)
Vegetables	0.84	3.10	36.79	30.91
	(0.01)	(0.01)	(0.14)	(0.10)
Banana	5.95	25.07	49.76	34.40
	(0.04)	(0.11)	(0.19)	(0.11)
Others	432.50	856.68	1,040.00	1,367.18
	(2.69)	(3.60)	(3.96)	(4.26)
Total	16,074.28	23,772.46	26,278.55	32,116.72
	(100)	(100)	(100)	(100)
Total % of loan distributed	(49.64)	(53.81)	(56.71)	(53.66)
Total loan distributed	32,383.83	44,178.41	46,342.47	59,855.00
	(100)	(100)	(100)	(100)

Source: Bangladesh Krishi Bank 1995.

Note: 1 lakh=100,000; Figures in parentheses indicate percentage of the total loan disbursed.

In 1990-1994 BKB disbursed a long-term loan for the development of different kinds of fruits, vegetables and other plant species as shown in table 3. Out of the total loan disbursement (1993-94), only 20% was disbursed for horticultural crops and 80% for tea garden development.

Table 3. Long-term loan disbursement of BKB for different income generating projects, 1990-94.

Project	Loan disbursement in lakh[a] tk./year			
	1990-91	1991-92	1992-93	1993-94
Fruits and vegetables (betel	29.87	80.77	59.30	244.15
leaf, coconut, others)	(5.26)	(12.37)	(100)	(20.36)
Rubber production	52. 21	52.95	NA	NA
	(9.20)	(8.11)	NA	NA
Tea garden development	482.86	498.90	NA	950.74
	(85.05)	(76.41)	NA	(79.30)
Others	2.82	20.34	NA	4.01
	(0.50)	(3.12)	NA	(0.33)
Total	567.76	652.96	59.30	1,198.90
	(100)	(100)	(100)	(100)

[a]*Codes as followed in table 2; NA - Not Available*

Credit for agribusiness

The BKB disbursed some current capital loans to the entrepreneurs of agricultural processing and storage business. No loan was distributed for horticultural crop processing and storage except potato. For marketing of different agricultural products/inputs, BKB disbursed some loans to the dealers of fertilizer and pesticides. BKB also provided current capital loan for promotion of export business that included some vegetables and fruits (table 4). Bangladesh Bank disburses a considerable amount of loans to growers of fruits and vegetables 15 days before crops are planted (table 5).

Marketing participants and channels

Marketing of vegetables in Bangladesh mainly involves three stages:

1. Farmgate to local primary markets;
2. Primary market to urban *Arath* center; and
3. *Arath* center to retail markets.

Faria, Bepari, Arathder, Paiker, and Retailer are traders and intermediaries involved in vegetable marketing. Table 6 shows their business characteristics.

Table 4. Capital loan disbursed by BKB for processing, marketing, and storage, 1990-94

Agribusiness	Loan disbursed in lakh tk./year			
	1990-91	1991-92	1992-93	1993-94
Processing				
Rice mill	90.90	154.59	153.02	287.15
Flour mill	108.53	293.83	297.33	250.45
Potato storage	749.07	824.23	1,334.54	1,806.80
Jute processing	-	5.95	-	-
Tobacco processing	713.00	289.76	-	-
Textile	58.36	37.40	78.85	87.53
Oil	44.44	38.09	66.14	43.30
Fish processing	4,312.66	2,880.78	2,847.41	2,080.79
Timber	51.78	42.01	166.96	233.86
Others	1,705.51	1,564.46	2,495.58	5,645.70
Total	7,834.25	6,131.10	7,439.83	10,435.58
	94.03%	86.35%	88.79%	88.43%
Marketing				
Fertilizer	67.20	130.38	254.19	148.92
Insecticide/fungicide	4.10	6.10	5.65	4.60
Cotton	-	24.33	-	-
Tobacco	12.50	10.40	11.50	2.50
Internal food grain collection	77.14	60.42	103.57	197.41
Wholesale/retail	17.18	22.83	53.94	83.39
Salt	9.54	22.19	2.98	55.38
DTW (borrowing)	19.50	5.33	5.00	-
Pump & other machineries	1.04	19.05	36.35	18.93
Others	204.64	325.67	375.90	752.52
Total	412.84	626.70	848.68	1,263.65
	4.96%	8.83%	10.13%	10.71%
Loan for export business	84.16	342.49	90.28	102.00
	1.01%	4.82%	1.08%	0.86%
Total	8,331.25	7,100.29	8,378.79	11,801.23
	100%	100%	100%	100%

Constraints to marketing

Marketing of vegetables in Bangladesh are constrained mainly by the following problems:

1. Majority of vegetables including potato in Bangladesh are produced and sold in the countryside. Several market participants are handicapped by poor roads and poor transportation facilities needed for marketing of perishable vegetables from the growers premises to the consuming centers.

2. Delay in transit, poor handling and packing cause considerable damage and spoilage of vegetables. Bamboo baskets, gunny bags, and long sacks are being used for packing.

3. Processing facilities in the country have not been properly developed because of high processing cost resulting to higher cost of processed products.

4. Major constraints relating to export of fresh vegetables include, production shortage; unavailability of export quality produce; seasonality of domestic supply; lack of proper storage and grading facilities; absence of improved packaging materials; and proper transportation systems and higher air freight.

5. Cold storage facilities are not dispersed throughout the country. Absence of cold storage facilities in certain areas causes marketing problems in potatoes. High perishability of most vegetables and lack of adequate storage facilities compel the farmers to dispose their produce at a lower price during the peak season.

Table 5. Production cost of of fruits and vegetables (tk/acre), loan disbursement, and repayment period in Bangladesh bank

Crops	Loan/acre	Loan distribution	Harvesting period	Repayment period
Winter Vegetables				
Country bean	9,412	Aug. - Sept.	Nov. - Feb.	Up to June
Lalsak	6,833	Jan. 15-Sept. 15	Nov. - Feb.	Up to June
Palong sak	7,861	Aug. 15-Dec.	Oct. - Mar.	Up to September
Radish	11,020	Oct. - Nov.	Jan. - Feb.	Up to June
Cauliflower	13,027	Oct. - Nov.	Jan. - Feb.	Up to June
Cabbage	10,466	Oct. - Nov.	Jan. - Feb.	Up to June
Knolkhol	10,481	Nov. - Dec.	Jan. - Feb.	Up to June
Lady's finger	7,209	Oct. - Nov. 14	May - Sept. 15	Up to Jan. 15
Brinjal	10,212	October	Jan. - Mar.	Up to June
Tomato	12,096	Aug. 15 - Dec.	Oct. - Mar.	Up to September
Summer Vegetables				
Cucumber	9,216	Feb. - Mar.	Apr. - May	Up to November
Pointed gourd	9,214	Oct. 15 - Nov.	Mar. 15 - Apr.	Up to June
Bitter gourd	9,436	Jan. - Feb.	Apr. - May	Up to November
Lady's finger	7,209	Mar. 15 - May 15	May 15 - Sept. 15	Up to Jan. 15
Sweet gourd	6,339	Oct. - Nov.	Apr. - May	Up to September
Kakrol	12,865	Jan. - Feb.	Apr. - May	Up to November
White gourd	9,013	Oct. - Nov.	Apr. - May	Up to November
Chichinga	9,745	Feb. - Mar.	Apr. - May	Up to November
Poi sak	7,861	Feb. - Mar.	Apr. - May	Up to November
Stem amaranth	6,401	Feb. - July	Mar. 15 - Sept.	Up to December
Fruits				
Papaya	17,118	Feb. 15 - Mar.	Sept. 15 - Nov. 15	Up to February
Banana	28,761	Feb. - Mar.	Sept. - Nov.	Up to March
Pineapple	28,998	Oct. - Nov.	Sept. 16 - Nov. 14 (next year)	Up to May
Tuber				
Potato	14,828	Sept. - Dec.	Feb. - Mar.	Up to August

Table 6. Business characteristics of intermediaries

Particulars	(% of traders)				
	Faria	*Bepari*	*Arathder*	*Paiker*	Retailer
1. Nature of business					
a) Independent	100.0	85.7	90.0	100.0	96.7
b) Joint	0.0	14.3	10.0	0.0	3.3
2. Source of financing					
a) Self	81.8	91.9	90.0	83.3	73.3
b) Friends and relatives	0.0	2.0	0.0	0.0	16.7
c) *Arathder*	0.0	4.1	0.0	16.7	0.0
d) Bank	18.2	2.0	0.0	0.0	3.3
e) Cooperative	0.0	0.0	10.0	0.0	3.3
f) Others	0.0	0.0	0.0	0.0	3.3
3. Status					
a) Permanent	9.1	0.0	100.0	0.0	90.0
b) Not permanent	90.9	49.0	0.0	100.0	10.0
4. Duration of business					
a) Less than 5 years	18.2	28.6	10.0	83.3	30.0
b) 6-10 years	36.3	26.5	50.0	16.7	23.3
c)11-15 years	18.2	32.6	20.0	0.0	16.7
d)16-20 years	9.1	12.3	0.0	0.0	16.7
e) 21-25 years	9.1	0.0	10.0	0.0	6.7
f) more than 25 years	9.1	0.0	10.0	0.0	6.6
5. Number of staff					
a) None	100.0	98.0	0.0	100.0	56.7
b) One	0.0	2.0	20.0	0.0	16.7
c) Two	0.0	0.0	40.0	0.0	26.6
d) Three	0.0	0.0	40.0	0.0	0.0

Source: Sabur 1990.

Recommendations

A. Credit

1. At present, crop loan distribution system of different commercial banks is comparatively easier than the past due to open market system. It does not need bonds of land mortgage for obtaining loan, however, interest rate is 10-14% compared to industrial loan which is only 8-12%. Repayment method should be modified and interest rate of agricultural loan be reduced. The existing system of loan disbursement and repayment of Grameen Bank (GB) and BRAC may be introduced.

2. Easy access to institutional credit facilities should be provided to the vegetable growers, specially to the commercial vegetable growers with soft terms and conditions.

3. Short-term credit (4-8 months) should be insured to the farmers before or at the time of growing vegetables. The amount should be equal to the cultivation cost of the respective vegetable.

4. Recovery period should be fixed during crop harvesting period (within 2-4 months) and loan repayment may be made on a weekly installment basis as followed by BRAC or GB.

5. Refinance systems of Bangladesh bank to other banks for disbursing agricultural loan should be reintroduced.

6. If the GKF-BARI joint program for vegetable production become successful, then this credit system may be introduced for the other parts of the country for large-scale production and marketing.

7. Strengthening of price stability through development of suitable varieties that can be grown year-round and establishment of cold storage facilities in the vegetable concentrated areas like Jessore, Bogra, Rangpur, Dinajpur, and Comilla to ensure year-round vegetable supply.

8. For large-scale production, low cost irrigation facilities should be provided to the vegetable growers.

B. Marketing

9. Transportation system should be improved through introduction of refrigerated transports and motorized boats to carry vegetables to distant markets. Handling, packaging and market intelligence systems should also be improved.

10. Suitable storage technologies should be established in both village and market levels to reduce price fluctuation due to seasonal glut, spoilage and damage and to ensure fair price to producer.

11. Establishment of suitable processing plants in small and big cities. Both private and public sectors should be involved in setting up these facilities to meet domestic and export demands for vegetables.

12. Institutional credit should be extended to private entrepreneurs to operate and establish processing and storage plants, introducing refrigerated transportation systems.

13. Institutional credit should also be extended to the marketing intermediaries specially for *Beparis, Arathder*, and retailers for promoting effective vegetable marketing systems.

14. Retailers, *Bapari* and *Arathder* need about Tk. 3 to 8 thousand per day, Tk. 10 to 15,000/week and Tk. 50 to 200,000/month, respectively.

15. At present, the government has not yet introduced a credit program especially for vegetable marketing. Special credit program for vegetable marketing might be helpful for improving the present marketing situation.

16. BRAC and Grameen Banks credit distribution and recovery systems can be followed for vegetable traders (weekly basis for retailers and *Bepari*, and monthly basis for *Arathder*). To establish processing plants and cold storage, BSCIC methods of providing credit facilities may be followed.

17. Establishment of a vegetable production and marketing corporation that will be responsible to give technical and logistic (credit) support to the marketing participants, private entrepreneurs, NGOs, farmers involved in production, input supply, processing, and marketing of vegetables.

References

Ahmed, M., Hoque, A. K. M. H., Matin, M. A. and Hossain, M. I. 1990. Winter vegetable marketing system in selected areas of Bangladesh. AED, BARI, Joydebpur, Gazipur, Bangladesh.

Akter. 1995. Team Leader. GKF-BARI joint programme for vegetable production. Paper presented at the workshop on vegetable crops agribusiness organized by BARC/BARI/ AVRDC/USAID. BARC, Farmgate, Dhaka, 2-4 May, 1995.

Amin, M.S. and Ahmed, M. 1992. Seasonality and agroecology of vegetable production, and supply in Bangladesh. In : Vegetable production and marketing. Proceeding of a national review and planning workshop. AVRDC, Shanhua, Tainan, Taiwan, Publication No. 92-379. 286 p.

Anonymous. 1993. Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of Bangladesh, (Various issues).

AVRDC. 1992. Vegetable production and marketing. Proceeding of a national review and planning workshop. Asian Vegetable Research and Development Centre, Shanhua, Tainan, Taiwan, Publication No. 92-379. 286 p.

Department of Agricultural Marketing. Agricultural Marketing Information Bulletin of Bangladesh, 1975-1993, Ministry of Agriculture, Government of Bangladesh.

Elias, S. M and Hossain, M.S. 1994. Agricultural Economics Research on Vegetables in Bangladesh. AVRDC/GTZ Workshop on Ag. Econ. Research on vegetable production systems and consumption pattern in Southeast Asia, Bangkok, Thailand.

Hossain, S. M. M. 1992. Status, constraints and strategies of vegetable research. International vegetable production and marketing. Proceedings of a national review and planning workshop. AVRDC,Shanhua, Tainan, Taiwan. Publication no. 92-379. 286 p.

Rampal and Gill, H.S. 1990. Demand and supply of vegetables and pulses in South Asia. In: p. 159-165. S. Shanmugasundaram (ed).Vegetable Research and Development in South Asia. Proceedings of a workshop held at Islamabad, Pakistan, 24-29 September, 1990. AVRDC publication no. 90-331. Taiwan.

Sabur, S. A. 1990. Price spreads and price structure of vegetables in Bangladesh. Department of Agriculture Economics and Rural Sociology. Bangladesh Agricultural Institute, Sheer-EBangla Nagar, Dhaka.

Sabur, S. A., Houqe, M. M. 1992. Profitability and farm level sale pattern of selected vegetables in Bangladesh. Bangladesh Hort. 20 (2): 41-48, 1992, Bangladesh Society for Horticultural Science, BARI, Joydebpur, Gazipur.

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Resources and Technology Requirement to Ensure Household Food Security through Home Gardening

Aminuzzaman Talukder, A. K. Tabibul, S. Baker, and M. W. Bloem

Helen Keller International, Bangladesh

Abstract

Helen Keller International has been working for the last seven years in promoting vegetable production and its consumption among landless households in the rural areas. Its gardening nutrition education surveillance program works through existing Nongovernment Organization structure supporting them technically and financially. The project encourages year-round fruit and vegetable production by developing nurseries at different levels for demonstration and timely input distribution to the target households. HKI also monitors the project activities by collecting data every three months. Village level nurseries in NGNESP over a period of one year has developed into a micro level development enterprise. The nursery holders produced seeds, seedlings, and saplings in their nurseries. Six months after the nurseries were established, they gained an average income of 260 taka per month from the sales of vegetables. Household level gardening showed a definite positive trend towards year-round vegetable production.

Technical exchange at different levels played a crucial role in the development of this project. Our experience suggests that gardening throughout the year at the household level is a very feasible approach for improving food security and overall nutrition of the vulnerable groups.

Introduction

Bangladesh, despite recent improvements in health, continues to have some of the worst rates of malnutrition and vitamin A deficiency in the world. According to the 1982-83 Bangladesh National Nutrition Survey, night blindness prevalence was 3.6% and HKI's Nutritional Surveillance Project has shown that it ranges from 0.7 to 1.4%-still a major public health problem.

Home gardening, the ability of local people to grow and produce a wide variety of vegetables rich in vitamin A, is an activity which is sustainable at the village level. Helen Keller International (HKI), an NGO working in Bangladesh, has been involved in home gardening since 1988. What started as a small pilot project in the northern area of the country has shown such successful results to warrant expansion into new and larger areas of the country. Over one-fifth of the country is expected to be covered by mid-1995.

The HKI Project

The HKI project is unique. It plays an exclusively technical assistance role, all implementation, including group selection is done by the collaborating indigenous NGO. A variety of inputs and support at various levels is provided to encourage not only the production but the consumption of vitamin A rich vegetables at the household level. At the head office in Dhaka, support, technical assistance, and training are given to those NGO workers who will manage what is called the "central nursery." The central nursery is located at the middle of the three thanas, or small districts, that are involved in the project. It mainly functions as a demonstration garden, seed and seedling producer for smaller and nearby "village nurseries." These nurseries directly serve the households in the village, providing seeds, training and any other assistance to all members of the home gardening group. Training for these village nurseries and household level gardeners is provided both directly and indirectly at the site. This method of reaching the most vulnerable population through indigenous NGOs proved sustainable and helped in the transfer of technology to the grass roots level.

The group is an example of community-initiated change in action. These groups are formed by local men and women who are interested in doing home gardening. Leaders are chosen by the villagers themselves and receive training in all aspects of vegetable production at the nearby village nursery. They in turn, impart their knowledge to their members. The groups meet monthly to talk about the problems and success of their gardens. The member's interest in home gardening is further sustained by the program's social marketing component. Local men and women are trained as "social marketers." They discuss educational topics with the groups concerning the benefits of vitamin A rich foods in the family's diet. Posters, radio, and TV spots, and colorful shirts complement the face-to-face contact.

Monitoring forms an essential component of the NGNESP. The objective of the monitoring system is to see whether the program activities are accomplished in time and if they reach their intended objectives as outlined in the project. Thus NGNESP staff can identify problems and plan necessary interventions. Data are collected from all the NGNESP thanas every three months.

The Nurseries

Nurseries were established in different villages. These nurseries were managed by farmers, usually women, on a regular basis. Our experience suggests that these village level nurseries has ultimately developed into a micro level development enterprise. The nursery holders produced seeds, seedlings, and saplings which they sold in local markets to earn money. They also sold vegetables of different varieties throughout the year. The average income which they gained from sale of vegetables, six months after the nurseries were established, was 260 taka. They also earned money by selling seeds, seedlings, and saplings. It had been observed that in some cases the nursery holders opened small seed stores in village and thana markets. This clearly showed that these nurseries have turned out to be a self-sustainable endeavor.

Production of Vegetables

Year-round vegetable production is one of the essential parts of ensuring household food security. Availability is a prerequisite in promoting consumption in the household. In Bangladesh for example, only 25% of the total requirement of vegetables are produced, 70% of those are produced during winter. The seasonality of vegetable production has also been documented in

several countries of the world. It is crucially important to ensure year-round vegetable production at the household level. NGNESP monitoring report showed that 6.6% of households were into vegetable gardening in the second phase compared to 3.2% in the first phase of project implementation. The average number of varieties has also increased significantly in the second phase of project implementation.

Technical exchange of recent knowledge at different levels is also important to ensure year-round production of vegetables in the garden. This exchange is done in such a way so that the local and traditional practices are enhanced and not discouraged. The theme of this exchange therefore is reinforcement of existing knowledge and not replacing it. One example from the NGO gardening project is the development of production plan for certain villages where the farmers choice and their existing practices are considered and at the same time the recent technological developments are shared for better production of more varieties. A format for continuous technical exchange has to be conceptualized for these projects.

The technology which needs to be adapted for maintaining a household garden has to be low cost using available resources and be feasible in the context of a poor household. The biodynamic organic gardens fit with this criteria and is applicable to the home gardening projects. The added advantage of this project is its environment-friendly approach.

In biodynamic organic garden, the fertilization is done by composting and green manuring. It also encourages use of other organic substances from plants and animals. The pest and disease control in this approach should be done by organic methods. The use of chemical pesticides is discouraged in a home-based production not only for its high cost but also for its hazardous effects towards man, animals, and the environment especially when is not handled properly.

Benefits of Vegetable Gardening

Promotion of consumption. This is one of the crucial elements of home gardening projects. The vegetables that are produced in the garden needs to be consumed by the households specifically by the vulnerable groups e.g. the children under six years and the pregnant and lactating women. We identified through research in HKI that promotion of various vegetable varieties offers more choices which positively influences consumption.

Food security and income generation. The project which looks at household food security issues should not be a short- term endeavor. Sustainability, therefore, is a big issue in home gardening project aiming at ensuring household food security. The advantage of household food production system specifically the home gardening project is basically the familiarity of the concept to the target households. It has been an age-old practice in Bangladesh (also in other parts of Asia). We are targeting for the improvement of traditional practices through reinforcement of new technologies in vegetable gardening. The profit which a household might gain from the investment in vegetable gardening is a key towards sustainability.

Involvement of women. This is a crucial aspect of home gardening project. The Bangladesh experience suggests that it is important to keep the focus of the project on women. This is to promote increased vegetable consumption in themselves and their families. They can also be benefited through the supplemental income being spent on food. The empowerment of women through their decision making in use of earning and overall participation can be a positive aspect of home gardening projects.

Technical exchange. Technical exchange at different levels played a crucial role in the development of this project. This entails transfer of appropriate and adaptable technology starting from the

central level of the project to the very household level in the village. The problems which a small household gardener or a nursery holder faces have to be addressed properly.

HKI experience suggests that gardening throughout the year at the household level is a very feasible approach for improving food security and overall nutrition of the vulnerable groups.

Role of Farmers, Private Sectors, NGOs, and the Government in Vegetable Crops Agribusiness

Kamal U. Ahmad

Vegetable Crops Agribusiness Consultant, AVRDC/BARC/BARI Vegetable Project, Bangladesh

Abstract

Agriculture in Bangladesh is often cereal related. Little emphasis has been given to vegetable production. Then, scientists and planners encouraged the promotion of vegetables as the cheapest sources of vitamins and minerals to combat malnutrition which has been prevailing in Bangladesh.

As partners in nation building, the roles of the farmers, private sectors, nongovernment organizations, and the government are discussed in this paper in order to present various activities necessary to uplift the living conditions of the Bangladeshi through improved vegetable production.

Introduction

Like other crops, vegetables, which are recognized as nutrition-givers are grown in Bangladesh since time immemorial. But it had almost always been farmers' own responsibility to grow whatever kinds and quantities of vegetables they felt like cultivating. The country's "Grow-More-Food" campaigns during the British and Pakistan days and onwards, had been mainly concentrated on cereals setting aside almost all other kinds of food. Today, 'affluence of food' or 'shortage of food' refers to rice and wheat. Potato, a staple food for nearly 25 developed and 30 developing countries, has not been accepted here under the terminology of 'food.'

General apathy for vegetables

In Bangladeshi life and culture, vegetables called "*Shak-shabji* " in Bengali, have never had a respectable connotation. About the prosperous time that prevailed in Bengal hundreds of years back, people say "*Math Bhara Dhan, Goal Bhara Goru Aar Pukur Bhara Mas,* " meaning the fields full of paddy, the sheds full of cow, and the ponds full of fish. In reference to the food habit of the Bengalees, they say "*Masebhate Bangalee,* " meaning the Bengalees live on fish and rice. And even today, when they mention of a modest dish, they say, "*Dal-bhaat* " meaning rice and pulses.

Here, all festival meals, wedding dinners, and most banquets remain almost entirely devoid of vegetables. Bangladesh has remained non-vegetarian, despite limited means of the majority of its population.

This has resulted to malnutrition among the Bangladeshi. Even the elite groups are suffering from ailments arising as a sequel of unbalanced and overconsumption of fatty and cholesterol-rich food. Very low level of per capita production and consumption of vegetables have made the entire nation remain highly dependent on the production and consumption of cereal food. The emphasis of the country's planners and decision makers during the last decades (except in some recent years) has been neither for horticulture nor for vegetable growing.

Role of Farmers

The farmers play a vital role in supplying food for the nation. They are often subjected to various farming activities to strengthen their ability to produce.

Maximization of land use

According to a survey conducted by Ahmad (1982), 75 percent of an average farmer's land are used for the cultivation of field crops and 25 percent is distributed as follows : housing-10%, fruit trees-5%, wild trees-4%, and fallow-2%. The area for housing is inclusive of the front and back yards which are used for heaping, drying and threshing of crops, cattle shed and kitchen gardens.

The homestead utilization pattern was surveyed by OFRD, BARI, at its various FSR sites in 1986-87. About 66% of the vegetables, on the overage, are grown in the yards, 30% in field and 4% on the alleys (roadsides, for wild trees, or they remain fallow). The information obtained is shown in table 1.

Table 1. Homestead utilization pattern in different farm categories

Farm Category	Average homestead size (m^2)	Allocation of Homestead areas (m^2)						
		Housing	Cattle shed	Pond	Trees & bushes	Thresh/ drying pavement	Vegetable garden	Others
Landless	386	86	12	11	117	61	83	16
Marginal	622	127	29	36	232	107	86	10
Small	812	174	66	62	237	127	75	61
Medium	1206	243	66	136	355	168	180	58
Large	1840	301	82	219	614	318	232	74
All farms	915	168	50	92	302	135	136	42

Source: Abedin and Quddus 1990.

Yard, homestead, and field vegetables. Vegetable cultivation in house-yards is more than twice the amount cultivated in the field. It is presumed that almost all the vegetables cultivated in the field are intended for sale.

Farmer's Activities

A farmer does various farming activities to obtain maximum yield of production. These include planning, land preparation, availment of credit and inputs, sowing/planting, fertilizing, spraying, intercultural operations, harvesting, and marketing.

He may also be involved in the implementation of various agricultural projects of the government, nongovernment organizations, and private sectors.

The choice of a crop in terms of production costs. It is hard for a farmer, who is usually a person of low means to decide which vegetable crop to grow. His land will remain occupied for a long time if he goes for brinjal or pulwal, even though the benefit-cost ratio for growing them is high as estimated on the basis of both cash-cost and full-cost. For short-term crops such as, cabbage and cauliflower, the cost is high even when the farmer owns the land and works on it with his family. When he ventures for radish, a short-duration crop, his expenses are low in terms of both cash-costs and full-costs. Production cost of some selected vegetables compiled by Elias and Mondal (1993) is shown in table 2.

Table 2. Production cost (tk/ha) of some selected vegetables

Cost/Item	Cauliflower	Cabbage	Radish	Country bean	Brinjal	Patal	Mukhi kachu
A. Costs							
Human labor	12,825	11,745	9,900	28,160	15,308	41,201	17,237
Draft power	1,297	1,273	1,630	1,938	1,620	2,363	2,266
Seeds/Seedling	8,040	10,704	1,059	292	4,612	2,199	8,104
Manures	2,313	740	575	98	1,108	2,058	2,399
Chemical fertilizers	10,840	11,098	4,798	3,756	2,819	4,654	3,057
Insecticide	1,526	3,232	263	5,005	314	5,554	--
Irrigation	2,332	1,787	1,577	2,421	—	2,190	322
Support material	—	—	—	8,958	—	4,913	—
Interest on operating cost	563	647	213	1,033	166	1,271	1,245
Land rental	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Total variable cost:							
—Cash cost basis	28,152	32,343	10,647	25,815	6,632	31,787	19,435
—Full cost basis	44,236	45,726	24,515	56,161	30,447	70,903	39,130
B. Other items							
Yield (t/ha)	19.36	33.32	14.26	19.60	28.36	31.81	14.00
Cost (Tk/kg)	2.28	1.37	1.72	2.86	1.07	2.23	2.80
Price Received (Tk/kg)	3.24	2.23	3.02	4.50	5.50	6.00	4.00
Net return (Tk/ha)	18,490	28,578	18,550	32,039	125,533	119,957	16,870
Benefit cost ratio:							
—Cash cost basis	2.23	2.30	4.04	3.42	23.52	6.00	2.88
—Full cost basis	1.42	1.62	1.76	1.57	5.12	2.69	1.43

Source: Elias and Mondal 1993.

Use of innovative practices

At various places of the country, there are farmers who are innovative, and/or interested to listen to researchers and extension agents. At Sachia in Bhola, the author visited a progressive farmer, Mr. M. Hatem Master, who owns 2.5 acres (1 ha) of land of which 20 decimals or .2 acres (1 acre=100 decimals) was allocated for multiple vegetable production, namely: tomato-pumpkin, 1st crop; and pumpkin -kankrol, second crop (after pruning the first crop). We visited several other plots including that of Sendu Bepari who is the owner of a 48-decimal vegetable crops. The district's prospective vegetable crops in both production and agribusiness were snake gourd, bitter gourd, pumpkin, kankrol, stem amaranth, and cucumber.

In some places, the farmers were using a system similar to the sorjan system, where flat ridges are raised by excavating side canals (as drainage is a great problem). Now, farmers of Bhola are

becoming vegetable conscious. They produce a lot of local watermelons which are sent to Barisal and elsewhere. Watermelon production forecast for Bhola (1994-95) was 1,993 ha, with possible production of 57, 390 t.

Nowadays, marginal farmers can obtain credit from a bank or a financial institution including many NGOs at often relatively cheap rates of interest. This is one of the reasons why vegetable cultivation like many other entrepreneurships is getting attention from a lot of farmers. However, the amount of loan-money against the specific crops are not as realistic as they should be.

Kandi-Bairh system

Some unions of a number of thanas in Pirojpur and Barisal districts in the south which had remained marshy with peat soil making crop cultivation almost impossible, have been growing vegetables for more than 100 years as a result of innovative entrepreneurship of some farmers. Deep and wide furrows were dug to raise wide ridges beside them. This made the furrows (bairh) become canals full of water, but the ridges (kandis) remain above inundation throughout the year.

As the years passed by, more and more silt was dug and placed on the beds, and the latter became arable and the owners began to grow vegetables. Farmers put up semicircular, convex trellises (*machas*) made from bamboo splits and other suitable materials covering the furrows/canals, and grow herbaceous and bushy vegetables on the beds, and trailing/viny kinds on the edges of the beds making them trail over the trellises. Thus when the crops, such as, snake gourds, bitter gourds, and hyacinth beans hang down through the trellis, these are picked from below, by means of an open-decked boat.

This system is highly successful. Vegetables, transported by boats through the main canals, are brought to the market by boats too, and sold to traders at the assembling market, who come in boats, trawlers, and launches and take them to bigger markets including those in the capital city. After visiting the area, the author was highly impressed by the performance of the system. This system is worth emulating by all farmers elsewhere having similar agroclimatic condition.

Seed production

The farmers have been producing vegetable seeds since time immemorial. According to GOB/ FAO Vegetable Seed Project's estimation, more than half of the total quantity of seeds used for the production of vegetables are farmer-saved seeds. The quality of such seeds may be questionable, but because of the farmers' general awareness of the performance of good and bad seed in the succeeding croppings, they collected seeds from relatively good (if not always the best) crops.

Farmer's Retained Seed

As stated by Samiruddin (1992), the bulk of the seed amounting to 640 t leaving aside 25 t produced by BADC, 5 t produced by DAE, and 330 tons imported by private traders came from the farmers. These were usually of low quality and from indigenous varieties. According to Rahman, only 579 t of quality vegetable seeds which cover 19.1% of the country's requirement presently are supplied by public and private sectors. The quality of the rest 2,458 t (80.9%) of vegetable seed being used by the farmers either from spot market collection or retained by themselves is unknown and mostly poor.

Vegetable cropping pattern

'Green Manure-Potato, Garlic, Pulwal Intercropping Pattern' has been found and accepted in Palashbari-Pirgachha area of Rangpur district as an outstanding cropping pattern involving vegetable crops. This was evolved by OFRD, BARI, to replace the conventional cropping patterns of (1) Potato (Local/HYV) Broadcast Aus Rice (Local); and (2) Potato (Local/HYV) and Jute (Olitorius) very effectively.

Homestead vegetable production

The Kalikapur Model. Trials conducted by OFRD, BARI, at Kalikapur site in Ishurdi, Pabna, about 10 km from BARI Regional Agricultural Research Station, in 1984-1989, involving 40 farmers from five farm categories using vegetable gardens of 6 x 6 m, resulted in evolving a package of five vegetable patterns. The area of 36 m^2 was divided into five 5 x 0.8 m beds, leaving 25 cm between the beds for shallow furrows utilized for irrigation and drainage, and a 50 cm space left around the garden for fencing and drainage (Chowdhury et al. 1992).

Based on the result and farmer's opinions, some modifications were introduced in the kind and sequence of vegetables used during the testing stage (Ibid). Finally, a package of five patterns was recommended (Karim et al. 1991).

Pesticide use in vegetable cultivation

Before, the farmers were taught on how to control insect pests and diseases. Information campaign was conducted to make them understand about the pests and diseases that damaged or destroyed their crops. Later on, pesticides were distributed free of charge for the farmers to save their crops from insect pests and diseases. Afterwards, the free distribution was withdrawn and pesticides became a commodity to be purchased. Now, pesticide use has become so high that many farmers have grown the habit of covering their crops with chemicals almost indiscriminately, sometimes leaving no chance for even a little bit of infestation to take place at any time.

Insecticides are used by farmers to control vegetable insect and mite pests at dosages and number of applications determined by themselves (Karim 1995). A recent survey of 250 farmers in Jessore district showed 2-150, 1-45, 2-90, 3-90, and 360 applications of insecticides by the farmers per crop per season for brinjal, cabbage, cauliflower, hyacinth bean, and bitter gourd respectively (Kabir et al. 1994).

Credit for vegetable production and agribusiness

Vegetables' share of the agricultural credit for crops has been absolutely negligible. For example, out of Bangladesh Krishi Bank's total crop-sector loan of Tk. 321 crore (1 crore = 10,000,000) in 1993-94, vegetable's share was only Tk. 30 lakh, (1 lakh = 100,000) or only 0.11%.

In the sphere of vegetable agribusiness, there has not been provision for credit in the form of capital-loan. Potato storage was the only capital loan disbursed by BKB for horticultural agribusiness (processing, storage, and marketing).

The share of credit for vegetables. The amount of money disbursed by various scheduled banks has been very negligible in the case of vegetable cultivation. The main reason for this perhaps rests in the general lack of interest for vegetable cultivation in a commercial scale. This is an area that deserves to be investigated in order to find out the reasons behind apathetic attitude toward vegetable cultivation entrepreneurship. Is it because the farmers themselves are not interested to grow vegetables, or they do not need to loan money for vegetable growing, or the banks do not encourage credit for vegetable growers?

The loan is given at the advent of land preparation and sowing of seed. Repayment is done several months after the harvest. In tomato for instance, the loan distribution period is August 15-December, and assuming that harvesting takes place in October-March, the repayment period is extended up to September of the following year.

It is not clear why the repayment period is extended for several months . This repayment system may create defaulters, as the loan-receivers are allowed to repay the dues 4-6 months after harvesting by which time they would have already spent the money from the sale of their crop.

A farmer can obtain loan by filling in a prescribed form provided for by the concerned bank. However, the rate of interest, which is 10-14%, is rather high, when compared with the rate of interest for industrial loans which is 8-10% only.

Amount of loan-money. In table 3, the production cost of six vegetables (in terms of both cash-cost and full-cost), as estimated by Hussain and Elias (1993), have been placed side-by-side with Bangladesh Bank figures for disbursement by various banks. The official loan-money ranges from as low as 72% to as high as 258% of the cash- cost; and from as low as 32% to as high as 112% of the full-cost.

In radish, the loan-money is about 2.5 times the cash cost, and even in terms of full-cost, it is more than adequate. For brinjal, the loan-money is 3.9 times the cash cost, and nearly adequate in terms of full-cost. For all the other crops, except cauliflower (where the loan-money appears to be nearly realistic), the loan-money is inadequate.

Table 3. Analysis of the amount of loan-money provided by a bank compared with the production costs (Tk.) of some vegetable crops

Crop	Total variable cost on the basis of[a]		Amount of loan money[b]	Loan money as % of	
	cash cost	full cost		cash cost	full cost
Country bean	10,326	22,464	9,412	91	42
Radish	4,259	9,806	11,020	258	112
Cauliflower	11,261	17,694	13,027	116	74
Cabbage	12,937	18,290	10,466	81	57
Brinjal	2,653	12,179	10,212	385	84
Pointed gourd	12,715	28,361	9,214	72	32

[a] Estimated by Hussain and S. M. Elias, 1993; [b]Bangladesh Bank's figures for loan disbursement.

The contract-grower system

Contract-growers system has been quite successful in the case of paddy, wheat, and potato seed. Compared to direct seed production by the public sector, the production of seed through private contract-growers has been found to be cheaper, and when efficiently managed, the quality of seed is maintained too.

Presently, several private seed companies have started vegetable seed production within the country through the contract-growers system involving farmers of specific localities to produce the desired kind and quantities of seed. These farmers are under the guidance and supervision of the private seed companies. As it appeared, the private seed companies, supported by government sectors, have been so far able to use the system of contract-growers to the advantage of all concerned.

The prerequisite. The prerequisites for effective contract-grower production of vegetable seed include (1) suitability of the area and land for the production of a particular crop; (2) availability of interested growers; (3) arrangement to impart adequate training to the concerned growers; (4) ensure credit facilities; (5) provide the farmers with seed, fertilizer, irrigation water, and pesticides; (6) ensure timely procurement of the produced seed; (7) provide as much financial benefit to the growers as possible; (8) proper supervision towards ensuring seed-quality; (9) arousing growers' interest; and (10) making the seeds available to the end-users at a reasonable price.

Marketing

Farmers in the rural areas usually sell their surplus produce to their neighbors or to the nearby villagers. There are *Paikars* or *Farias* (i.e., middlemen) who collect the produce from the farmers or from the local markets and sell them to the wholesalers who sell the same to the retailers. There are also some producers' cooperatives, though insignificant in number, who sell their produce directly to the wholesalers in the urban markets.

The market. In the rural areas, markets are held daily, twice or thrice a week either in the morning or in the evening. In the urban areas, markets are held daily. The 'market' as an institution, is hundreds of years old and very little improvement has taken place over the years. Markets in general and vegetable markets in particular are dirty and congested. In the dry season, markets are generally dusty while in the rainy season, they are muddy.

The information system. The market intelligence system is beset with various problems . If the sources of information are not so reliable, the institutional situation for generating and supplying information is not up-to-date.

Market information of vegetables, like other agricultural produce, comes from both government and private sources. The major governmental agency reporting the prices and other market information is the Directorate of Agricultural Marketing (DAM). This agency publishes a daily price report of essential items for Dhaka City and some other big cities and assembly centers, and a weekly price bulletin covering wholesale prices.

Research-extension-farmer linkage

The farmers implement a particular production program once they are convinced of its benefits especially on financial terms. They do not miss nutritional advantages once it is clearly defined to them. Recent Homestead Vegetable Production Program of the government, which followed the Kalikapur Model, experimented and developed by BARI, received acceptance from innumerable families possessing a piece of land in the homestead suitable for year-round vegetable cultivation. This has been an example where the research and extension workers of the Ministry of Agriculture acted hand-in-hand.

Private Sectors

Private sectors, businessmen, seed companies, importers of seed, and exporters of the produce are among many others who play a vital role in various stages of vegetable crops agribusiness.

Private sectors can be categorized as traders who buy vegetables from the growers, and those from whom the grower buys his vegetable seed, or those others who sell various inputs that are nearly common for the cultivation of crops other than vegetables.

Export of vegetables

It is known that many vegetables and fruits produced in the Indian subcontinent have, for some time now, been finding way into the markets of Saudi Arabia and a number of other Middle East countries. Among those, vegetables, such as, potatoes, onion, lady's finger, cabbage, tomato, and leafy vegetables and fruits like pineapple and banana deserve special mention. The recent increase of the Indo-Bangladesh-Pakistan population in those countries paved the way further. Fortunately all those vegetables and fruits are produced in Bangladesh with potentials for more production. But this country has yet to make a sizeable dent on it.

The quantity and value of the exports. The export of fresh vegetables worth 1.36 lakh taka (1 lakh = 100,000) in 1973 had increased in 1983-84 to 7.9 crore taka (1 crore = 10,000,000) and, went up to 35 crore taka by 1993-94. In 1993-94, as much as 9,055 tons of vegetables were exported, mainly to the United Kingdom, the Middle East (Kuwait) Oman, Qatar, UAE and Saudi Arabia, and Germany. This activity is being taken cared of mainly by the private sector, with BADC taking care of a small part only in terms of quantity, but giving big support in the area of management as well as supply of quality products like papaya and barbati. The supply of which is somewhat beyond the capability of private sectors. The export of vegetables in 1994-95 (up to April) was 10,200 t (worth taka 39 crores), according to Aminul Islam, Director of Agricultural Marketing.

Kinds of vegetables exported

Among the major vegetables presently exported from Bangladesh are bitter gourd, white gourd, bottle gourd, barbati, and papaya, and the minor ones cover a wide range including mukhi kachu, country bean, snake gourd, shat-kora, lalsak, puisak, green chili and different parts of arum, such as, leaf, stem and runners (*loti*).

Seed production by private companies

There was no private company producing vegetable seed in the country until recently. Many companies came into existence in the 80s for the importation of vegetable seed. Only the farmers themselves were producing vegetable seed. There used to exist a farmer-to-farmer system of seed distribution. Some nursery owners who were selling seedlings, grafts, gooties, and saplings had gone into the production of vegetable seed too, though to a nearly insignificant extent in terms of quantity.

The private sectors have organized a vegetable seed production under the supervision of BADC in their project areas. It is almost only after the initiation of GOB/FAO Vegetable Seed Project that some private companies were interested in producing vegetable seed for commercial purpose.

There are at least 23 companies engaged in the production of vegetable seed. Fifteen of them have addresses in Dhaka, three in Chittagong, three in Munshiganj, one in Narayanganj, and one in Kushtia. These private seed producers were interested in producing and selling vegetable seed at different times and under different situations.

According to BADC and GOB/FAO Vegetable Seed Project, the target of seed production by private sector in 1994-95 had been 50 t. One of the seed companies named Mollika Seed Company alone took up the program of producing as much as 21.6 t of vegetable seed.

Private sector seed associations

There are at least two private seed producers and/or merchants association/societies in the country. They are the (1) Bangladesh Seed Merchants' Association (146/1, Siddique Bazaar, 1st

floor, Dhaka-1000), and (2) Seedmen Society of Bangladesh (Middle Building, 6th floor, Khamarbari, Farmgate, GPO Box 4258, Dhaka-1000).

There are 129 members of the Bangladesh Seed Merchants' Association. The members are seed entrepreneurs, seed importers and seed dealers located in different parts of the country. The members of the Seedmen Society of Bangladesh are also concerned with various activities relating to seed agribusiness. It is interesting to note that these associations/societies maintain contacts with the government's seed-concerned agencies, such as, the Seed-wing of the Ministry of Agriculture, BARI, GOB/FAO Vegetable Project, BADC, and Crop Diversification Project (CDP).

Seed Importation

The quantity of vegetable seed for importation in 1984-85 was 2.3 t only, against as many as 23 kinds of vegetables (49 varieties). More than half of the total quantity of seed consisted of radish. Other vegetable seeds of a fairly sizeable quantity were of cabbage (mostly F_1), watermelon (mostly F_1), carrot, tomato, pea, cauliflower, knolkhol, beet, turnip, and Chinese cabbage. The importation at that time aimed at bringing in seed of winter vegetables.

In a period of just over five years, the quantity of imported seed went up to as much as 334 t, according to Samiruddin (1992) who mentioned Bangladesh Seed Growers Association as the source of the information. More than one-third (120 t) of the total quantity of 334 t of imported seed against 33 items/vegetables was of radish seed, valued at US$600,000. In terms of quantity, onion and okra seeds were the second largest quantity, being 80 t each. In terms of value, watermelon hybrid (7.2 t) was the most expensive (US$806,400), followed by radish, cabbage hybrid (US$420,000), onion (US$160,000), tomato OP (US$140,000), and cauliflower OP (US$100,000).

Storage

Except for potatoes (and sweet potatoes), onions, garlic, and dried beans, there is no significant storage of any vegetable, either at the farm or at the commercial level.

Potatoes are stored both in ordinary or traditional storage at the farm level and in the cold storage at about 2-4° C. Installed capacity of existing 170 cold storages is 425,000 t. In 1991, as much as 375,000 t of potato were stored (BBS. 1994). Cold storage facilities were often used for storing potato seeds. Individual cold storages sometimes have up to 70% of table-purpose potatoes. The percentage of stocked table-potatoes has increased recently. At present, the cost of storing potatoes in the cold storage is quite high and nearly equal to the cost of potatoes during harvest time.

Processing

Some vegetables are already being processed for consumption. Processing is done considering their increased values as processed items. Some vegetables become qualitatively superior and tastier in processed form than their original entities in fresh form.

The prospective products. There is a demand abroad for many kinds of vegetables in processed form, that are produced in tropical and subtropical climatic conditions. Canned and dehydrated products have export potentials. The canned products include tomato juice, baby corn, peas, bamboo shoots, asparagus, mushrooms, beans and carrots; and among the dehydrated products are white gourd or ash gourd (Chal kumra), plantains in the form of chips, and mushrooms. Gherkin or pickled cucumber, has a good market throughout the western countries. Pickles from garlic, chilies, green mango, and Indian olive have also export potentials.

An example of private initiative. Pran Food Factory of Ghorashal, one of the leading (but recently established) industries of the country has taken up a pioneering role in processing-cum-export of vegetable and fruit products. It produces and processes canned gherkins, baby corns and mushrooms. Tomatoes are processed into ketchups. Besides the canning line, it has a jam-jelly-pickle line and a bottling line. Among its containers/packing materials, glass bottles for jams, jellies and pickles are of local origin; cans, and lug caps are from Sri Lanka; and cans and lug caps for jars and bottles are from Thailand. This is indicative that the processing industries have a fair amount of dependence on supplies from abroad.

Involvement of NGOs

As advisory service is very important, in view of the dynamism prevailing in the areas of research (coming up with newer varieties and production technologies) and extension (disseminating the latest information on varieties, seed, and technologies), farmers have to be involved with such agencies. Recently, the NGOs concerned with agricultural activities are getting interested in vegetable-production effort and tend to fill in the gap between the farmers, researches, and extension workers, and even in the matter of providing credit facilities.

Agricultural development comprises only a fraction of the total efforts of the NGOs, and many of them are not involved in vegetable production (Ahmad 1992). However, some organizations that have extension activities in agriculture place emphasis on vegetables, a great source of nutrients for the malnourished poor. Compared with government efforts, which are inadequate in terms of the real need of the country, the present NGO programs are much more insignificant, as well as exceedingly limited in terms of geographical areas and the number of people covered.

Vegetable-specific activities of NGOs

In involving themselves in the promotion of agricultural production, most NGOs are handicapped by the limitation of land area of their beneficiaries. Because most agricultural technologies require land, only a few NGOs are currently working for the improvement of many farmers who own land (Chowdhury 1993). But since vegetable production requires minimal land, some NGOs have included this activity in their development programs particularly where nutrition improvement is involved.

Few NGOs concerned with vegetable production include BRAC, CARE, Christian Commission for Development (CCDB), Development Service Center of Bangladesh Mission (DSCs), Friends in Village Development Bangladesh (FIVDB), Gono Unnayan Prochesta (GUP), Grameen Krishi Foundation (GKF), Helen Keller International (HKI), Land Reclamation Project (LRP), Mennonite Central Committee (MCC), Proshika Manobik Unnayan Kendra, Rangpur—Dinajpur Rural Service (RDRS), Save the Children Fund (SCF)-USA, and Worldview International Foundation (WIF).

Government-NGO Collaboration

In view of the service-delivery systems of the government, the NGOs have a key role to play in this country where poor farmers take the lion's share of the farming community. In fact, the very nature of the development activities for agriculture and the clientele makes it expedient to obtain a smooth partnership between the government and the NGOs.

Research collaboration

The author has been instrumental in initiating several collaborative research works between the national agricultural research system (NARS) institutions of the government and the NGOs (Ahmad. 1993). As a private sector research facilitator, engaged in a USAID-assisted project executed by Checchi and Company Consulting, Inc, and supervised by BARC, the author arranged for negotiations, and accomplished the establishment of 10 Memoranda of Understanding (MOU) and 17 letters of agreement between four research institutes and seven NGOs (Ahmad 1994).

Collaboration in extension activities

NGOs can bring about awareness on the importance of vegetables in human nutrition, employment, and income generation. They can also provide training on production techniques, storage, and consumption.

DAE-RDRS collaborative program. According to Hasanullah (1991), the Department of Agricultural Extension (DAE) has successful collaboration with RDRS (Rangpur Dinajpur Rural Service) in group formation, training, and credit management in the Marginal and Small Farm System Crop Intensification Project in Kurigram. MCC acknowledged the cooperation, encouragement, and support of government officials with whom they worked with at the local, district and national levels. The priorities of food production, nutrition, and family planning reflect MCC's Bangladesh program and fully support the government's goal of food self-sufficiency through increased production, the use of fallow land, and crop diversification.

BARI-GKF joint program . A joint program was initiated by BARI with GKF for technology transfer and boosting farmers' economic conditions. Tomato, radish, cauliflower, cabbage, garden pea, China shak, bati shak and sweet gourd were grown. Inputs, such as, seed, fertilizer, irrigation, pesticides, and agricultural machineries under different sharing arrangements were provided by GKF. Land, animal labor, and human labor for different intercultural operations where provided by the farmers. These resulted in increased income to the beneficiaries, whereas 100% of the loan could be recovered.

Collaboration in production

Homestead vegetable production. This is perhaps the most appropriate area for NGO intervention. The basic NGO objective of helping the poor, landless, small, and marginal farmers attain self-employment, poverty-alleviation, income generation, and nutritional security can be best fulfilled by this single venture. The involvement of women and children can be maximized in this production enterprise. Women are found to be greatly involved in planting, water management, fertilizer application, daily maintenance, harvesting, seed collection, and seed storage (Chowdhury et al. 1992).

This fits into the existing development programs of many of the NGOs including CARE, MCC, BRAC, CARITAS, and HKI. The government's target of homestead vegetable production of 11.81 lakh t (1 lakh = 100,000) by the year 1994-95, against 2.54 lakh to 1987-88 cannot be fulfilled without a nationwide full-scale grow-more vegetable campaign and participation of all development agencies. Many collaborative programs can be taken up in this vital sector of applied human nutrition.

Credit, input supply, and support service. The self-employment programs of Bangladesh have become well known outside the country mainly due to the innovative credit operation oriented towards the rural poor (ILO 1991). The characteristics of the lending mechanism are: easy access to credit for the poor; extension of banking service to rural areas; lending without collateral; and

group responsibility in repayment of loans. The repayment performance is highly satisfactory, being more than 98% loan-recovery in case of lendings made by Grameen Bank, BRAC, and RDRS.

RDRS's training in income-generating activities include joint farming, pisciculture, and cottage industries based on local expertise and raw materials. RDRS supplies winter seed vegetables to the beneficiaries. GKF is one of several nongovernment organizations that combine credit, input supply, and support service in an integrated fashion to make vegetable cultivation (both in the field and in the homestead) a success in the existing project area and all over the country. GKF is collaborating with BARI in technology transfer through assisting in credit, input-supply and support-service matters.

Collaboration in postharvest handling and processing

One of the major objectives of the NGOs in Bangladesh is to assist rural people in proper marketing of their produce/products and getting its right price. (Hossain et al. 1984). By quick handling and transportation to distant markets and preserving a portion through preparation of various products, it is possible to save the vegetables and fruits from imminent waste. Some NGOs have extended assistance in this important area. This is an area where government-NGO or farmer-NGO collaboration can be effective.

Participation of women

Since the inception of Grameen Bank, the largest number of loans were disbursed to women who were engaged in livestock and fisheries. For growing fruits and vegetables, as much as two-fifths of the total number of loans was given to women (Grameen Bank. 1985).

As Talukder et al. (1992) wrote : "The involvement of women is a crucial aspect of home gardening project. The Bangladesh experience suggests that it is important to keep the focus of the project on women. This is to promote increased vegetable consumption in themselves and their families. They can also be benefited through the supplemental income being spent on food. The empowerment of women through their decision making in use of earning and overall participation can be a positive aspect of home gardening projects."

Because of their wide and longstanding experience with women groups and members, NGOs are very much in a position to bring about effective participation of women in vegetable production, consumption, and utilization. The planners and policymakers, as well as concerned NGOs may make adequate provision of vegetable programs involving women.

NGO-NGO Collaboration

MCC collaborative programs. The collaborative activities of MCC have expanded in recent years. They have vegetable activity through 14 partner-NGOs in Faridpur, Kushtia, Jessore, Jhenaidaha, Pabna, Sirajgonj and Noakhali districts. Six experienced field staff from MCC are working with those NGOs to strengthen their vegetable and other agricultural activities with farmers.

HKI collaborative role. An exclusively technical assistance role is being played by HKI. The collaborating NGOs implement programs/projects including group selection. Inputs supply and support service are provided by HKI to encourage both production and consumption of vitamin A rich vegetables at the household level. At the head office in Dhaka, support, technical assistance and training is given to those NGO workers who manage the central nurseries.

Future prospects. Increased production and consumption of vegetable is an area where the government agencies can collaborate with the NGOs. The NGOs can collaborate among themselves in an effective manner.

Role of the Government

Rice production in Bangladesh accounts for nearly 78 percent of the land area under cultivation. Vegetables' share of land is only about one percent (166,801.6 ha), and a little more than one percent (176,113.4 ha) share for potatoes (Irish potato : 131,174.1 ha; sweet potato : 44,939.3 ha).

Past policies of the government

General bias for rice. There is a general bias for rice, which is evident from information with regarding institutional efforts devoted to crop production. In 1982, Stefan de Vylder had stated, "As it is today, virtually all resources, extension services and subsidized inputs go for rice."

The Bangladesh Rice Research Institute (BRRI) has by far the highest number of scientists engaged in research among all monocrop research centers. The Department of Agricultural Extension, having a network throughout the country, with more than 10,000 extension workers at the grassroots level of villages and unions, places emphasize on the production of food grains.

The Second Five-Year Plan (1980-85) provided the country with agricultural development strategy on an annual food-grain production growth of 5.7% to offset the less than 3% annual growth in population.

No provision for horticultural development. The Intensive Crop Program in 1984-85 of the Ministry of Agriculture began with an introduction saying, "Self-sufficiency in food-grain production by the terminal year of the Second Five-Year Plan period." The target acreage was set by the program for various crops, like 88 percent for rice, and six percent for each of wheat and jute, with the remaining 10 percent for crops of various kinds. Neither vegetables nor fruits found any place in this exercise.

The Third Five-Year Plan (1985-90) had included (a) food self-sufficiency; (b) development of minor crops; (c) livestock development; and (d) fisheries development, as some of the major issues and strategies of the agricultural sector. So, if in the Second Plan, at least the desire was there for intensification of fruit and vegetable production (though not supported by action plans and provision of money), the Third Plan had classified fruits and vegetables as minor crops.

Vegetables are considered as minor crops and its emphasis are laid through a crop diversification program which devoted to pulses, oilseed, and potato. To quote from Dr. Amzad Hossain (1992) again, "Vegetable crops were listed as one of the minor crops by the Planning Commission, and, as a consequence, very little has been achieved in vegetable development during this period due to the absence of an action-oriented program." The emphasis of the country's planners and decision makers during the last few decades, except in some recent years only, had been neither for horticulture nor for vegetable growing.

The Fourth Five-Year Plan. It was almost for the first time that, at the advent of the Fourth Plan, planners felt serious with regard to non-cereal food items vis-a-vis nutrition. The Fourth Plan (1990-95) stated, "The situation with respect to other key nutritional foods, has been disappointing. The per capita availability of vegetables has dropped from about 58 g/day in 1969 to about 36 g in 1983. While these crops are less significant in terms of their contribution to GDP, they are important in providing a balanced nutritional diet for the people. This suggests the direction of

emphasis that has to be provided in future development of the sector for the promotion of a nutrition-based agriculture in the country."

Targets for vegetables. "Considering the production potential, vegetables (both summer and winter) production is projected to grow from the bench mark level of 9.25 lakh t to 13.26 lakh t in 1994-95," according to the Plan. The targets are shown in table 4.

Table 4. Vegetable production (lakh t) targets during the Fourth Five-Year Plan

Crops	Benchmark	
	1989-90	1994-95
Summer vegetables	2.9	3.8
Winter vegetables	6.8	9.4
Total vegetables	9.8	13.3

Note : 1 lakh = 100,000

Mechanism for achieving the goal

The mechanism included involvement of rural women (since the major part in the homestead crop and horticultural production is contributed by women), BADC's seed multiplication program for vegetable seeds; propagation and sale of vegetable seedlings at DAE's base nurseries and upazila nurseries; BARI's Horticultural Research Center; an expanded self-help cultivation program (based on the least-cost approach as vegetables are short-duration crops suitable for intercropping and help to generate cash for small and marginal communities); identification and development of high value export products and exploring markets for them; exploring and encouraging processing of vegetables, fruits and spices in the private sector (with necessary technical and other associated backup by the public sector.

The seed policy in 1992. Against an absolute freedom on importation of vegetable seed, the policy in 1992 brought in the question of registration of the persons, companies or agencies concerned with the importation or local development of the seed. This regulation holds well for all crops other than rice, wheat, jute, potato, and sugarcane.

The seed policy (1992) states : "Varieties of crops other rice, wheat, jute, potato and sugarcane that are imported or locally developed by private person, company or agency must be registered with the NSB, giving prescribed cultivar description, but will not be subjected to any other restrictions."

"Any individual, company or agency wishing to import seed, develop and register new seed varieties, or package seed in labelled containers must first be registered with National Seed Board."

Socioeconomic and management aspects

The socioeconomic aspects on the interest of the producers must be well presented. The management of the entire subject with appropriate policy planning will remain as a keystone for taking advantage of the presently emerging situation in the whole channel of vegetable agribusiness starting from research on variety; seed and technology; production process in the fields and factories; storage and preservation; and transportation and marketing within the country and abroad.

From producer-to-consumer : the long chain

In the developed and even in some developing countries, such as Taiwan, appropriate link between the producer and the consumer has been attained. The consumers' preferences at the farthest end of the channel are recognized at the producers' point, and every activity between these two ends takes into account the producers' and the consumers' needs and requirement. This places should also be linked to Bangladesh. Appropriate planning shall complete the chain.

Measures for Vegetable-Based Agribusiness

Vegetable crops agribusiness is a long process starting from the research stage, including plant breeding for development of suitable varieties for production under various agroecological conditions and internal use as fresh and processed vegetables, and for exportation thereof, upto the stage of consumption, preservation, processing and exportation. Government policies have been improving this sector gradually.

Recommendations

1. Knowing that more than 80 vegetable varieties are grown in the country, and, at least 50 of them are important, the BBS should collect and publish more data on acreage and production of these vegetables.
2. Researches in vegetable breeding may be geared around the need of agribusiness in terms of developing varieties and seeds of some of the vegetables suitable under Bangladesh agroecological conditions. Such varieties which include both open-pollinated and hybrid lines can be exported in fresh or processed form.
3. Further researches should be conducted on pesticide application on specific crop.
4. There is a need for (a) the introduction of production-bonus system; (b) financial support for seed industries; (c) attracting foreign seed companies for joint venture; and (d) encouraging possible production of seed of some vegetable types and varieties for export purposes.
5. Conduct a study on the quality of different kinds of seeds retained by farmers which are often subjected to as poor quality seeds.
6. Gradually reduce the quantity of imported vegetable seeds starting from those which can be produced in the country.
7. Efforts may be made to promote and popularize the techniques of raised bed, sorjan cropping, and kandi-bairh systems.
8. Need for a detailed analysis of contract-growing system of vegetables and its seeds for a wider understanding and improvement of the system which appears to be very appropriate in the context of Bangladesh agroecological, land tenure and socioeconomic situations.
9. Review and modify the repayment scheme of loan- money which stretches months beyond harvest time with the bank authorities and the beneficiaries.
10. Banks should review , revise, and make a realistic estimation on the prevailing amount of loan-money.
11. Vegetable-processing industries should be encouraged by reducing the rate of custom duties on imported cans, jars, glass-bottles, caps, and crown corks used for preservation and processing of vegetable products.

12. Introduce a regular system of broadcasting information over radio and television on the daily and weekly prices of different vegetables prevailing at the important markets.

13. Formulate an export-oriented master plan of vegetable crops agribusiness taking advantage of a large market of fresh and processed vegetables in the Middle East, EEC countries, USA and Western Canada, Japan and some Asian countries .

14. Develop specific types and varieties of vegetables (supporting production of specific export-oriented vegetables), development of suitable processing methods, and arranging for quality standardization and control are some other possible activities of the government towards promotion of vegetable exports.

15. Present and ongoing activities of GO-NGO, NGO-NGO and NGO-farmer collaboration should be reviewed aimed at understanding the future prospects of such collaborations, and the possibilities of expanding them, giving both farmers and consumers the maximum possible benefits.

16. The present partnership activities of Bangladesh NARS institutions, such as BARC and BARI, with AVRDC should continue and expand to cover the entire area of vegetable crops agribusiness.

References

Ahmad, K. U. 1982. Gardener's book of production and nutrition. Publisher: Mrs. Mumtaj Kamal, Dhaka 448 p.

Ahmad, K. U. 1992. NGOs: Promoting vegetable production in Bangladesh. In: Vegetable production and marketing. Proceedings of national review and planning workshop. AVRDC/ BARI/BARC USAID ARP-II (Supplement), pp. 235-244.

Ahmad, K. U. 1994. Involvement of NGOs in vegetable development and related activities. In: Vegetable research and development in Bangladesh. AVRDC Publication No. 94-430. pp. 106-117.

BBS. 1994. Statistical Yearbook of Bangladesh. 1993. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning. 735 p.

Chowdhury, M. K., Islam, M. A. and Satter, M. A. 1992. Homestead vegetable production in Bangladesh. In : Vegetable production and marketing. Proc. of a workshop. AVRDC, pp. 64-77.

Chowdhury, M. K. 1993. Opening FSRD linkages for NGOs: why and how to do it. FSRD working papers. BARC. 8 p.

Hasnaullah, M. 1991 NGOs and public sector agricultural research and extension in Bangladesh. Asia regional workshop on NGOs, 16-20 Sep., Hyderabad, India.

Grameen Bank. 1985. Annual Report. 1985. 2 6 p.

Hossain, A. K. M. A. 1992. Welcome Address. In : Vegetable production and marketing. Proc. national review and planning workshop. AVRDC/ BARI/BARC: USAID ARP-II Supplement. pp. 21-30.

Hussain, M. S. and Elias, S. M. 1993. Economics of Vegetables. In : Intensive vegetable growing and its utilization. A compilation of lecture materials, 22-25 November.

ILO. 1991. Self-employment program in Bangladesh. ILO, Area Office-Dhaka. 145 p.

Kabir, K. H., Baksh, M. E., Rouf, F. M. A., Mondal, N. A., Hossain, M. A., Satter, M. A., Asaduzzaman, M. S. M., and Karim, M. A. 1994. Insecticide usage pattern on vegetables at farmers' level of Jessore region: A survey report. Unpublished report of the Entomology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. 20 p. (mimeo).

Karim, M. A., Basak, N. C., Hossain, S. M. M., Ahmad, K. U. and Ullah, M. M. 1991. Intensive vegetable cultivation in the homestead garden (in Bengali). 2nd Edn, OFRD, BARI, 31 p.

Planning Commission. 1990. The Fourth Five-year Plan. 1990-95. Ministry of Planning Govt. in Bangladesh.

Rahman, L. 1994. Promotion of private vegetable industries in Bangladesh : problems and prospects in vegetable research and development in Bangladesh. pp. 136-145.

Samiruddin, M. 1992. Vegetable and vegetable seed in national economy. Horticulture in National Development: Proc. 6th national hort. convention and symposium. Bangladesh society for horticultural science.pp. 12-22.

Samiruddin, M. 1992. Vegetable seed production and management. In : Vegetable production and marketing. Proceedings of national review and planning workshop. AVRDC/BARI/BARC, USAID ARP-II (S). pp. 51-63.

Talukder, A., Khan, T. A. Sultana, N. and Bloem, M. W. 1992. Combating Vitamin A deficiency in Bangladesh through homegardens. In : Vegetable production and marketing. AVRDC, No. 92-379. pp. 271-72.

Recommendations

Plenary/Concluding Session

Chairman: Dr. M.S.U. Chowdhury

Rapporteurs: Dr. Nurul Alam
Dr. S. Dasgupta

Recommendation/Finalization Committee

Convener: Dr. A. Quasem

Members: Dr. M.A. Hamid Miah
Dr. S.M. Monowar Hossain
Dr. M.L. Chadha

Constraints/Opportunities	Recommendations	Implementing Agency*
	General Policy	
1. Vegetable crops agribusiness has a potential in local and foreign markets.	1. Exploit the potential of vegetable crops agribusiness through the adoption of policies and plans, and proper execution and implementation thereof.	MOA, BARI, DAE, BADC
2. Unavailability of data on acreage, production and extent of postharvest losses and utilization of vegetables and seed requirement in Bangladesh hampers realistic planning, formulation and production of development projects, and evaluation process.	2. (a) Develop a mechanism to collect and record proper data on acreage, production, postharvest losses and utilization of different vegetables and its requirement in the country. (b) Assess the existing vegetable production and market situation in various areas and identify other market oriented production zones.	BBS, DAE, BARC
3. Food and nutrition are integral parts of each other, but, these have not been tried to be established through adequate action programs.	3. Provide enough opportunities and activities in ensuing the fifth five-year plan towards increased production and consumption of vegetables in order to bridge the wide gap between food and nutrition.	MOA, Pl. Com.
4. Communication gap between the policymakers and scientists on the contribution of vegetables to national upliftment for nutrition.	4. Arrange a convention for policy makers and scientists to discuss different issues related to vegetable agribusiness.	MOA, BARC, BARI
5. No accurate information delivery system on vegetable crop production and agribusiness in Bangladesh.	5. Develop a mechanism (like GIS/MIS) to provide farmers, private trade organizations and policy makers an access to timely and accurate information on new technologies, markets and financing process.	AIS, BARC, BARI

6. Lack of awareness on food and nutrition, importance of vegetables, postharvest losses and consumption methodology.	6. Conduct massive information campaign through various media on proper nutrition, importance of vegetable consumption, and reduction of postharvest losses.	MOI, AIS, MOA, MOA, MOHFW
7. Women and children are concerned on homestead vegetable cultivation.	7. (a) Further train women in homestead production and consumption of vegetables through formal and non-formal education. (b) Integrate training in the school curriculum at the primary level.	MOE, DAE, NGOs
8. No market assurance for vegetable growers.	8. Develop an organized location-specific production and marketing system, and encourage cooperativism among vegetable growers. The cooperatives will manage both production and marketing of vegetables produced.	Coop. Dept., BRDB, NGOs, Grameen Bank, BADC
9. Some farmers use pesticides excessively.	9. (a) Conduct massive information campaign on the adverse effects of pesticide misuse to health and environment. (b) Control/regulate pesticide use. (c) Establish facilities to monitor pesticide residues.	NARS, MOI, AIS, DAE
10. Need for the establishment of AVRDC outreach station in Bangladesh (AVRDC/BARI coordinated efforts have been very useful).	10. Request AVRDC to establish an outreach station in Bangladesh in order to take full advantage of the center's R and D system.	MOA, AVRDC, BARC

1. Due to various constraints, vegetable research has been insufficient to fully response the need of the vegetable industry in the country.	1. Strengthen research activities to improve production and quality of vegetables specially on agroecological location and specific production technologies.	MOA, BARI AVRDC Donor agencies
2. There is a need to intensify researches on germplasm, cultivation techniques, postharvest handling and processing.	2. Introduce new varieties, collect germplasm, practice organic farming and off-season production, proper postharvest handling, and development of exportable vegetables.	BARI
3. Hybrid varieties contributed a lot in improving the production and quality of vegetables in Bangladesh, however, the country spends a large amount of money on its importation.	3. Develop hybrid varieties of some commercially important vegetables.	BARI, AVRDC
4. The kandi-baihr system of vegetable production in Pirojpur, Barisal needs to be improved and replicated in other countries having similar agroclimatic condition.	4. Develop a special collaborative project to study and improve the kandi-baihr system and transfer the specialized technology to other countries having similar agroclimatic condition.	BARC, BARI, DAE
5. Handling, packaging, and marketing of fresh and processed vegetables in Bangladesh do not conform with the international standard.	5. Develop appropriate technologies for handling, packaging, and marketing of exportable vegetables.	BARI, BCSIR, BADC BAEC
6. Meeting the quarantine requirements of agricultural produce based on fumigation practices using many undesirable chemicals are being phased out internationally.	6. Explore the possibility of using alternative promising technology including irradiation of exportable vegetable products.	DAE, BARC, BARI
7. Need to showcase vegetable technologies in different vegetable growing areas in Bangladesh.	7. Establish BARI-research stations in vegetable- growing areas like Pahartali (Chittagong), Bogra, and Joydebpur to serve as technology outlets of improved vegetable production.	BARI

Agribusiness

1. The contract system has been found effective in creating an organized production and marketing system, reduction of postharvest losses, and in obtaining the best grading and transportation.	1. (a) Strengthen contract growing system for seed and vegetable production. (b) Develop contract-grower zones and contract- grower villages for specific commodities.	BADC, DAE, Grameen Bank, NGOs, Private entrepreneurs
2. Homestead vegetable production has been perfected by BARI, and extended successfully by DAE in some parts of the country. This has broadened the scope of homestead horticultural production.	2. Prepare and execute adaptive homestead-based horticulture research project for developing some models suited for diverse agroecological zones of the country.	BARC, BARI
3. Trained manpower is very important in vegetable agribusiness.	3. Organize extensive training program on vegetable agribusiness (seed production, processing, and export).	BARI, BADC
4. The vegetable seed industries of the private sectors are gradually emerging as an important entity to play a very significant role in keeping the producers supplied with quality seed in sufficient quantities. Potential for seed importation will eventually materialize	4. Encourage private sectors to produce, preserve, and market vegetable seeds according to international standard through effective seed quality central measures.	MOA, SCA, NGOs
5. No clear amount of existing investment opportunities in different vegetable agribusiness.	5. Conduct training on subsectoral feasibility studies to identify sound vegetable agribusiness opportunities.	BARC, MOP
6. No effective marketing system to take care of the needs of vegetable agribusiness. Some constraints hamper smooth flow of a comprehensive producer-to-consumer delivery system.	6. (a) Train farmers in pre and postharvest vegetable production. (b) Establish storage facilities. (c) Develop appropriate pack aging materials. (d) Establish good wholesale market.	MOA, BARI, BADC, DAM

7. Limited market for exportable vegetable products like asparagus, babycorn, mushrooms, peas, garlic, ginger, etc.	7. (a) Assess export potential of fresh and processed vegetables around the world. (b) Develop export production zones of different kinds of vegetables proven to have export demand to ensure maintained international export standard.	EPB, DAM, Private entrepreneurs, NGOs, Grameen Bank
8. Vegetable crops agribusiness is not considered as an industry.	8. Provide tax holidays and other benefits like any other industries to boost vegetable crops agribusiness as an industry.	MOP
9. Need for technology transfer of year-round vegetable production through extension agencies and NGOs.	9. Encourage extension services and conduct training programs for year-round vegetable production. Materials and techniques will be developed by BARI through AVRDC collaboration, and locally through OFRD of BARI, extension agencies, and NGOs.	MOP, Grameen Bank Krishi Bank
10. Lack of credit facilities and soft loans for vegetable crops agribusiness.	10. Strengthen credit system and provide soft loans for vegetable crops agribusiness.	MOP, Grameen Bank Krishi Bank

*AIS — Agriculture Information Services
AVRDC — Asian Vegetable Research and Development Center
BADC — Bangladesh Agricultural Development Corporation
BAU — Bangladesh Agricultural University
BARI — Bangladesh Agricultural Research Institute
BARC — Bangladesh Agricultural Research Council
BBS — Bangladesh Bureau of Statistics
BAEC — Bangladesh Atomic Energy Commission
BRDB — Bangladesh Rural Development Board
DAE — Department of Agricultural Extension
EPB — Export Promotion Bureau
DAM — Department of Agricultural Marketing
MOA — Ministry of Agriculture
NARS — National Agriculture Research Station
NGO — Nongovernment Organization
Pl. Com. — Planning Commission
SCA — Seed Certification Agency

Participants

Asian Vegetable Research and Development Center

Tsou, Samson C.S.
Chadha, M.L.

Bangladesh Agricultural Development Corporation

Alam, Mohammad
Hossain, M.M.
Panna, A.B.M. Shamsuzzaman
Rahman, A.F.M. Habibur
Islam, Shahidul

Bangladesh Atomic Energy Commission

Karim, Abdul

Bangladesh Agricultural Research Council

Chowdhury, M.S.U.
Miah, M.A. Hamid
Alam, M. Nurul
Mohammad, Ali
Chowdhury, A.T.M. Salehuddin
Razzaque, II. A
Roy, Indrajit
Khan, Jahan Ara
Dasgupta, S.
Awal, A.
Hossain, Gul
Razzaque, A
Saif, Saifullah M.
Begum, Mansura
Rahman, Rowshan A.

Bangladesh Agricultural University

Huq, Md. Azizul
Rahman, Lutfur

Bangladesh Agricultural Research Institute

Elias, S.M.
Mazed, M.A.
Quasem, A.
Hossain, A. E.
Basher, Abul
Habib, A.k.m. Anwar
Hoq, Mosiul
Khan, Ashraf
Rahman, Matiar
Ahmad, Sahabuddin
Saha, Satya Ranjan
Houque, M. Mozammal
Chaudhury, J.C. Saha
Chowdhury, Dauleten Nesa
Amiruzzaman, Md.
Uddin, Nazim
Biswas, Monmohan
Rahman, Tauhidur
Malik, M.A.
Islam, Jamiul
Begum, Rowshan Ara
Miah, M.A. Monayem
Hossain, M. Sahadad
Karim, M.A.
Saha, Suranjan Kumar

On—farm Research Station, Jessore

Haque, Fazlul

On—farm Research Division, Rangpur
JKF—BARI Joint Programme

Akter, Shafiqul

Department of Agricultural Extension

Huq, Enamul
Siddique, A.B.
Habib, Qumrul
Ahmed, Maijuddin
Uddin, Md. Kafil
Mollah A. Salam
Ahmed, Dewan Nesar
Das, Mrinal Kanti

Department of Agricultural Marketing

Begum, Shahnaz
Islam, Aminul
Chowdhury, Sadrul Wala

Export Promotion Bureau

Ahsanullah, M.

Institute for Postgraduate Studies in Agriculture

Quadir, A.

Ministry of Agriculture

Islam, A.B.M. Kamrul

Agribusiness Technology Development Project

Bosley, Roy E.

Agro-Industries, Ltd.

Huda, Nawserul

Other Agencies

BARC/BARI/AVRDC Project

Ahmad, Kamal U.
Hossain, A.K.M. Amzad

Bangladesh Rural Advancement Committee

Bakar, A.

BASE

Barua, P.K.

Food and Agriculture Organization
Rekhi, S.S.

Gonokallayan Trust

Hoque, Sayad Ansarul

Horticulture Production and Marketing Survey Project, EPC, Ltd.

Hossain, S.M. Monowar

Krishibid Nursery

Samad, A.

Mennonite Central Committee

Roy, Amal K.

Mollika Seed Company

Malik, F.R.
Malik, A.R.

NCTB

Ahmad, Muslim Uddin

UPAKAR

Palit, Tapan K.
Berna, Shina

United States Agency for International Development

Brown, Richard
Swanson, John B.
Paulson, Lawrence E.
Rahman, Latifur
Ahmad, Nasim
Khan, M.H.