BANGLADESH JOURNAL OF POLITICAL ECONOMY

VOLUME 20 NUMBER 1
JUNE 2004

বাংলাদেশ অর্থনীতি সমিতি
Bangladesh Economic Association

REGIONAL CONFERENCE

Agri-Business Development in Bangladesh

Bangladesh Journal of Political Economy

VOLUME 20, NUMBER 1, JUNE 2004

This volume contains selected papers presented at the
Regional Conference of the
Bangladesh Economic Association held at the
Bangladesh Agricultural University,
Mymensingh in December 2003

Qazi Kholiquzzaman Ahmad
Editor

This Regional Conference Volume has been edited by
Rezaul Karim Talukder
M.A. Sattar Mandal

Bangladesh Economic Association
4/C, Eskaton Garden Road, Dhaka-1000
Phone : 9345996, Fax : 880-2-9345996
E-mail : becoa@bdlink.com

- Bangladesh Journal of Political Economy is published by the Bangladesh Economic Association.
- No responsibility for the views expressed by the authors of articles published in the Bangladesh Journal of Political Economy is assumed by the Editors or the Publisher.
- Bangladesh Economic Association gratefully acknowledges the financial assistance provided by the Goverment of the People's Republic of Bangladesh towards publication of this volume.
- The price of this volume is Tk. 200, US $ 15 (foreign). Subscription may be sent to the Bangladesh Journal of Political Economy, c/o, Bangladesh Economic Association, 4/C, Eskaton Garden Road, Dhaka-1000. Telephone: 9345996. E-mail : becoa@bdlink.com Members and students certified by their concerned respective institutions (college, university departments) may obtain the Journal at 50% discount.

Cover design by:
Syed Asrarul Haque (Shopen)

Printed by:
Agami Printing & Publishing Co.
25/3 Green Road, Dhanmondi
Dhaka-1205, Phone: 8612819

BEA Executive Committee 2002-2004

Bangladesh Journal of Political Economy

VOLUME 20, NUMBER 1, JUNE 2004

Bangladesh Economic Association

বাংলাদেশ জার্নাল অফ পলিটিক্যাল ইকনমি

বিংশ খণ্ড, ১ম সংখ্যা, জুন ২০০৪

বাংলাদেশ অর্থনীতি সমিতি

৪/সি, ইস্কাটন গার্ডেন রোড, ঢাকা-১০০০
টেলিফোন ঃ ৯৩৪৫৯৯৬, ফ্যাক্স : ৮৮০-২-৯৩৪৫৯৯৬
ই-মেইল : becoa@bdlink.com

Preface

I am pleased that Volume 20, No. 1 of Bangladesh Journal of Political Economy (BJPE) is ready for printing.

This volume includes papers presented at the regional conference held at Bangladesh Agriculture University (BAU), Mymensingh. The articles have been duly reviewed by experts and modified as required. This particular volume has been finally edited, as a special arrangement for the Mymensingh regional conference approved by the BEA Executive Committee, by Rezaul Karim Talukder and M. A. Sattar Mandal, both Professors, Department of Agricultural Economics, BAU. It gives me great pleasure to commend this volume of the Journal to BEA members and others interested.

I wish to thank the authorities of the Bangladesh Agriculture University, Mymensingh for their goodwill and cooperation. Special thanks are due to the convenor and members of the conference organizing committee and all others who have helped one way or another in the organization of the conference. The efforts and cooperation of the editors of this volume and the authors of the articles are deeply appreciated.

Qazi Kholiquzzaman Ahmad
President, Bangladesh Economic Association
Editor, Bangladesh Journal of Political Economy

Editors' Note

Agribusiness involves a complex set of interlinked activities related to commercial production of agricultural commodities, value addition to the commodities, supply and delivery of inputs, and marketing, distribution and trade of the agricultural commodities. Over the nineties, agribusiness in Bangladesh has grown at about 6 percent per annum, while agriculture has grown at an average of about 3 percent. Import trade of main agricultural primary products (cereals, oilseeds and raw cotton) has increased from US$ 638 million in 1992/93 to US$1139 million in 2002/03, growing at an average of 10 percent per annum. Over the same period, export trade of primary and processed agricultural products (raw jute and jute products, tea, frozen foods, vegetables, fruits and leather) increased from US$ 754 million to 910 million, growing at about 2.1 percent per annum. The number of various stakeholders has increased manifolds and the domestic sales of products originating from crops, aquaculture, horticulture, poultry and dairy increased significantly. The government has also provided the agro-entrepreneurs with various incentive packages including tax exemption, import duty concession, special budgetary allocation for agricultural export promotion and so on.

The main problem of agribusiness development in this country is that effective value chain linkages among the farmers, traders, processors and business service providers are yet to develop. Farmers need to be integrated with domestic as well as international market. This is especially true for high value perishable agricultural commodities. There is serious dearth of information on agribusiness, which precludes any useful analysis and policy making on the sector. One needs reliable quantitative data on many aspects of agribusiness. Who are the stakeholders involved in different agribusiness activities? What are the types of high value agricultural commodities that are produced? How diverse is the commercial production of agricultural commodities? Is the market for inputs and agribusiness products efficient? What is the state of agro-processing? Are the agribusiness activities profitable from farmers' point of view? What are the constraints to agribusiness expansion?

Bangladesh Economic Association (BEA) in its regional conference held at the Bangladesh Agricultural University, Mymensingh on 17 December 2003 addressed some of these issues. The main theme of the conference was Development of Agro-processing and Agribusiness in Bangladesh. Altogether nine research papers were presented and discussed in the seminar. This conference volume of the Journal of Political Economy contains all of those

papers as well as two other papers considered to be very relevant to the agribusiness theme.

There has been significant expansion of small scale poultry farming in the country over the recent past years. The paper by *Sabur* and *Rahman* deals with micro level analysis of production and marketing of poultry in Bangladesh. Shrimp has been the major agricultural export earner in Bangladesh; but the sector faces formidable challenges in production, processing, marketing and trade. One spectacular feature of the shrimp industry is the rapid growth of a series of backward and forward linkages activities centering round production, processing and marketing of shrimp. The paper by *Islam et al*. makes an analysis of the role of various stakeholders involved in the shrimp industry and presents some findings on the livelihood patterns of the stakeholders.

Milk production in the country has been individualistic and dispersed, and needs some form of integration of production with commercial processing and marketing. The specific case of vertical integration of small scale milk production and marketing by Milk Vita is discussed in the paper by *Raha* and *Talukder*. Another case of integration is the production, marketing and processing of poultry and poultry products, as has been highlighted in the paper by *Ahsanuzzaman* and *Islam* through case study of the Aftab Bohumukhi Farm Ltd (AFBL). Production of goat and goat meat is considered to have positive impact on pro-poor growth, but not enough is known on this enterprise. The paper by *Miah et al*. presents an analysis of goat production and marketing in selected locations in Bangladesh.

Value addition to agricultural products is a priority issue. The contributions by *Tongsiri* and *Alam*, *Khan*, and *Shams-Ud-Din* and *Talukder* present discussions on the pertinent issues and micro level evidence on some value addition activities. The papers also identify the constraints and potentials of value addition to a number of agricultural products. Market–oriented agriculture is dependent on the sustainable production, processing and marketing system. The paper by *Rahman* and *Lutfa* emphasizes the need for market-led initiatives for production of seeds and processing of a high-value crop.

Development of profitable technology plays an important role in promoting agribusiness. The paper by *Alam et al*. presents an analysis of a growing market for power tiller technology. Finally, the paper by *Akteruzzaman* and *Parvin* provides a picture on economics of paddy drying by mechanical drier in a typical wet season paddy production environment in Bangladesh.

Rezaul Karim Talukder
M. A. Sattar Mandal

বাংলাদেশ অর্থনীতি সমিতির ষান্মাসিক জার্নাল Bangladesh Journal of Political Economy *প্রকাশনার নীতিমালা*

১। অর্থনীতির বিভিন্ন শাখায় তাত্ত্বিক এবং প্রায়োগিক বিষয়ে প্রবন্ধ প্রণয়ন করার জন্য প্রবন্ধকারদেরকে অনুরোধ জানানো হবে। ইংরেজী এবং বাংলা উভয় ভাষায় রচিত প্রবন্ধ জার্নালের জন্য গ্রহণ করা হবে।

২। Initial screening নির্বাহী সম্পাদকের এখতিয়ারভুক্ত থাকবে, তবে প্রয়োজনবোধে সম্পাদনা পরিষদের অন্য সদস্যদের সহায়তা তিনি নেবেন। নির্ধারিত format মোতাবেক সংশোধনের জন্য এই পর্যায়ে প্রাথমিক ভাবে short-listed প্রবন্ধসমূহ প্রবন্ধকারের কাছে প্রেরণ করা হবে।

৩। অভ্যন্ড়রীণ reviewer সাধারণতঃ সম্পাদনা পরিষদের সদস্যদের মধ্য থেকেই মনোনীত হবেন। বহিঃস্থ reviewer সম্পাদনা পরিষদের সিদ্ধান্ড়ক্রমে প্রবন্ধের বিষয়ের ভিত্তিতে সম্পাদনা পরিষদের বাইরে থেকে মনোনীত হবেন, তবে তিনি দেশের অভ্যন্ড়রে বা বিদেশে অবস্থান করতে পারেন। সম্পাদনা উপদেষ্টা কমিটির সকল সদস্য reviewer হতে পারবেন। তৃতীয় reviewer প্রয়োজন হলে সম্পাদনা পরিষদের বাইরে থেকে তাঁকে মনোনীত করা হবে।

৪। ক) সমিতির দ্বিবার্ষিক কনফারেন্সে উপস্থাপিত প্রবন্ধগুলো referral প্রক্রিয়ার মাধ্যমে জার্নালের জন্য বিবেচিত হবে।

খ) বিভিন্ন সময়ে সমিতি কর্তৃক আয়োজিত সেমিনারে পঠিত আমন্ত্রিত প্রবন্ধসমূহ জার্নালের সম্পাদনা পরিষদের অনুমোদনক্রমে জার্নালে প্রকাশ করা যেতে পারে।

৫। অর্থনীতি সমিতির সদস্য এবং সদস্য-বহির্ভূত যে কোন আগ্রহী প্রার্থী জার্নালের গ্রাহক হতে পারবেন। তবে সদস্যদের ক্ষেত্রে গ্রাহক ফি (subscription fee) পঞ্চাশ শতাংশ রেয়াত দেয়া হবে।

৬। জার্নালের footnoting এবং writing style এতদ্সঙ্গে সংযোজিত হলো (অপর পৃষ্ঠায় দ্রষ্টব্য)

৭। ক) Reviewer হিসেবে সম্পাদনা উপদেষ্টা কমিটির সদস্যদেরকে involve করা হবে।

খ) দেশের অভ্যন্ড়রে অবস্থানকারী উপদেষ্টা কমিটির সদস্যদেরকে বছরে দু'বার সম্পাদনা পরিষদের সাথে মিলিত সভায় আমন্ত্রণ জানানো হবে।

৮। ক) তিনটি কোটেশন সংগ্রহ করে সম্পাদনা পরিষদের সিদ্ধান্ড়ক্রমে মুদ্রক প্রতিষ্ঠান নির্বাচন করা হবে।

খ) প্রথম proof প্রেস দেখবে, পরবর্তীতে floppy তে প্রবন্ধকার ফাইনাল proof দেখে দেবেন।

Bangladesh Journal of Political Economy
VOLUME 20, NUMBER 1, JUNE 2004

Contents

Agribusiness of Poultry and Poultry Products in Bangladesh

S. A. Sabur
M. H. Rahman*

1. INTRODUCTION

Agribusiness encompasses all activities from the "paddock to the consumer" that are relevant to the eventual transformation/value adding, distribution and retailing of food, fibre and associated products. Agribusiness is a name given to the farm inputs, farm and associated consumer products business and their study as an economic and business system.

Poultry, an important agribusiness sector, witnessed spectacular expansion in the recent past. A large number of commercial poultry farms have been established. For supplying day old chicks to these farms a substantial number of poultry hatcheries have also been established in the private sector. Additionally, a number of mills have started producing poultry feeds and more entrepreneurs are coming forward to establish poultry processing plants.

Since the industry has an enormous potential for expansion, great deal of investments have been rushed in this sector during the last few years. But many farms could not tolerate the temporary shock arising from market failure, which caused low price of egg and poultry meat in the market. The scenario in the poultry farming is that almost every day there are new farms coming up and some of the old ones closing down.

Sometimes egg and broiler prices go so down (which is lower than the production cost) in the wholesale market that many small and medium farms have no other alternative but to close down temporarily (Prothom Alo, 30/03/02). Moreover, there is high fluctuation of egg and broiler prices. It is blamed that the Aratdars have been earning more profit although the farm owners have to sell eggs and broiler at low price. Consequently, the consumers are not getting the benefit of low prices.

---

*The authors are Professors, Dept. of Cooperation & Marketing and Dept. of Agricultural Economics respectively of Bangladesh Agricultural University (BAU), Mymensingh.. The paper is partially derived from a report (Rahman et. al., 2002) submitted to the BSERT, BAU, Mymensingh.

The farm owners complain that the Aratdars compel them to sell egg and broiler at low price despite prevalence of higher demand in the market. It is reported that although four eggs are sold at Tk. 11 to Tk.12 at retail market, they are sold at Tk. 6 to 7.50 at wholesale market. Farm owners say that they never witnessed such large difference between wholesale and retail prices of eggs. According to farm owners the Aratdars were mainly responsible for this crisis. Eighty-two Aratdars in Tejgaon area control the whole poultry business in Dhaka. The government has no control over them. They fix price according to their will. The Aratdars, however, refute the farm owners' complain. They say that they earn only Tk. 5 as profit from selling 100 eggs. A study showed that the large wholesalers' (Aratdars) profit ranged from Tk. 6 to Tk. 7 per 100 eggs (Ahmed, 2001). The farm owner association reported that there is no appropriate government policy for the poultry industry. The present study was undertaken to address some of the problems mentioned above.

This study is expected to be useful both at micro and macro levels. It will identify some basic problems that are faced by the owners of broiler and layer farms and wouldalso suggest measures for probable solutions. The research may be of use to the officials of the relevant government and non-government agencies and extension workers in making an appropriate decision regarding further expansion of poultry farming. The unemployed people and potential entrepreneurs will have an avenue for earning income through poultry farming if it is revealed to be a profitable business. Hence the present research was undertaken to study the agribusiness of poultry farming with the following objectives:

(i) to study the market structure and distribution system of important inputs used in poultry farms,

(ii) to estimate the cost, return and profitability of broiler and layer farms;

(iii) to examine the existing marketing system and estimate the cost, margin and profit of traders involved in the marketing chain; and

(iv) to suggest some policy measures for increasing the price at wholesale level and lowering the production cost of farm owners.

2. METHODOLOGY

The study used data both from secondary and primary sources. Secondary sources included previously done theses, reports and researches. In order to substantiate the findings from the secondary sources, empirical data were collected from broiler and layer farmers. Field visits were made in Kishoregonj, Savar, Gazipur, and Kaliakoir areas during July 2002. To know about the marketing margins, costs and net margins, the Dhaka city market was surveyed at the same time. Data

obtained from empirical sources, were compared with those from the previously accomplished researches to arrive at meaningful conclusion. The findings were also subjected to sensitivity analysis to confirm the stability of the results.

Both tabular and statistical methods were used in this study. For collecting empirical data the farmers were divided into three classes: small, medium, and large. Costs, returns and profits of layer and broiler farms were estimated. A field survey was conducted in 2002 to look into the profitability of layer birds. Eighteen small, 12 medium and 10 large layer farms were selected.

For marketing study, Gazipur district and Dhaka city were selected as producing and consuming areas respectively for poultry products. From each type of trade (egg and broiler) 15 farm owners, 10 Aratdars, 6 wholesalers and 15 retailers totalling 46 traders and farm owners were interviewed for this study. That means the total sample size was 92 (46+46). To know the spatial price integration of eggs, Dhaka, Chittagong, Gazipur, Rajshahi, Sylhet and Bogra districts were chosen. Apart from the primary data, the average weekly wholesale prices of eggs of the selected markets during 1991 to 2001 were collected from the Directorate of Agricultural Marketing (DAM).

Ratio to moving average method was used for estimating seasonal price variation of egg and chicken for Dhaka market during 1991 to 2001. A commonly employed method for measuring the integration between agricultural markets is that of correlating time series price data for different market places and product. Simple correlation coefficient using nominal price as a measure of market integration has been criticized by many authors. (Blyn, 1973; Harriss, 1979; Lundahl and Petersson, 1982). Therefore, in this study, the correlation coefficient using first difference in nominal prices was calculated for weekly and monthly egg prices.

3. MARKET STRUCTURE AND DISTRIBUTION SYSTEM OF IMPORTANT INPUTS USED IN POULTRY FARM

The main inputs used by poultry farms are: day old chicks, feed and medicine. The market structure and distribution system of these inputs are discussed below:

Day old chicks

There are over one hundred poultry hatcheries firms in Bangladesh. The market structure of hatchery is oligopolistic in nature. One study (Hossain, 2003) showed that the largest four hatcheries controlled 45% and 65% of production in the case of broiler and layer respectively. They have associations and price of chicks differ a little among the farms (Appendix table 1). In this market structure the big farms

fix the price and the small ones follow them. The individual hatchery sets price unilaterally considering the probable reaction of other farms. This type of price setting may be termed as interdependent action without agreement. The other characteristics of this industry are: atomistic buying condition, evidence of product differentiation in the form of strain and existence of barrier to entry in the form of huge capital requirement.

In order to get chicks the poultry farms have to place order through agent well ahead. For ensuring timely delivery of day old chicks (DOC) the farms require advance deposit of a portion of contract value. One study (Islam et. al., 2002) showed that 84% of farms paid about 30% of full amount in advance for getting DOC. The farms have to wait 3 to 8 weeks for delivery of DOC after advance payment. After receiving chicks, the agent sells them to farm owner and receive commission fixed by the hatchery. Generally the price of chick remains the same throughout the year. Sometimes price changes due to change in demand.

The farm owners mentioned various problems in the case of buying chicks. Sometimes they failed to purchase the necessary number of chick due to shortage of supply. As it is very difficult for them to identify good chicks, sometimes they have to accept bad quality (C grade) chicks. Generally they cannot purchase chicks directly from the hatchery and have to book earlier through agent. They have no scope to bargain and have to purchase at prices fixed by the hatcheries. The price, according to them, was much higher and the hatchery earns abnormal profit. Hossain (2003) showed that although economic profit existed in the hatchery industry, one-third of capacity remained unutilised during 2002.

Feed

The broiler farms purchase ready made feed for their birds. On the other hand, the layer farms prepare own feed after purchasing ingredients from the market. Like hatchery, the feed mills supply feed through their agents/dealers via their sales centres at a price fixed by them. The price of feed does not vary much throughout the year. However, at times of high demand the agents raise price by creating artificial scarcity.

The structure of feed mill industry in Bangladesh is moderate concentrated oligopoly. It was found that the largest four firms produced one-third of total industry's production (Roy, 2001). A degree of interdependency in determining price was found among the firms. They were always conscious about the probable reaction of the rivals in the case of setting/changing price. As a result, the price variation across firms was not significant. The price per kg of feed ranged from Tk. 14 to Tk. 16 (Appendix Table 2). Atomistic buying condition, product differentiation in the form of quality and entry barrier in terms of less access to

liquid fund were the major characteristics of this industry. The capacity utilization of this industry was satisfactory, which was 94% during 1999 and the profit margin was found positive (Roy, 2001).

The layer farms purchased ingredients like maize, bran, soybean and oyster shell from wholesaler, protein, laycin, enzyme plus, mithionin and layer premix from agents/dealers and salt from retailers. The price of ingredients such as protein, enzyme, premix etc. supplied by different companies was more or less the same in the study area (Appendix Table 2).

The farm owners faced problems of selecting good quality of feed. As a result, sometimes they incurred loss by purchasing adulterated feed. Sometimes necessary feed was not available in the market. The layer farm complained on the non-availability of ready feed in the market.

Medicine

The farms purchased medicine from agents at price fixed by the company. At the time of large-scale disease attack the agents raised price of necessary medicine by creating artificial scarcity. The price of the same medicine varied markedly across different companies. For example, the retail price of Arif's Allvit was Tk 182 per 100gm, whereas the same medicine/ vitamin of Square named Megavit was sold at Tk.400 per 100 gm. Due to ignorance, the farm owners faced problem of selecting appropriate good medicine at the time of need. Sometimes, it is complained that the necessary medicine either was not available or available at a higher price.

4. PROFITABILITY OF BROILER AND LAYER PRODUCTION

A study (Karim, 2000) was conducted on broiler farms that were contact growers under Aftab Bahumukhi Farm Ltd. (ABFL) in Kishoregonj (Tables 1). The Aftab farm provided some support services and guaranteed price. The net return per 100 birds amounted to Tk 1078, Tk. 1089, Tk. 1239 and Tk. 1056 for small, medium, large and all farms respectively. As ABFL supplied necessary inputs on credit as well as provided technical services to contact growers, it offered lower than market price to the growers. As a result, their net return was found lower. These returns appeared to be the lower bound return of broiler farming. Another study (Begum, 2000), which covered wider range of flock size in Trishal and Mymensingh Kotwali thanas, revealed that the small, medium, large and all farms received respectively Tk. 1752, Tk. 2636, Tk. 2497 and Tk. 2401 as net return per 100 birds. (Table 2). Thus it appears that broiler farming is certainly profitable. The findings of the study by Begum (2000) may be accepted as the upper limit

regarding profitability of broiler farming and for making some projections. The rate of return from broiler raising is substantially higher than the opportunity cost of capital. Thus it may be suggested that if a medium size broiler farm is started with 4500 birds/year, it is likely to generate an annual net return of Tk 1,18,620.00.

It was also found that net return per 100 birds of broiler increased with the increase of farm size. This indicates that the medium and large farms were capable of earning more profit per bird compared to small farms. Fokrul et. al. (2002) obtained similar results which showed that larger farms achieved higher efficiency not only due to better cost economy but also due to better technical performance of the flock.

Table 1: Cost and return of contact broiler growers by farm size

(Tk./100 birds)

Particulars	Small	Medium	Large	All farms	% of total cost
Variable Cost Items					
Feed cost	4066	4046	4066	4057	52.55
Day old chick	2200	2200	2200	2200	28.50
Hired labour	165	155	145	154	1.99
Veterinary cost	406	492	532	493	6.39
Cleaning	34	38	34	36	0.47
Transportation	120	119	113	117	1.52
Electricity	107	95	78	90	1.17
Litter cost	33	35	30	33	0.43
Total variable cost	7131	7180	7198	7180	93.01
Fixed Cost Items					
Family labour	110	73	54	73	0.95
Housing	126	119	106	115	1.49
Tools & Equipment	28	30	34	31	0.40
Interest on operating capital	303	305	305	304	3.94
Land use cost	18	29	28	17	0.22
Total Fixed Cost	585	556	528	540	6.99
Total cost	7716	7736	7726	7720	100.00
Total Gross Return	8921	8940	9071	8987	-
Net return	1205	1204	1345	1267	-
Benefit-Cost Ratio	1.16	1.16	1.17	1.16	-

Source: Karim, 2000

Table 2. Cost and return of broiler production by farm size

(Tk./100 birds)

Particulars	Small	Medium	Large	All	% of total cost
Variable cost items					
Feed cost	3613	3445	4027	3826	46.17
Day-old-chick	2342	2367	2300	2343	28.27
Hired labour	328	481	426	445	5.37
Veterinary cost	320	319	323	325	3.92
Electricity	95	117	75	94	1.14
Carrying cost	88	94	74	84	1.02
Total Variable cost	6787	6822	7226	7117	85.88
Fixed cost items					
Family labour	460	291	146	239	2.88
Housing cost	81	97	81	88	1.06
Tools and equipment	91	68	54	64	0.77
Interest on operating capital	576	579	853	744	8.98
Land use cost	45	40	27	35	0.43
Total Fixed cost	1252	1074	1160	1170	14.12
Total cost	8039	7896	8386	8287	100.00
Gross Return	9791	10532	10883	10688	-
Net Return	1752	2636	2497	2401	-
Benefit-cost Ratio	1.22	1.33	1.30	1.29	-

Source: Begum, 2000

To explore the profitability of layer farms, a very recent survey was conducted in Gazipur in 2002 (Tables 3). The findings of the study were substantiated by Khanum's study (Table 4). According to the recent survey, costs per 100 birds amounted to Tk 52581, Tk 50135, Tk 48398 and Tk 50070 for small, medium, large and all farms respectively. Annual net return per100 birds amounted to Tk 23310, Tk 20115, Tk 22236 and Tk 21946 for the small, medium, large and all farms, respectively. The net return per 100 birds obtained from Khanum's study (2002) amounted to Tk 19551, Tk 22416, Tk 23909 and Tk 19480 for the small, medium, large and all farms, respectively. The findings of the two studies varied slightly. Hence it appears that both broiler and layer farming are profitable enterprises. Layer farming, however, is more profitable than broiler farming. Assuming a flock size of 8000 layer birds, the annual net returns may range between Tk 16.00 lakh to Tk 17.00 lakh. Farmers, however, are still more interested in broiler rearing because of quicker returns.

Table 3: Cost and return of layer production by farm size

(Tk/100birds)

Particulars	Small	Medium	Large	All	% of cost
Variable cost items					
Feed cost	40536	39512	39213	39682	79.25
Hired labour	1825	1655	1473	1622	3.24
Veterinary cost	941	980	896	933	1.86
Electricity	594	485	354	458	0.91
Carrying cost	413	314	173	280	0.56
Litter cost	340	227	136	219	0.44
Day-old-chick	2420	2322	2200	2296	4.59
Total variable cost	**47069**	**45494**	**44446**	**45489**	
Fixed cost items					
Family labour	1507	984	654	984	1.97
Housing cost	679	605	514	586	1.17
Tools and equipment	722	540	484	566	1.13
Interest on operating cost	1586	1587	1546	1569	3.13
Land use cost	1018	925	754	876	1.75
Total fixed cost	**5512**	**4641**	**3952**	**4581**	9.15
Total cost	52581	50135	48398	50070	100.00
Gross return	75891	70250	70634	72016	
Net Return	**23310**	**20115**	**22236**	**21946**	
Benefit-cost Ratio	1.44	1.40	1.46	1.44	

Source: Field Survey, 2002

Feed comprises a larger share of total cost in broiler and layer rearing. For broiler rearing, feed cost roughly constituted around 50 per cent of the total cost. The corresponding cost for layer rearing constituted closer to 80 per cent. There is a scope to reduce feed cost by increasing management efficiency. Timely availability of feed and its quality very often cause higher feed cost to poultry farmers.

Table 4: Cost and return of layer production by farm size

(Tk./100birds)

Particulars	Small	Medium	Large	All	% of total cost
Variable cost items					
Feed cost	42931	42140	41889	43346	78.28
Hired labour	1809	2015	1796	2025	3.66
Veterinary cost	999	1002	1004	1002	1.80
Electricity	668	495	404	535	0.97
Carrying cost	446	301	146	298	0.54
Litter cost	354	231	142	242	0.44
Day-old-chick	2410	2154	1992	2185	3.95
Total Variable cost	**49617**	**48338**	**47374**	**49632**	**89.64**
Fixed cost items					
Family labour	1659	1038	711	1063	1.92
Housing cost	778	604	518	633	1.14
Tools and equipment	787	601	504	631	1.14
Interest on operating cost	2481	2497	2369	2482	4.48
Land use cost	1278	982	635	929	1.68
Total Fixed cost	**6983**	**5722**	**4737**	**5737**	**10.36**
Total cost	56600	54060	52110	55369	100
Gross return	76151	76476	76019	74849	-
Net Return	**19551**	**22416**	**23909**	**19480**	**-**
Benefit-cost Ratio	1.35	1.41	1.46	1.35	-

Source: Khanum, 2002

5. MARKETING CHAINS OF BROILER AND EGGS

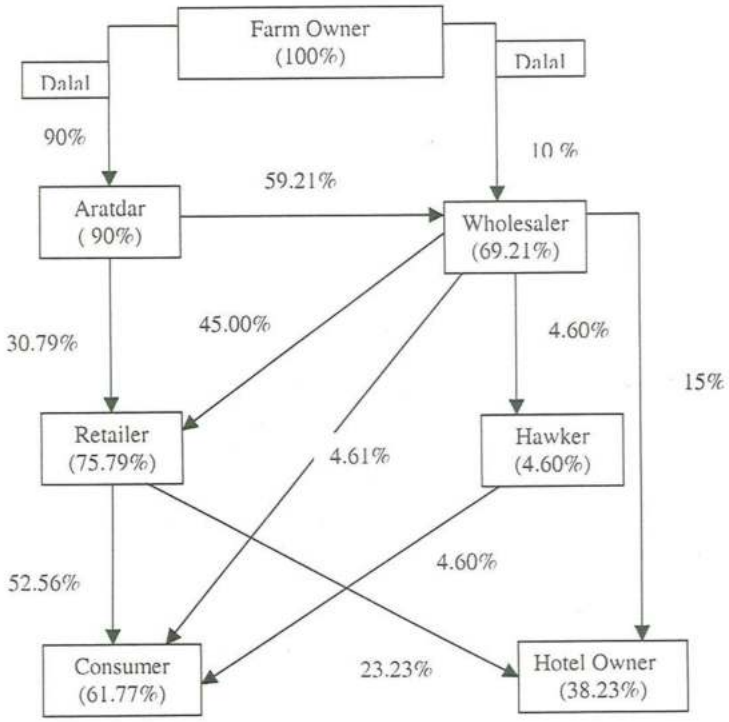
Egg

The market participants involved in marketing of egg are farm owner, Dalal, Aratdar (large wholesaler), Wholesaler, Hawker and retailer. The farm owners sold 90% of their eggs at their farm gate to the Aratdar and 10% to wholesaler through Dalal. Dalals are the local people who arrange contacting farm owners with Aratdar or wholesaler for transaction. They received Tk. 4 to Tk. 5 for selling 100 eggs from the farm owner for their service. Sometimes they did not disclose the actual selling price to the farm owner.

After purchasing eggs from farm owner, the Aratdars sell two third of their eggs to wholesaler and one thirds to retailer (Fig. 1). The wholesalers purchase most of their product from Aratdars (large wholesaler) and sell two-third to retailers and one fourth to hotel owners. They dispose of some amounts to Hawker and directly

to consumers. Retailers purchase 60% eggs from wholesalers and 40% from Aratdars and sell 70% to consumers and 30% to hotel owners.

Figure 1: Marketing chain of egg in the Dhaka city

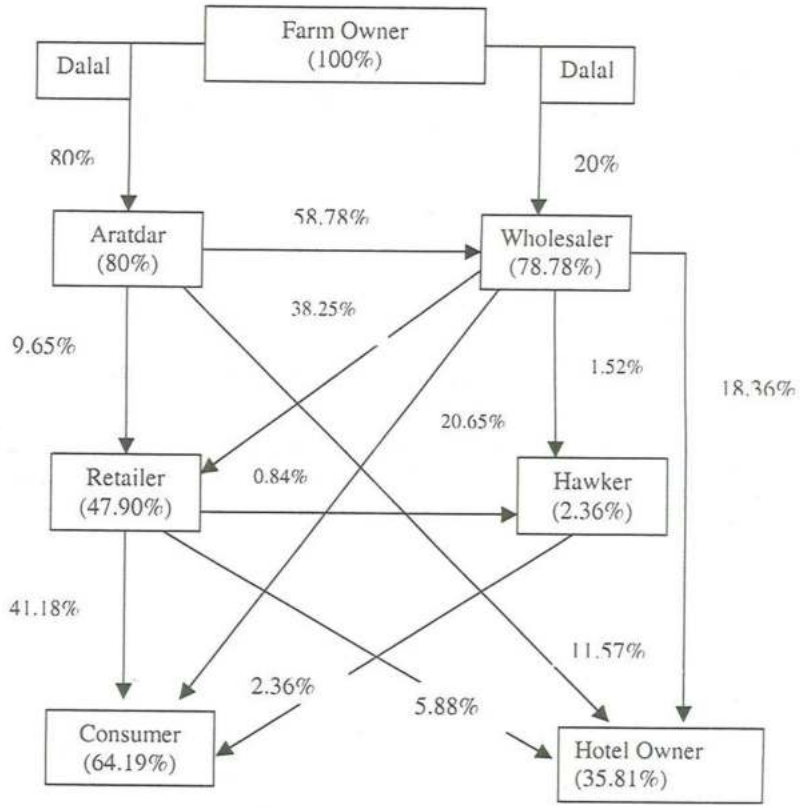


Broiler

Like egg marketing chain, the intermediaries involved in broiler marketing are farm owner, Dalal, Aratdar (large wholesaler), Wholesaler, Hawker and retailer. The broiler farms sell 80% of their produce to the Aratdars and 20% to wholesalers at their farm gate through Dalals who help the owner to sell product. Dalals generally obtained Tk. 50 for selling per 100 kg of broiler. The Aratdars, on the other hand, sell 73% of their product to

wholesalers, 15% to hotel owners and 12% to retailers (Fig. 2). The wholesalers vend one half to retailers and one fourth directly to consumers. They also dispose of over 20% to hotel owners and a little quantity to Hawkers. Retailers purchase 80% eggs from wholesalers and 20% from Aratdars and sell 86% to consumers and 12% to hotel owners.

Figure 2: Marketing chain of broiler in the Dhaka city



6. MARKETING COST, MARGIN AND PRICE FIXATION PROCEDURE

Marketing cost and margin

Egg: The total marketing cost incurred by different intermediaries for one hundred eggs was calculated at Tk. 12.67, of which more than three fourth (78%) was shared by Aratdar (Table 5). Transportation was the highest cost item comprising about one half of total marketing cost. Wastage, the second highest cost item, accounted for about one-fourth of total cost. As Aratdars used to bring eggs directly from farms, which were located far away from Dhaka city, they incurred higher transportation and wastage cost compared to other traders.

Among the traders, retailers' net margin or profit was over three times higher than that of wholesalers (Table 6) because of the fact that they assumed more risk compared to other traders. Retailers generally have to wait for a long time to sell a fixed quantity of eggs compared with other traders. Although Aratdars' per unit profit was lower (4%of sale price), their total profit per unit of time was higher because of selling large quantity of eggs in a day.

Table 5: Marketing cost of egg intermediaries

(Tk/100 eggs)

Cost item	Aratdar	Wholesaler	Retailer	Total	Percentage
Transportation	5.32	0.38	0.55	6.25	49.33
Storage	0.63	0.10	0.00	0.73	5.76
Market toll	0.28	0.15	0.12	0.55	4.34
Labour	0.31	0.05	0.08	0.44	3.47
Wastage	2.21	0.33	0.50	3.04	24.00
Rent	0.57	0.25	0.19	1.01	7.97
Miscellaneous	0.52	0.09	0.04	0.65	5.13
Total	9.84	1.35	1.48	12.67	100.00

Table 6: Marketing margin of egg traders

(Tk./100 eggs)

Intermediaries	Purchase price	Sale price	Marketing margin	Marketing cost	Net margin
Aratdar	229.76	249.15	19.39	9.84	9.55
Wholesaler	272.13	279.50	7.37	1.35	6.02
Retailer	281.86	303.33	21.47	1.48	19.99

Broiler: Among the traders, Aratdars' marketing cost was the highest comprising about 60 per cent of total marketing cost of all traders because of the fact that they moved product from long distance (Table 7). Transportation, the highest cost item, accounted for about 40 per cent of total cost, followed by wastage of 20 per cent and storage of 15 per cent. Unlike egg traders, profit of wholesalers was found higher than that of other traders, although retailers bear more risk (Table 8). This has happened due to the fact that contrary to egg wholesalers, broiler wholesalers sell more than one half of their product either directly to the consumers or to the hotel owners. They may better be called as wholesaler cum retailer instead of simply wholesaler. As Aratdars trade more amount of product per unit of time, their total profit was higher than that of other traders.

Table 7: Marketing cost of broiler intermediaries

(Tk/Kg)

Cost item	Aratdar	Wholesaler	Retailer	Total	Percentage
Transportation	2.56	0.30	0.18	3.04	38.83
Storage	0.49	0.43	0.27	1.19	15.20
Market toll	0.08	0.12	0.17	0.37	4.73
Labour	0.45	0.12	0.13	0.70	8.94
Wastage	0.85	0.28	0.43	1.56	19.92
Rent	0.19	0.23	0.22	0.64	8.17
Miscellaneous	0.03	0.15	0.15	0.33	4.21
Total	4.65	1.63	1.55	7.83	100.00

Table 8: Marketing margin of broiler traders

(Tk/Kg)

Intermediaries	Purchase price	Sale price	Marketing margin	Marketing cost	Net margin
Aratdar	53.20	60.16	6.96	4.65	2.31
Wholesaler	58.00	63.70	5.70	1.63	4.07
Retailer	59.41	64.58	5.17	1.55	3.62

Price fixation procedure

Aratdars and farm owners jointly determine the farm level broiler and egg prices. At Arat level, price is settled by open bargaining mainly based on competition among the Aratdars. Wholesale price is fixed on the basis of competition among the sellers. Finally, retailers follow mark-up method to fix up selling price.

Marketing problems

Illegal payment, hooliganism, terrorism, fluctuation of prices and death of birds are the major problems mentioned by all broiler traders. Additionally, the wholesalers and retailers pointed out weight loss and increase in feed cost due to delayed sale as problem. Like broiler traders, egg traders mentioned illegal payments, terrorism, price fluctuation, wastage of eggs are the major problems. Besides, Aratdars cited poor communication system, presence of Dalal, Hartal, blockade etc. as the main problems.

7. PRICE VARIATION

Seasonal Price Variation

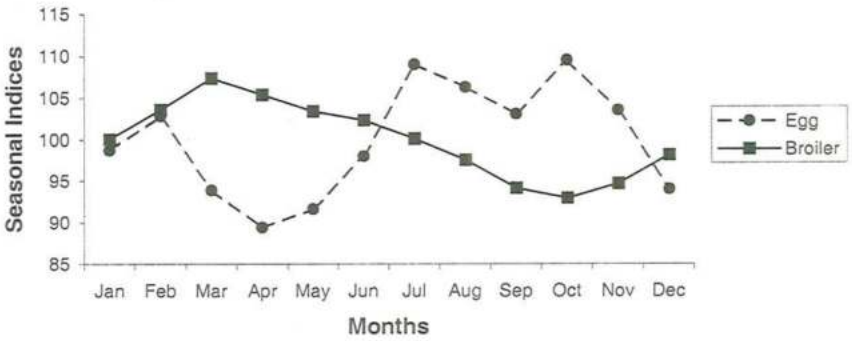
Egg: It is evident from Fig. 3 that the seasonal price index of egg was the highest in October and the lowest in April. After initial peak in February, the price began to fall and reached the lowest level in April. After April, the price began to rise and reached the highest level in October with a small decrease in September. The seasonal price indices showed three peaks in the months of April, July and October. The prices remained higher than average in February, July to November and they were lower than average in the remaining months. The difference between the highest and the lowest indices and the coefficient of variation on indices were 20.06 and 6.75 respectively (Appendix table 3). The causes of such price variation might be as follows:

i) In winter season, production of eggs increase because of congenial climate. Conversely, the production remains lower in summer season. Average production of egg per day and price received in different months by the sample farms as depicted in fig. 4 show that there is a strong negative relation between production and price. The correlation coefficient between production and price was estimated at –0.792.

ii) Due to more availability of indigenous poultry eggs (chicken and duck) in April, the price of eggs remain at the lowest level. Another reason for lower price during April to June is that in those months, the demand for egg is lower due to hot weather.

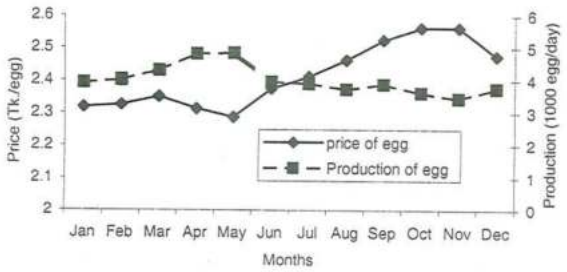
iii) Because of lower production, the price of egg is generally the highest in October. Moreover, higher demand due to cold weather cause the price to rise in October-November.

Figure 3: Seasonal price variation of egg & broiler during 1991 to 2001



Broiler: The seasonal price variation of chicken/broiler in Dhaka market during 1991 to 2001 is also presented in Fig. 3. The broiler price started to rise from November, reached peak in March, decreased thereafter and finally reached the lowest level in October. Unlike egg price, the broiler price was the highest in March–April and the lowest in September-October. The price remained above average (100) during January to July and below average during August to December. Compared with egg, the seasonal price fluctuation of broiler was found lower. Another interesting result is that negative relation existed between the seasonal price variation of egg and broiler. That means when the egg price was higher, the broiler price was lower. Lower production due to unfavourable weather condition causes higher broiler price in March-April. Moreover, in this period the availability of fish is lower. On the other hand, the price remain lower during autumn season (September-October) because of higher production arising from favourable weather condition and because of availability of more fish in the market. Instead of winter, broiler production is the highest during autumn because during winter the mortality of smaller chicks is higher due to cold weather. Besides, during winter season the demand remains slightly higher due to occurrence of more social ceremonies like marriage, picnics etc. Price is mainly determined on the basis of demand and supply of broiler in the market. However, influence of supply was higher than that of demand because supply was more fluctuating.

Figure 4: Average production per day in thousand & price of egg received by farm



Spatial Price Variation

The estimated correlation coefficients between different markets for weekly and monthly prices are presented in Tables 9 and 10 respectively. In the case of weekly prices, all the coefficients were below 0.30 and only 8 out of 15 coefficients were significant. This indicates that all the selected egg markets were either not integrated or integrated poorly in the short run.

Table 9: Correlation coefficient matrix of weekly egg prices in selected markets

Markets	Dhaka	Chlttagong	Rajshahi	Gazipur	Bogra	Sylhet
Dhaka	1.00	0.28*	0.13*	0.18*	0.04	0.13*
Chittagong	0.28*	1.00	0.13*	0.06	-0.007	0.19*
Rajshahi	0.13*	0.13*	1.00	0.19*	0.06	0.09
Gazipur	0.18*	0.06	0.19*	1.00	0.07	0.07
Bogra	0.04	-0.007	0.06	0.07	1.00	0.12*
Sylhet	0.13*	0.19*	0.09	0.07	0.12*	1.00

* Significant at 1% level

For monthly price data, all the coefficients are low but significant. Except thecoefficient between Dhaka and Chittagong, all the coefficients were below 0.6. The correlation coefficient between Dhaka and Chittagong markets was highly related in the long run. This has happened due to the good communication (road and telephone) between these two markets. All other markets were moderately integrated in the long run.

Table 10: Correlation coefficient matrix of monthly egg prices in selected markets

Markets	Dhaka	Chlttagong	Rajshahi	Gazipur	Bogra	Sylhet
Dhaka	1.00	0.75*	0.49*	0.53*	0.23*	0.39*
Chittagong	0.75*	1.00	0.49*	0.52*	0.26*	0.49*
Rajshahi	0.49*	0.49*	1.00	0.45*	0.34*	0.30*
Gazipur	0.53*	0.52*	0.45*	1.00	0.44*	0.32*
Bogra	0.23*	0.26*	0.34*	0.44*	1.00	0.22*
Sylhet	0.39*	0.49*	0.30*	0.32*	0.22*	1.00

* Significant at 1% level

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Input sector: Poultry inputs like chick, feed and medicine markets are oligopolistic in nature, in which prices are determined individually considering probable reaction of others. Invisible collusion in determining prices exists among the firms and the possibility of earning abnormal profit cannot be ruled out. For that reason the prices of inputs of different firms were noted to be high and by and large equal. Except in the case of medicine, prices vary a little across the firms. The prices do not vary significantly throughout the year. However, at times of high demand the agents raise price by creating artificial scarcity. The farm owners have little knowledge to select the good quality inputs and incur loss by using poor quality inputs. They have no choice but to accept inputs at a price fixed by the company.

Production Sector: It has been observed that both broiler and layer farming are profitable enterprises. Farmers, however, are more inclined to broiler production because of quicker returns. These enterprises, at present, are confronted with a number of technical, biological, marketing and management constraints. In order to make the broiler and layer enterprises sustainable the management skills, among others, of the owners of the enterprises must be improved.

Marketing Sector: Although farm owners and Aratdars jointly determine the farm level prices of eggs, the demand and supply forces are very important in determining prices in the market. However, because of weak bargaining power of producers compared to the Aratdars, especially at the time of excess supply, Aratdars have an upper hand in fixing prices. Farm owners sometimes reportedly incur loss by selling eggs and broiler at a price lower than their production cost whereas such situation never arises in the case of Aratdars. That means Aratdars'

profit is certain and constant while producers' profit remains very uncertain and fluctuating. In majority cases, the transaction between Aratdar and farm owner has taken place through local Dalal. For that reason both the parties incur loss to the amount paid to the Dalal as commission. Although Aratdars' profit (4% of sale price) is lower, their total profit per unit of time must be higher as they handle larger volume of product. High wastage cost (about one-fourth of total marketing cost) implies lack of physical facilities, especially storage, in the market.

Egg and broiler prices show a distinct and regular seasonality in a year. The pattern of price is a reflection of number of factors including, among other things, availability of eggs and broiler (both commercial and indigenous) and change in demand arising from change in weather condition. For a perishable commodity, this high fluctuation of prices makes poultry industry very much uncertain. The study also shows that egg markets are poorly integrated despite development in communication facilities over the recent past years.

8.2 Recommendations

(i) Government should take appropriate policy measures for ensuring steady supply of quality feed and day old chick to the farm owners.

(ii) Farmers should be given short-term training to improve their technical know-how and management skill.

(iii) Appropriate housing design, especially to reduce summer stress is essential for reducing production loss due to heat stress.

(iv) Extension services need to be strengthened for imparting knowledge on improved feeding, housing, nutrition, management and disease control measures.

(v) Establishment of grandparent stockfarms is needed which could certainly reduce the price of day old chicks resulting in higher profit of farms.

(vi) Introduction of processing (dressed) and further processing (cut up parts) of poultry and increased use of poultry egg and meat in value added products should help to reduce price fluctuation.

(vii) Farm owners may be organised into viable pressure groups so that they can sell their produce directly to the Aratdars instead of via Dalal. This would improve their bargaining power and thus help them to obtain a better price for their produce.

References

Ahmed, S. (2001). "Marketing System and Price Behaviour of Eggs in Selected Area of Bangladesh," MS thesis submitted to the Department of Cooperation and Marketing, Bangladesh Agricultural University, Mymensingh.

Anonymous. (2002). "Low Price of Egg in Wholesale Market: Aratdars are blamed to create Artificial crisis", *Prothom Alo* (The Daily Newspaper), Dhaka, 30th March, 2002.

Begum, S. (2000) A Comparative Analysis of Broiler and Layer Production in Some Selected Areas of Mymensingh district. MS thesis, submitted to the Department of Agricultural economics, Bangladesh Agricultural University, Mymensingh.

Blyn, G. (1973). "Price Series Correlation as a measure of Market Integration", Indian Journal of Agricultural Marketing, 28(2).

Harris, Barbara, (1979). "There is Method in my Madness: or is it Vice Versa? Measuring Agricultural Market Performance, Food Research Institute Studies, 17(2).

Hossain, D. (2003). "Market Structure, Conduct and Performance of Poultry Hatchery Industry in Bangladesh", MS thesis submitted to the Department of Cooperation and Marketing, Bangladesh Agricultural University, Mymensingh.

Islam, S. M. F., M. A. Jabbar, M. I. Khan and S. K. Ehui (2002), "Differential Impacts of Policy and Scale Factors on Poultry Producers in Bangladesh," Paper presented for the dialogue on policies and institutions affecting dairy and poultry producers in Bangladesh, 13-14 October, Dhaka.

Karim, M.R. (2000) An Economic Analysis of Broiler Enterprise under Contract Farming System in an Area of Bangladesh. MS thesis, Submitted to the Department of Agricultural economics, Bangladesh Agricultural University, Mymensingh.

Khan, R. A. (1998). "Hatchery Industry in Bangladesh: A Market Structure Analysis," Unpublished M.S. thesis Submitted to the Dept of Cooperation & Marketing, Bangladesh Agricultural University, Mymensingh.

Khanum, R. (2002) Performance of Layer Farming and its Impact on Women Empowerment and Environment in Gazipur District. MS thesis, submitted to the Department of Agricultural economics, Bangladesh Agricultural University, Mymensingh.

Lundahl, M. and E. Petersson, (1982). " Price Series Correlation and Market Integration: Some Further Evidence," Indian Journal of Agricultural Economics. 37(2).

Rahman, H., M. A. R. Howlider and S. A. Sabur (2002). "Low and Fluctuating Prices of Broilers and Eggs: Crisis in Poultry Industry," Report submitted to Bureau of Socio-economic Research and Training, Bangladesh Agricultural University, Mymensingh.

Roy, A. (2001). Livestock Feed Mill Industry in Bangladesh: An Agribusiness Study," Unpublished M.S. thesis Submitted to the Dept of Cooperation & Marketing, Bangladesh Agricultural University, Mymensingh.

APPENDIX

Appendix Table 1: Price of day-old chicks for different companies

Name of company	Broiler chicks		Layer Chicks	
	A grade	B grade	A grade	B grade
National	22.00	13.00	16.00	11.00
Naris	23.00	14.00	17.00	10.00
Dhaka	20.00	12.00	16.00	10.00
Kazi	20.50	12.00	15.00	10.00
Paragon	22.00	13.00	16.00	11.00
Finix	18.00	10.00	-	-
Royal	19.00	11.00	-	-
BRAC	19.00	14.00	-	-
Sylhet	-	-	15.50	9.00

Appendix Table 2 Price of broiler feed and layer feed ingredient for different companies

Name of company	Broiler feed	Layer feed ingredient (Tk/Kg.)		
	Price (Tk/Kg.)	Protein	Enzyme	Premix
Quality	14.25	-	-	-
BRAC	16.00	-	-	-
Pacha	14.20	32	315	120
Narish	14.00	35	320	125
ACI	-	35	300	120
Ranata	-	40	350	130
Arifs	-	36	335	125
Novertis	-	35	320	125

Appendix Table 3: Seasonal price indices of egg and broiler received by farm in 2001.

Months	Seasonal Price Indices	
	Egg	Chicken
January	98.74	100.08
February	102.87	103.63
March	93.90	107.40
April	89.42	105.42
May	91.65	103.45
June	98.01	102.37
July	109.00	100.16
August	106.30	97.54
September	103.08	94.17
October	109.48	92.95
November	103.52	94.70
December	94.02	98.15
Range	20.06	14.45
C. V.	6.75	4.63

An Analysis of Stakeholder Profiles in Relation to Production, Marketing and Processing of Shrimp in Bangladesh

M. S. Islam*
R. K. Talukder*
A. A. Miah**

1. INTRODUCTION

Shrimp farming and related activities contribute significantly to the national economy of Bangladesh. The main areas of contribution are export earning and employment generation through on- and off-farm activities. Bangladesh has about 2.5 million hectares of coastal tidal land under brackish water shrimp culture. Farming area is steadily expanding. But most of the farmers still follow the traditional method, and per unit production is very low (150-250 kg/ha). As a result, production cost is higher compared to other shrimp growing countries of the world (Braten 2001). However, even with the present production practices, a large number shrimp farmers and other stakeholders are involved in the shrimp industry, although some of them are adversely affected. In the recent past, Islam and Wahab (2000) conducted a study to assess the environmental and socioeconomic impacts of shrimp farming in Bangladesh. The present study addresses the effects of shrimp farming in changing the livelihoods of different classes of people involved in shrimp farming and the ancillary activities. The shrimp industry consists of four distinct subsectors viz., shrimp farms/*ghers*, shrimp hatcheries, feed mills and shrimp processing plants (Haque 1994). Shrimp farms are the mainstay of the industry and the activities of the other subsectors depend largely on the growth and sustainable development of shrimp farms in the country. Shrimp farming offers excellent employment opportunity through a

* Professors, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

** Research Associate, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

series of backward and forward linkage activities and accordingly, different groups of people (stakeholders) are directly and indirectly involved in the shrimp industry. The major stakeholders are shrimp farmers, shrimp farm labourers, owners of related establishments (feed mill, processing plant, depot and hatchery), shrimp seed collectors, land lessors and shrimp traders.

In many of the sub-sector activities, women get opportunity for employment and they are actively involved in different activities. Although both male and female workers participate in different activities, male participation is dominant compared to women. The gender role and equity issue in respect of income earning need to be determined. Also, the extent and pattern of involvement of different stakeholders and their stake in the industry needs to be carefully examined. In order to address all these issues, the paper aims to accomplish the following objectives:

- To determine the effect of shrimp related activities in changing the livelihoods of different classes of people (stakeholders) involved in the shrimp industry.
- To examine the differential aspect of livelihood effects for the stakeholder categories.
- To assess the gender dimension of participation in different activities and examine the related equity aspects, particularly in respect of income earning and social participation.

2. APPROACH OF THE STUDY AND DATA SOURCES

Three major socioeconomic aspects were considered in the assessment of the present status and livelihood patterns of the stakeholders and gender involvement in the shrimp industry.

- Access to fisheries resources of the stakeholders in shrimp production and overall shrimp industry.
- Contribution of shrimp industry's activities to household income generation and household livelihood security (e,g. food, housing, education, healthcare and other basic needs).
- Assessment of gender role and equity, and women involvement in the sub-sectors of the shrimp industry.

Three study areas were selected from Khulna, Satkhira and Cox's Bazar districts on the basis of concentration of shrimp farming activities in the areas. The study areas included Paikgacha of Khulna, Shamnagar of Satkhira and Teknaf of Cox's Bazar district. In addition, Bhaluka Upazila of Mymensingh district was selected

to study the employment opportunities created for workers in the feed meal. In total 300 stakeholders who were involved in shrimp farming and related activities were selected to examine the livelihood patterns of the stakeholders (Table 1).

Table 1: Sampling design for assessment of livelihoods of stakeholders of the shrimp industry

Stakeholders of shrimp industry	Sample households No.	Study areas
Shrimp farmers	80	Paikgacha, Shamnagar and Teknaf
Land lessors	30	Paikgacha and Teknaf
Hatchery owners	10	Cox's Bazar
Depot owners	10	Paikgacha
Shrimp seed collectors	40	Teknaf and Paikgacha
Shrimp farm labourers	30	Teknaf and Paikgacha
Processing plants workers	30	Khulna, Cox's Bazar
Hatchery workers	20	Cox's Bazar, Teknaf
Feed mill workers	20	Bhaluka, Mymensingh
Depot workers	20	Teknaf and Paikgacha
Shrimp traders (*faria*)	10	Teknaf and Paikgacha
Total	300	-

3. SOCIOECONOMIC PROFILE OF STAKEHOLDERS INVOLVED IN THE SHRIMP INDUSTRY

3.1 Stakeholders' Access to Fisheries Resources and Opportunities for Employment

Table 2 shows the number of firms actively involved in the four sub-sectors of the shrimp industry in Bangladesh. However, each of these sub-sectors has different dimensions where rural people, both skilled and unskilled labourers, get opportunity to be employed. An integrated picture of the shrimp industry linking the relevant sectors is depicted in Figure I. Shrimp production and supply chain (Fig. I) clearly indicates the production process of shrimp and its distribution where different kinds of agents and firms are involved. From different sources and study, it was reported that a lot of workers and labourers, both male and female, were employed in the farms and processing factories, whereas small traders and agents were involved in marketing and distribution. But exact number of workers and/or agents involved in different stages of supply chain are not known precisely. However, it was reported that about 0.2 million people including men and women

were engaged in shrimp fry collection, transportation, processing and other related business activities (Azahar 2001).

Table 2: Shrimp farms and other allied establishments representing the subsectors of the shrimp industry

Sectors of shrimp industry	Cox's Bazar region	Khulna region	Other areas	Total
Shrimp farms	2369	4014	198	6581
Shrimp hatchery	38	5	-	43
Shrimp processing plants	69	27	19	127
Feed mill	1	1	18	20

Sources: DOF 1994, Hossain 1994, Karim and Aftabuzzaman 1995, Socioeconomic Survey 2002 and DoF (*Matshaw Pakha*) 2002.

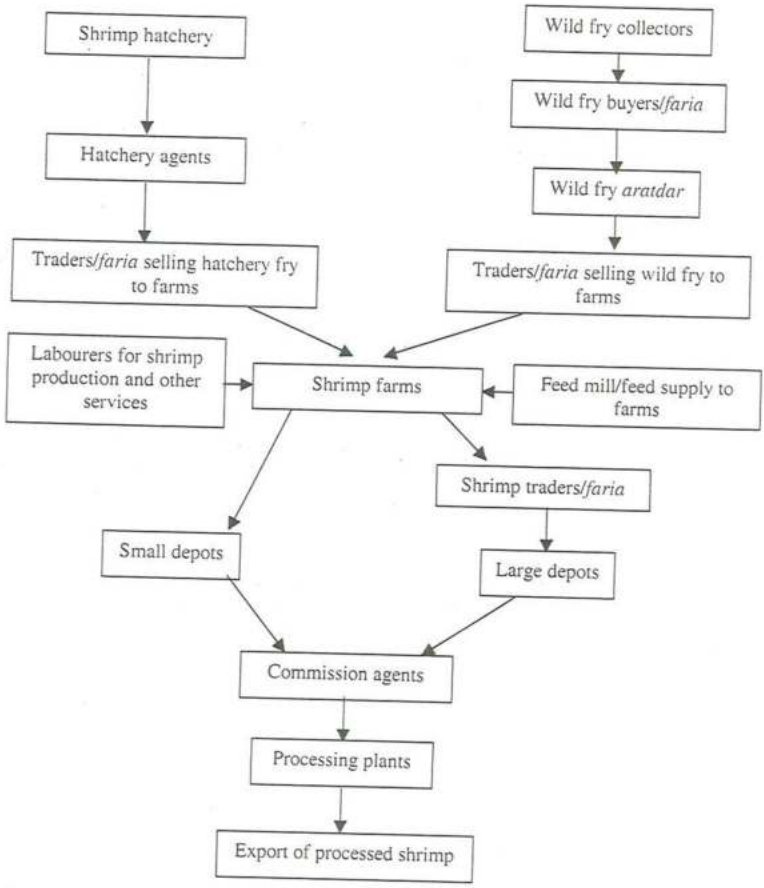
Commercial shrimp culture has created a substantial economic and social transformation in the shrimp belt of Bangladesh (Hamid and Alauddin, 1996). A large number of big *gher* owners, urban and semi-urban stakeholders have made a quick fortune by producing and trading shrimps. The gains of the big farmers and traders are alleged to have been achieved at the expense of the interest of small/marginal farmers and the fishers community. Alauddin and Tisdell (1996) reported an uneven distribution of gains from shrimp culture between big *gher* owners and the small land owners who lease out lands to the *gher* owners for shrimp cultivation.

The departure from predominantly rice based farming system to commercial shrimp culture has created a new employment structure involving movement of rural labour force within rural areas and between rural and urban areas (Hamid and Alauddin, 1996). According to MPO (1986) estimate, shrimp culture generated 10.2 million persons days of employment on- and off-farm from 51,000 hectares of shrimp area in 1983. With the projected increase in shrimp area, the volume of employment was projected to increase to 59.5 million person days in 2005.

Shrimp culture has also opened up the avenues of new employment opportunities for rural women. The emergence of commercial shrimp farming and the related backward and forward linkage activities has opened up new dimension for women's involvement in many of the activities. Shrimp depots are the largest source of employment for women. Karim and Aftabuzzaman (1995) reported that women represented 40% of depot workers. They also estimated that 45% of

workers in the shrimp processing plants were women. Shrimp fry collection is also an important source of employment for rural women. Collection of shrimp fry by women in knee to shoulder-deep water in the coastal belt is a familiar scene (Talukder 1999).

Figure 1: Shrimp (bagda) production and its supply chain



Sources: Socioeconomic Survey (SES) Conducted in Coastal Areas of Bangladesh. NORAD Project. Bangladesh Agricultural University. Mymensingh.

Karim and Aftabuzzaman (1995) estimated that about 55000 rural women were engaged in fry collection, constituting 45% of the fry collectors. Besides, a large number of rural women are engaged in the collection of shrimp seed and production artisanal fish trapping and packing materials. However, to know the socioeconomic condition and livelihood patterns of stakeholders involved in the shrimp industry, occupational profile and household economics of respective group of stakeholders are discussed.

3.2 Contribution of Shrimp Industry's Activities to Household Income

Occupational Profile and Household Income

Shrimp farming was the main occupation of shrimp farmers. Main occupation of a farm family was considered as the occupation from which major portion of the income was earned. Occupation of shrimp farmers and other stakeholders who were involved in shrimp related activities are presented in Table 3. The table indicates that the majority of shrimp farm owners and depot owners (40-75%) had shrimp farming and shrimp related activities as their main occupation. Petty trading was practised mostly by land lessors, depot owners and shrimp traders (*faria*) (40-60%). Most of the shrimp farm labourers (73%) worked mainly in the shrimp farms. Shrimp seed collectors were mainly dependent on fry collection to maintain their livelihoods. While hatchery, shrimp processing and depot workers had shrimp related activities as their main occupation, shrimp feed mill workers derived major part of their livelihood support from sale of labour elsewhere.

Table 3: Distribution of principal occupation of stakeholders involved in the shrimp industry

Stakeholders	Principal occupation, %				
	Shrimp farming/Shrimp related activities	Agricultural crop farming	Petty trading	Rickshaw/ Van/Ear thwork	Labourers/ Service
Shrimp farmers	75	10	5	-	10
Land lessors	10	20	60	-	10
Hatchery owners	70	10	-	-	20
Depot owners	40	10	40	-	10
Shrimp seed collectors	67	-	13	20	-
Shrimp farm labourers	73	-	13	13	-
Processing plant workers	60	7	27	7	-
Hatchery workers	60	-	20	20	-
Feed mill workers	-	-	10	20	70
Depot workers	60	-	10	30	-
Shrimp traders (*faria*)	20	-	60	20	-

Most of the shrimp farm owners spent their time mainly in shrimp farming and some of them had opportunity to be engaged in crop (or salt) farming, petty trading and other non-farm activities. Land lessors, shrimp farm labourers, shrimp seed collectors and depot workers were also mainly involved in shrimp related activities, but their secondary occupation was rickshaw pulling and otherwise labour selling.

Household Income and Expenditure

The average annual income of different groups of stakeholders involved in the shrimp industry are shown in Table 4. Level of income of the sample households varied widely among different categories of stakeholders. Average incomes of the shrimp farmers, and depot and hatchery owners were several times higher than those of other categories of households. However, household incomes of shrimp seed collectors were substantially lower compared to those of land lessors and workers of processing plants. In case of shrimp farmers and shrimp farm labourers, shrimp related activities contributed more than 80% of the total income, while for other group of people contribution of these activities was 30-50% of total income.

Table 4 also shows annual expenditure of stakeholders of the shrimp industry. Since household income of shrimp farm labourers and shrimp seed collectors were very low, they spent more than 90% of their income on basic items. Shrimp farmers and depot owners spent 84.22% and 44.41% of their income as investment in shrimp farming and other activities, whereas land lessors used about 31% of their total expenditure for crop production activities. Since other stakeholder groups had relatively lesser income, they had to spend major part of their income on food, clothing and other necessities, and had therefore very negligible proportions of their income left for investment.

4. MARKETING CHANNEL OF SHRIMP AND GROWERS' SHARE OF THE EXPORT PRICE

Some of the stakeholders such as shrimp producers, depot owners, wholesellers and processing plant owners were involved in shrimp marketing activities. Long and short marketing channels, marketing margins and marketing costs of market participants are shown in Tables 5 and 6. In the long marketing channel, shrimp producers sold their harvested shrimp to depot owners/traders (Table 5), while in the short marketing channel they sold it directly to wholesalers/commission agents (Table 6 and Fig 2). Through these two channels, usually processing plant owners and exporting agents exported shrimp abroad and their net margin was same (Tk 49/Kg) in both the channels.

Table 4. Annual income and heads of expenditure of stakeholders of the shrimp industry

Sample respondents (stakeholders)	Household income (Tk/Year)			Total household expenditure (Tk/Year)	% of expenditure spent					
	Shrimp related activities	Farm and non- farm activities	**Total household income**		Food	Clothing	Health care	Education	Housing	Investment in Shrimp/crop farming and other options
Shrimp farmers	670180 (78.34)	185270 (21.66)	855450	785190	6.13	3.40	1.25	3.20	1.80	84.22
Land lessors	32890 (23.82)	105185 (76.18)	138075	85475	25.75	11.90	5.50	16.70	9.10	31.05
Hatchery owners	870135 (84.96)	153985 (15.04)	1024120	812570	5.95	4.50	2.30	5.70	8.50	73.05
Depot owners	126600 (47.42)	140400 (52.58)	267000	205450	18.19	8.25	7.25	14.50	7.40	44.41
Shrimp seed collectors	13550 (37.85)	22250 (62.15)	35800	33915	64.00	17.00	5.20	5.25	7.80	0.75
Shrimp farm labourers	40170 (75.00)	13340 (25.00)	53510	49370	55.00	15.00	6.50	9.00	10.25	4.25
Processing plant workers	50780 (51.33)	48150 (48.67)	98930	87840	53.00	17.25	6.10	11.25	8.93	3.47
Hatchery workers	61000 (70.64)	25350 (29.36)	86350	81375	57.00	12.00	5.12	11.65	9.13	5.10
Feed mill workers	55584 (78.41)	15300 (21.59)	70884	65031	58.00	15.00	5.15	12.30	8.30	1.25
Depot workers	19200 (36.20)	33840 (63.80)	53040	51250	54.00	16.00	7.10	9.25	9.70	3.95
Shrimp traders (*faria*)	48500 (65.63)	25400 (34.37)	73900	67950	57.00	12.00	5.50	12.00	10.00	3.50

Figures within parentheses indicate percentage of total income

From Tables 5 and 6, it may be observed that purchase and sale price were the main determinants in making net margin for both the channels. In the short marketing channel, per Kg sale price for shrimp producer was higher by Tk 12 compared to long marketing channel, and the net margin of producer was Tk 84/Kg in the short marketing channel. On the other hand, purchase and sale price for wholesallers/commission agents was lower in the short marketing channel. In this case, sale price for wholesaler was lower by (Tk 630- Tk 524) Tk 106/Kg and as a result, wholesalers earned 56% less profit in the short than in the long marketing channel.

Figure 2: Short and long marketing channels of shrimp

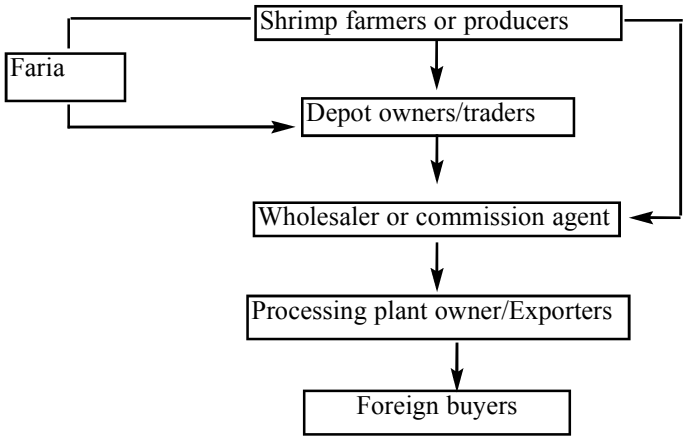


Table 5: Long marketing channel, marketing margin and marketing cost of the market participants

Market participants	Particulars of marketing (Tk/Kg)					
	Production cost	Purchase price	Sale price	Marketing margin	Marketing cost	Net margin
Shrimp producers	347	-	427	-	5[a]	75
Depot owners/traders	-	427	470	43	11[b]	32
Wholesaler/ commission agent	-	470	630	160	26[c]	134
Processing plant owners/ exporters	-	630	720	90	41[d]	49

Table 6: Short marketing channel, marketing margin and marketing cost of the market participants

Market participants	Particulars of marketing (Tk/Kg)					
	Production cost	Purchase price	Sale price	Marketing margin	Marketing cost	Net margin
Shrimp producers	347	-	439	-	8[a]	84
Wholesaler/ commission agent	-	439	524	85	26[c]	59
Processing plant owners/ exporters	-	524	601	77	41[d]	49

a Cost items of producers/ shrimp farmers: transportation, loading and unloading, basket, ice, wastage, and personal expenses.

b Cost items of depot owners/*traders*: wages and salaries, ice, basket, house rent, wastage, transportation and personal expenses.

c Cost items of wholesaler/commission agents: wages and salaries, ice, transportation, loading and unloading, basket, entertainment, house rent, wastage, telephone, polythene, and electricity.

d Cost items of processing plant/exporters: commission paid, loading and unloading, processing plant rent, salary for employee, transportation, maintenance, ice, freezing, electricity, packing, bleaching powder, medicine and others.

Table 7. Price spreads and farmers' share in the export price of shrimp

Channel	Export price (Tk/Kg)	Farmers gross price (Tk/Kg)	Farmers net price (Tk/Kg)	Price spreads (Tk/Kg)	Farmers gross share as % of export price	Farmers net share as % of export price
1	2	3	4=GP-MC	5=2-3	6=(3/2)*100	7=(4/2)*100
Long channel	720	427	422	293	59.30	58.61
Short channel	601	439	431	162	73.04	71.71

Note: GP = Gross price, MC = Marketing cost

Price spread and farmers' share under two shrimp marketing channels are shown in Table 7. In the long marketing channel the export price, farmers' gross price and net price per Kg of shrimp were Tk 720, Tk 427 and Tk 422 respectively. The corresponding price spread was Tk 293 per Kg of shrimp and the farmers' gross share and net share were 59.30 and 58.61 percent of export price respectively. On the other hand, in the short marketing channel the price spread was Tk 162 per Kg

of shrimp and the farmers received 73.04 and 71.71 percent of export price as gross share and net share respectively. The lower share of shrimp producers in the long marketing channel compared to the short marketing channel indicated that farmers' gross share and net share of export price decreased with the increase of middlemen in the long marketing channel.

5. HOUSEHOLD LIVELIHOOD SECURITY OF STAKEHOLDERS

5.1 Livelihood Security

The livelihood of a household is assumed to be secured when the members have adequate and sustainable access, through farm and non-farm activities, to income and resources to meet their basic needs. The typical basic needs include food, clothing, health care, educational opportunities, physical safety and housing. The principal components of household livelihoods security examined in the exercise were food security, economic security, educational security, health services and childcare, and social status of the people.

Food security

Adequate and sustained food consumption was considered as the main determinant of household food security. Food consumption and food purchasing capacity of the stakeholders were critically dependent on their income. The lower income group could not afford to manage a reasonably balanced diet and they could hardly eat fish in 10-15 meals and meat once in a month. Most middle-income groups could manage a moderately balanced diet. The upper income groups obviously managed a reasonably sufficient balanced diet (Table 8). The consumption of meat, milk, vegetables and fruits were found insufficient for lower income group, while rice and fish were either sufficient or moderately sufficient for them. As can be seen from Table 8, the level of consumption varied substantially among the different stakeholder groups in the study areas.

Health security

A household may be said to be 'health secured' when all of its members have sustainable access to medicare facilities and get health problems addressed by competent health care professional. The upper income group had almost 100% health facilities. Among the other stakeholder groups, 60% of the households were dependent on local quacks. Particularly the labourers, depot workers, feed mill workers and shrimp seed collectors were the clients of these local village healers. Most respondents reported not to be getting health service facilities from the loca

Table 8: Food consumption and food security of the stakeholders

Stakeholders	Adequacy of food consumption						
	Rice	Flour	Milk	Meat	Vegetable	Fish	Fruit
Shrimp farmers	S	S	MS	S	MS	S	S
Land lessors	S	S	MS	S	MS	S	MS
Hatchery owners	S	S	S	S	S	S	S
Depot owners	S	S	MS	S	MS	S	MS
Shrimp seed collectors	MS	I	I	I	I	I	I
Shrimp farm labourers	MS	I	I	I	I	I	I
Processing plants workers	S	MS	I	I	I	MS	I
Hatchery workers	S	I	I	I	I	MS	I
Feed mill workers	MS	S	I	I	S	I	I
Depot workers	MS	I	I	I	I	I	I
Shrimp traders (*faria*)	S	M	I	I	I	MS	I

Note: S=Sufficient, MS=Moderate sufficient, I=Insufficient

Educational security

Since primary education service is compulsory and free, there exists the scope for every child to become literate. But the universal primary education facility was not utilized due to poor socioeconomic condition of the households. It was evident that a good number of households could not take advantage of such facility. Considering all categories of stakeholders, on an average 75-80% of upper income groups had educational security. On the other hand, 40-50% of the middle income groups and 10-15% of the low income groups had educational security (Table 9).

Social status

The low income group of the stakeholders had relatively lower social status in the community. In most cases, the lower income group did not get proper judgment from the community. Their poor social status prevented them from getting access to information and in using public resources.

Physical capital of the stakeholder households

Among the stakeholder groups, upper income group used to live in *pucca* houses, and middle and low income groups lived in small houses which were either tin roofed or straw roofed. Sixty to 100% of upper income respondents used *pucca* toilet and safe drinking water from HTW. Sanitation of middle and low-income group was not developed. Most low income stakeholders used *Kutcha* toilet and a few stakeholders in the study areas did not have any toilet facility at all.

Maximum stakeholders were found to have electricity connection, except shrimp farm labourers, shrimp seed collectors and depot workers. Only a few labourers owned some modern amenities like radio, television and watch (Table 10).

5.2 Gender Equity in the Shrimp Industry Activities

Both men and women were engaged in shrimp farming and related activities in the coastal areas. Women were involved in shrimp related activities as shrimp seed collectors, shrimp farm labourers and workers in the shrimp-processing plant. It was observed that shrimp farms provided an opportunity for socially displaced women, particularly those who had marital problems and were deserted by their husbands. It was also observed that, usually women workers in different section of the shrimp industry were assetless and poor, and some of them were widow and destitute or divorced women. They were compelled to get out from their houses in order to find jobs for survival. In some cases women had to work to earn money to supplement the household income and to meet the basic need of the family members.

It was revealed that women participation was considerably higher in some of the shrimp production and processing activities as shown in Table 11. However, male participation and involvement was dominant. Secondly, it was observed that there was significant difference of wage rate between male and female in different sectors of shrimp industry where both male and female labourers put similar efforts.

Most of the farm labourers were resource poor and had only a small amount of land. Usually they sold their labour to work in other farmers' fields. They worked as casual and contract labourer and very few of them got permanent employment either in shrimp farm or in other farms and/or non-farm activities.

6. CONCLUSIONS

The emergence of commercial shrimp farming and the related backward and forward linkage activities opened up new dimension for the employment of both men and women in different activities. The majority of shrimp farm owners and depot owners (40-75%) had shrimp farming and related activities as their main occupation. Petty trading was practiced mostly by land lessors, depot owners and shrimp traders (*faria*) (40-60%). Labourers working in *bagda* hatchery, processing plant, depot, and feed mill earned wage and salary as their main occupation. Shrimp farmers and other related stakeholders derived major proportion of income from respective activities of the shrimp industry. Farmers'

Table 9: Wealth ranking of the stakeholders

Heads of wealth ranking	Characteristics of stakeholder groups		
	Upper income group[1]	Middle income group[2]	Lower income group[3]
Yearly household income	Tk. 138000 – 855000	Tk. 73000 - 99000	Tk. 35000 -71000
Savings	Most of the households could make a good savings	Most of the households could make a moderate savings	Had little savings
Credit	Generally did not require credit	Credit was required by some	Generally required credit
Housing shed	Pucca/tin shed house	Tin shed house	Tin shed/straw shed house
Food security	Had reasonably sufficient balanced diet	Had moderately sufficient balanced diet	In some households food was not available for 3 times in a day
Consumption of fish and meat	Could consume meat for 10 –12 days and fish for 20 –25 days in a month	Could consume meat for 5 –7 days and fish for 15 –20 days in a month	Could consume meat for 1 –2 days and fish for 10 –15 days in a month
Availability of drinking water	100% of households had own HTW, all could drink tube well water	80-100% of households had own HTW, all could drink tube well water	50-80% of households had own HTW, all could drink tube well water
Latrine	Pucca sanitary latrine was available	Semi–*pucca* latrine was available	Used traditional latrine
Social status	Had higher status in the society	Had moderate status in the society	Had poor social status in the society
Radio/TV	About 100% households had Radio/TV	About 75 –80% households had Radio/TV	About 40% households had Radio and 10% had TV
Electricity supply	90% households had electricity connection	50% households had electricity connection	10-20% households had electricity connection
Educational security	Every households had educational facility	Every households had educational facility but not of good quality	Educational facility was limited
Health security	100% households had healthcare facility	Moderate healthcare facility was available	Healthcare facility was inadequate
Skillness	Almost all were technically skilled in respective work	Most of them were semi-skilled	Most of them were non-trained and unskilled

Note:

1. Shrimp farmers, land lessor, hatchery owners and depot owners
2. Processing plant workers, hatchery workers and shrimp traders
3. Shrimp farm labourers, shrimp seed collectors, feed mill workers and depot workers

Table 10: Physical assets of the stakeholder households

Stakeholders	% of stakeholders owning and using physical assets										
	Housing shed			Sources of water for household use		Toilet		Modern amenities			
	Pucca	Tin roof	Straw roof	HTW	Pond/river	Sanitary	*Kutcha*	Radio	Watch	TV	Electricity
Shrimp farmers	70	30	-	100	-	100	-	80	100	90	80
Land lessors	60	40	-	100	-	90	10	90	100	50	70
Hatchery owners	100	-	-	100	-	100	-	90	100	100	100
Depot owners	60	40	-	100	-	90	10	80	100	60	80
Shrimp seed collectors	-	20	80	80	20	-	100	50	30	-	-
Shrimp farm labourers	-	20	80	80	20	-	100	40	40	-	-
Processing plant workers	-	60	40	80	20	40	60	60	70	20	80
Hatchery workers	-	60	40	80	20	30	70	70	80	20	80
Feed mill workers	-	50	50	100	-	-	100	40	90	-	50
Depot workers	-	20	80	70	30	-	100	30	50	-	-
Shrimp traders (*faria*)	-	60	40	90	10	30	70	40	80	20	70

Table 11: Gender role and equity and women involvement in the shrimp industry

Stakeholders involved in shrimp industry	**Activities performed**	Gender distribution (%)		Estimated income, Tk/month		**Gender equity condition**
		Male	Female	Male	Female	
Shrimp farm labourers	• Preparing shrimp farm	80	20	2000-3000	850-1200	Male and female had specified job. Male dominated and organized and managed by male labourers. Women were low paid.
	• Stocking shrimp seed	100	-	1500-2500	-	
	• Watching farm	100	-	1500-2000	-	
	• Reconstruction of dyke	80	20	2500-3000	1000-1500	
	• Collecting weeds	70	30	1000-1500	850-1200	
Shrimp seed collectors	Collection of shrimp seed from the Sea, Rivers and Sundarban	55	45	1500-1800	1000-1200	Self-employed. Free movement. No discrepancy between men and women.
Depot workers	Cleaning and deheading of shrimp	60	40	2500-3000	1200-1500	Moderately maintained gender equity. Women were employed for deheading and cleaning.
Workers of shrimp processing plants	Deheading, cleaning, icing and packing of shrimp	55	45	2500-5000	1500-2500	Maintained gender equity but in some factories male supervisors control the supply of women labour.
Feed mill workers	Producing feed, dumping, crashing, loading and unloading	100	-	3000-4000	-	No women workers were recruited due to laborious job.
Hatchery workers	Feeding shrimp, watering, harvesting of fingerlings	100	-	4000-6100	-	No women workers were employed.
Shrimp traders	Buying shrimp from the shrimp farm owners and sell to the depot owners	100	-	2500-5000	-	No female trader was engaged.

gross share and net share of export price of shrimp were higher in the short marketing channel compared to the long marketing channel.

Among the stockholders involved in the shrimp industry, livelihoods of upper income group and to some extent, middle income group were more secured compared to those of lower income group. Male participation and involvement was dominant almost in all works of the shrimp industry. Usually women workers in different sections of the activities were relatively poor, and some of them were widow, destitute or divorced women. Women were required to be employed to earn money to supplement the household income and to meet the basic needs of the family members. There was significant difference of wage and salary between male and female in different sectors of the shrimp industry where both male and female put similar efforts. However, social attitude towards increasing empowerment and improving socio-economic status of women was gradually increasing.

Some policy interventions are warranted to ensure equity of income and resource endowments among the stakeholders in general and between male and female stakeholders in particular.

References

Alauddin, M. and Tisdell. 1996. Bangladeshis Shrimp Industry and Sustainable Development: Resource Use Conflict and Environment. Working Paper No. 1. Dept. of Economics, The University of Queensland, February. 1996

Braten, B. 2001.Environmental Impacts and Socio-economic Problems of Shrimp Farming in Various Countries. Paper presented at the workshop on Environmental and Socioeconomic Impacts of Shrimp Farming in Bangladesh, held at BAU, Mymensingh, February, 2001.

Hamid, M. A. and Alauddin, M. 1996. 'Shrimp Production and Employment Generation in Bangladesh: Changing Role of Women", A Paper Presented at the Bangladesh: Economy, People and the Environmental Conference, Brisbane, June 10, 1996.

Haque, S.M. 1994. Annual Report of Bangladesh Frozen Food Exporters' Association(BFFEA). In BFFEA Special Bulletin, January 1994.Dhaka.

Islam, M.S. and Wahab,M. A. 2000. A PRA Report of Socioeconomic and Environmental Impact of Shrimp Farming in Bangladesh.

Karim, M. and Aftabuzzaman, M. 1995. Brakiswater Marine Water Aquacuture: Potential, Constraints and Management Needs for Sustainable Development. A Paper Presented at the National Workshop on Fisheries Resources, Development of Management, Dhaka. October 29-November 1, 1995.

Miah, A.A. 2001. An Economic Study on Alternate Shrimp- Crop Farming in Coastal Areas of Bangladesh. M. S. Thesis, Submitted to the Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

MPO.1986. Coastal Shrimp Aquaculture Resources, Technical Report No. 18, Dhaka: Master Plan Organization, Government of Bangladesh.

SES 2002. Socioeconomic and Environmental Impact of Shrimp Farming in Bangladesh. Socioeconomic Survey (SES) Conducted in Coastal Areas of Bangladesh, NORAD Project, Bangladesh Agricultural University, Mymensingh.

Talukder, R.K. 1999. Financial Profitability of Shrimp-based Farming System in Bangladesh. Paper presented at the closing workshop on Economic, Social and Environmental Implications of Shrimp-Rice Integrated Farming System in Bangladesh, held at BIDS, Dhaka on 26 December 1999.

Vertical Integration in the Dairy Sector in Bangladesh – The Case of Bangladesh Milk Producers' Co-operative Union Ltd.

S.K. Raha*
R.K. Talukder*

1. INTRODUCTION

Milch cow keeping has been practiced for centuries by millions of rural households in Bangladesh. Livestock have been an integral part of the farming system from time immemorial. During the British reign, dairy farming was conducted both commercially and at subsistence level. Commercial production of milk was done by a professional group called *Ghosh* who used to rear large herd of dairy cows and produce milk and milk products commercially. Most of these entrepreneurs either left this profession or left the country due to changes in various socioeconomic and political conditions in the country. Dairy farming seems to have emerged as a profitable enterprise over the recent past years. In the Fifth Five Year Plan, the government set objectives to develop appropriate technologies for livestock production, generate income, and alleviate poverty through livestock development. Involvement of private sector and NGOs in the production of cattle, milk processing, input supplies and marketing of livestock products was also another objective in the overall development of the livestock sector. (GOB 2000). A lot of private initiatives are in place to exploit the potentials of the livestock sector in the country. In this paper, a modest attempt is taken to examine the activities of the Bangladesh Milk Producers' Cooperative Union Ltd (BMPCUL) as a case study of vertical integration in the dairy sector of Bangladesh.

The paper is mainly based mainly on secondary data and information available in the relevant context. The paper is divided into five sections. A brief description of

* The authors are Professors, Department of Cooperation and Marketing, and Department of Agricultural Economics respectively, Bangladesh Agricultural University, Mymensingh

the dairy sector in Bangladesh is presented in section II. Genesis of the BMPCUL is discussed in section III. Role and performance of BMPCUL are analyzed in section IV. Conclusions and their implications are presented in section V.

2. DAIRY SECTOR IN BANGLADESH

Features of the Dairy Sector

The dairy sector in Bangladesh is characterized by small-scale, scattered and unorganized milch animal holders; low productivity; inappropriate animal feeding and health care; lack of assured year-round remunerative producer price for milk; inadequate basic infrastructure for procurement, transportation, processing and marketing of milk; and lack of professional management. Other important characteristics of the dairy sector are the predominance of mixed crop–livestock farming and the fact that most of the milch animals are fed on crop by-products and residues, which generally have lower nutritional values. Additionally, dairy development policies and programmes followed in the country including those relating to trade are not congenial to the promotion of sustainable and equitable dairy development.

Position of Private Entrepreneurs in the Dairy Sector

The dairy sector in Bangladesh is mainly operated by the private entrepreneurs. Most of the milk is produced by the rural households and majority of the households have 1 or 2 dairy cows. Most of these dairy cows are used for both milk production and draught purposes. There are some milk pocket areas where dairy farming has been traditionally an important and major component of mixed farming system. These areas are particularly located in the districts of Pabna, Sirajganj, Manikganj, Munshiganj, Faridpur, Madaripur, Rangpur, Tangail and Kishoreganj. In these areas there are some farmers who keep dairy cows only for milk production.

The present milk production is estimated at 1.62 million tonnes of which approximately 90% comes from cows and the rest 10% from goat and buffaloes. Of the total amount consumed, only 3.4% is obtained from processing plants and the rest (96.6%) is obtained from indigenous sources (Saha and Haque 2001).There are quite a good number of organized milk processing firms currently operating in the country. A list of the major ones is presented in Table 1.

Table 1: Volume of sales of processed liquid milk by different dairy enterprises

Enterprise	Daily sales (000 litres)	Percent
BMPCUL	110	62.16
BRAC Dairy	38	21.48
Abdul Momen Ltd.	4	2.26
Shelaida Dairy	4	2.26
Bikrampur Dairy	3	1.69
Savar Dairy	3	1.69
Aftab Dairy	5	2.82
Safa Dairy	3	1.69
Tulip Dairy	7	3.95
Total	177	100.00

Source : Saha and Haque, 2001

However, at districs level there are a few commercial dairy farms which sell non-pasteurized packaged milk. In district towns these types of firms have created their own market for their produce (Amin, 2000). The market for processed milk has been gradually increasing in the country. This in turn is creating opportunities for profitable investment in the dairy sector. In addition to private sector farms, there are only a few dairy farms in the public sector. These are located at Savar, Rajshahi, Sylhet and Faridpur.

The current milk production does not meet the present requirement. To meet the wide gap, powdered milk is imported by spending foreign currency ranging between Tk. 2000 to Tk. 2500 million per annum (Saha, 2002). The private entrepreneurs are more interested in importing powdered milk than investing in the dairy sector. This is one of the reasons for slow growth of the dairy sector in the country.

3. GENESIS OF THE BANGLADESH MILK PRODUCERS' CO- OPERATIVE UNION LTD. (BMPCUL)

In 1946, before the partition of India, an organization named 'National Nutrients Co. Ltd.' made a plan to set up a dairy plant with a capacity of 2000 litres of milk per day at Lahiri Mohanpur, Pabna. But the plan was not fully executed due to partition of India in 1947. In 1952 an entrepreneur, Mr. Mokhlesur Rahman of Calcutta exchanged his property with this dairy plant. Within a few years the plant came out with the name 'Eastern Milk Products Ltd' and adopted the brand name,

Milk Vita for its products such as milk, butter and Ghee. Through government patronization, cooperative system was introduced in the management and operation of the plant and the first Milk Producers' Cooperative Society was formed in 1965 with the apex organization 'Eastern Milk Producers' Cooperative Union Ltd'. In 1967 it was handed over to the Cooperative Marketing Society. Another dairy named Asto Dairy at Tejgaon was also handed over to the Cooperative Marketing Society.

In 1972, after independence, the Government of Bangladesh initiated two major surveys (Kastrup 1972; Nielsen 1973) for the rehabilitation of the two existing dairy plants, i.e. the Lahiri Mohanpur Dairy at Pabna and the Asto Dairy at Dhaka. Based on the recommendations of the surveys, the government started a new development project, the Cooperative Dairy Complex, based on the AMUL pattern of India (Latif 1973). New project areas were identified and the earlier two dairies, along with their assets and liabilities, were amalgamated into the project. The organisational name of the project, the Eastern Milk Producers' Cooperative Union Ltd., was maintained until 1977.Subsequently, it was changed to the Bangladesh Milk Producers' Cooperative Union Ltd.

Table 2: Plants of the Bangladesh Milk Producers' Cooperative Union Ltd

Location	Distance from Dhaka (Km)	Nature of plant	Capacity/ day (Litre)	Date of installation
Mirpur	10	Milk & milk products processing	110,000	May 1976
Tangail	100	Milk Chilling	10,000	June 1975
Manikgonj	90	Milk Chilling	10,000	September 1975
Takerhat	190	Milk Pasteurization	25,000	December 1977
Baghabari	125	Milk products Processing	162,000	November 1977
Srinagar	30	Milk Processing	5,000	October 1993
Rangpur	300	Milk Chilling	10,000	December 1995
Bhangura	155	Milk Chilling	5,000	October 1999
Lahirimohanpur	155	Milk Chilling	10,000	November 2000
Bhairab	75	Milk Chilling	5,000	April 2001
Raipur	208	Milk Chilling	10,000	February 2002
Natore	265	Milk Chilling	5,000	January 2003
Islampur	211	Milk Chilling	5,000	May 2003
Gabtali	185	Milk Chilling	5,000	August 2003

Source: BMPCUL 2003

Five plants at Dhaka, Tangail, Baghabari ghat and Manikgonj were established with an investment of Tk. 129.67 million which included foreign currency of Tk. 61.07 million. Nine more chilling plants were also established with BMPCUL's own resource (Table 2).

BMPCUL – A Vertically Integrated Firm

Vertical integration refers to the extent to which successive stages involved in the production of a particular product or service are performed by a single firm or by a selected number of firms with mutual understanding. Vertical integration is also used to describe the action of a firm in acquiring or constructing facilities, carrying out productive stages, which formerly either preceded or succeeded its original productive activities (Needham, 1973). So a firm is vertically integrated when it integrates both the input and output sector. Here, we would like to study the 'Bangladesh Milk Producers Cooperative Union Ltd' as an example of vertically integrated firm in the dairy sector in Bangladesh.

4. ROLE OF BMPCUL

The organization has covered 568 village milk producers' cooperative societies with 65,000 farmer-members. It has created job opportunities of 4,000 people in the rural areas and 750 people in the processing plants. The farmers have an assured market and a reasonable price for a defined quality of milk. The farmers thus have been able to get rid of the exploitation by middlemen namely Ghosh who used to exploit farmers by offering lower price, and fraudulent weights and measures. Over the years the volume of milk production increased with the increase in unit price of milk (Table 3).

The BMPCUL processes a number of milk products namely, pasteurized liquid milk, flavoured milk, butter, Ghee, ice- creams and lollies, full cream milk powder, skimmed milk powder, sweet curd and *Rasa Malai.* All these products are sold using the brand name Milk Vita. Now Milk Vita is a symbol of quality and hygienic standard of products in the market. The volume of sales of some of the major products of different years is shown in Table 4. Considering 1991-92 as the base year, the volume of sales of Ghee increased by 1862 % in 2000-01 followed by ice-cream (953 %), milk (791 %) and butter (163 %). Table 4 presents some of the milk products processed by the BMPCUL.

Table 3: Milk collection and price paid to the farmers

Year	Milk (Production)			Average	
	(Million litres)	Price Fixed base Index	Average Fat (%)	Taka /litre	Fixed base Index
1990-91	6.22	100. 00	4.4	10.77	100.00
1991-92	6.48	104.18	4.6	11.68	108.45
1992-93	10.24	164.63	5.0	11.57	107.43
1993-94	12.05	193.73	5.1	11.77	109.29
1994-95	17.45	280.55	4.4	13.49	125.26
1995-96	18.33	294.69	5.2	14.33	133.05
1996-97	19.46	312.86	5.0	15.67	145.49
1997-98	26.52	426.37	4.7	15.87	147.35
1998-99	29.47	473.79	4.4	15.85	147.17
1999-2000	33.99	546.46	4.7	16.10	149.49
2000-01	41.32	664.31	4.6	16.50	153.20
2001-02	53.81	865.11	4.5	16.16	150.05

Source : BMPCUL 2003

Table 4: Sales of milk and various milk products of BMPCUL

(sales in '000' litter / Kg)

Year	Milk		Butter		Ghee		Ice-cream	
	Sales (Litres)	Fixed base Index	Sales (Kg)	Fixed base Index	Sales (Kg)	Fixed base Index	Sales (Litres)	Fixed base Index
1991-92	4558.54	100.00	170.47	100.00	13.08	100.00	39.35	100.00
1992-93	6923.54	151.19	189.55	111.19	83.38	637.46	89.72	228.01
1993-94	10337.37	226.77	209.97	123.17	58.31	445.80	133.09	338.22
1994-95	14418.16	316.29	247.18	145.00	72.14	551.53	185.95	472.55
1995-96	17154.78	376.32	276.23	162.04	95.50	730.12	104.55	265.69
1996-97	17150.38	376.23	219.55	128.79	96.55	738.15	130.76	332.30
1997-98	21765.70	477.47	250.39	146.88	116.67	891.97	225.11	572.07
1998-99	25498.77	559.36	285.49	167.47	115.51	883.10	302.88	769.71
1999-00	24446.93	536.27	282.51	165.72	82.50	630.73	289.38	735.40
2000-01	33293.63	730.36	349.22	204.86	108.18	827.06	345.15	877.13
2001-02	36696.74	805.01	392.17	230.05	182.67	1396.56	382.52	972.09
2002-03	40627.78	891.25	455.02	266.92	256.65	1962.16	414.23	1052.68

Source: BMPCUL 2003

An attempt was made to account for the extent of value additions to selected milk products. Substantial value addition occurred in the process of manufacturing of various milk products. The measurement of value addition is a complex procedure. However, here the difference of sales price of milk product and the farm price for an equivalent amount of raw milk was considered as the gross value addition to the product concern. Table 5 shows gross value addition to selected milk products, calculated for the years 1991-92 to 2000-01. The table shows that the gross value addition to the selected products in nominal price increased substantially during the period. Gross value additions on account of pasteurized milk, butter and Ghee were estimated at Tk. 407.82 million, Tk. 50.63 million and Tk. 21.99 million respectively for the fiscal year 2000-01 (Table 5).

Table 5: Gross value addition by types milk products

	Gross value addition by types of products (million Taka)		
Year	Pasteurized milk	Butter	Ghee
1991-92	49.98	27.90	1.64
1992-93	83.44	33.66	0.67
1993-94	126.22	31.29	6.81
1994-95	138.72	30.54	8.23
1995-96	183.57	36.34	13.08
1996-97	193.34	26.73	12.58
1997-98	247.70	42.77	16.56
1998-99	273.20	44.42	26.15
1999-2000	385.59	51.07	22.21
2000-01	407.82	50.63	21.99

Note: 1. Gross value additions were calculated using data collected from the BMPCUL.
2. Value additions to butter and Ghee include value of skimmed milk powder

The sales revenue from the major products is shown in Table 6. The revenue from milk and butter consistently increased while the return from Ghee and ice cream slightly fluctuated over the years.

Table 6: BMPCUL's sale proceeds from major products

(Tk in Million)

Year	Milk	Butter	Ghee	Ice Cream
1991-92	90.49	38.72	2.69	4.05
1992-93	139.51	43.70	6.93	7.29
1993-94	209.72	42.15	11.08	10.16
1994-95	293.44	49.39	15.66	12.38
1995-96	349.03	55.18	22.22	7.84
1996-97	381.46	46.08	24.18	11.34
1997-98	504.93	63.72	20.11	19.83
1998-99	594.69	64.96	37.52	26.50
1999-2000	678.69	68.98	29.82	26.06
2000-01	825.80	74.60	32.70	33.30
2001-02	920.87	83.70	54.78	39.48
2002-03	1016.92	96.31	77.46	42.98

Source: BMPCUL 2003

The BMPCUL has developed marketing channels for the distribution of its products. It has its own sales center at plant gate in Dhaka. Rickshaw Van Cooperative Societies are engaged in distribution to distributors in the Dhaka city. Distributors and agencies are also appointed in different district markets for the distribution of its various products.

To have a better understanding of the system of procurement and processing of milk by the BMPCUL, it should be viewed as an agribusiness system. As we know, the system comprises three sectors namely input sector, production sector and processing/ manufacturing sector (Beierlein and Woolverton, 1991). Our dairy farming is beset with problems in all the three sectors. In the i**nput sector,** the major problems are scarcity of feed, non- availability of cross- bred cows, inadequate treatment facilities, lack of credit, lack of extension services and technical know-how. In the p**roduction sector** farming operation is handicapped due to poor functioning of the input sector. In the p**rocessing/ manufacturing sector,** producers have limited access to market and improved processing facilities (see for example Raha, 2001; Miah and Mandal, 2002). The following steps have been taken by the BMPCUL for improving its performance:

Feed: The BMPCUL has high yielding fodder production program. Moreover, it supplies balanced concentrate cattle feed (crude form) on 'no profit no loss' basis to the farmer- members; but the amount is not sufficient to meet the full requirement of the members. The organization makes arrangement to lease Bathan land from the government. Bathan land is used as grazing ground and also for the production feed grains.

Cross-bred cows: The BMPCUL provides artificial insemination service with deep- frozen semen for upgrading local breed. In the Baghabari area a high yielding breed is available. The organization tries to expand this stock in other areas through distribution of semen.

Treatment facilities: The BMPCUL has arranged free preventive and curative services for all cattle heads of members of the Cooperative Society (Table 7). The service is provided on emergency basis and is available for 24 hours.

Table 7: Breeding and treatment services provided by BMPCUL to its member-farmers

Year	No. of Primary Societies	No. of members ('000')	No. of Treatment ('000')	No. of Vaccination ('000')	No. of Artificial Insemination ('000')
1991-92	258	30.50	31.26	16.04	14.89
1992-93	268	34.82	32.66	19.87	21.62
1993-94	298	36.30	48.56	26.01	23.25
1994-95	322	42.50	60.68	28.65	16.25
1995-96	314	45.61	71.16	38.50	15.48
1996-97	358	47.99	92.57	35.61	22.52
1997-98	358	48.33	101.77	42.84	23.58
1998-99	390	49.36	98.03	60.27	28.58
1999-2000	450	59.62	68.75	60.03	37.42
2000-2001	518	60.00	81.34	36.28	44.47
2001-2002	568	65.00	96.76	54.33	49.80

Source: BMPCUL 2003

Credit facilities: Considering the need of the group members, the BMPCUL introduced interest free credit program to support the poor milk producing farmers for purchasing dairy cattle in 1994. The amount of loan fund available is about Tk.10 million per annum. The repayment is made from the weekly milk bill of the farmers. The repayment rate is 100% without any additional cost of collection.

E**xtension services and technical know-how:** The BMPCUL has its own training programme on better animal husbandry practices. It displays audio-visual shows on improved cattle rearing practices and cooperative management. It also makes arrangement for training / study tour for the farmer- members to acquaint them with the modern scientific management and rearing practices of dairy animals.

Output marketing: Milk-producing farmers have limited access to market. They are mainly small in size and their individual production is also low. Consequently, their access to market is limited. The BMPCUL has developed a process of milk collection from the group members. Transportation system from collection point to processing plant and to Dhaka is also arranged. So the milk-producing farmers now have an assured market and a reasonable price for their milk. These arrangements significantly contributed to stabilization of production of milk in the areas.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The livestock sector in Bangladesh is characterized by the preponderance of smallholders typically possessing only one or two milch animals. Low productivity, lack of proper feeding and animal health care, inadequate infrastructure for supply of inputs, procurement, processing, storage, transport and marketing of milk are the basic features of the sector. Despite these problems, the dairy sector holds high promise as a dependable source of livelihood for the vast majority of the rural poor in Bangladesh. The structure of BMPCUL, allowing for small-scale dairy production and marketing, as evolved through long experiences of trial and error, holds high promise for smallholder dairy development in the country. The structure may be reorganized in the pattern of AMUL of India (Singh 1999) and can be replicated in all the milk producing areas of Bangladesh.

Management is been the key factor in the success of smallholder dairying. This has been evident through the experience of BMPCUL (Bangladesh) and many other successful dairy development projects in other countries. The future of smallholder dairying will also rely on the continued adaptation of management techniques to suite markets, environments and socio-economic conditions of the country.

Liberalization of world trade in dairy products under the new trade regime of the WTO poses new challenges for the dairy industry in Bangladesh, as in other South Asian countries. We need to enhance our competitive economic advantage in dairy products. The role of government should be to direct, co-ordinate and regulate the activities of various organizations engaged in dairy development, to establish and maintain a level playing field for all stakeholders and to create and maintain a congenial socio-economic, institutional and political environment for smallholder dairy development. There is an urgent need to formulate and announce a comprehensive dairy development policy for the country. Such policy should be an integral part of the national development policy, and due consideration should be given to its direct and indirect effects on other sub sectors of the economy.

The agro-climatic and socio-physical features of Bangladesh seems to be conducive to small scale dairying, as a means of increasing income and employment, particularly for the rural disadvantaged classes of people. Public support is needed to protect the producers from adverse market conditions. Adequate public support is also needed to provide infrastructures to facilitate integration of production with processing and distribution, for attaining the two prong objective of increased production and consumption of milk in the country.

References

Amin, K. R. (2000). "A Study on Marketing of Milk in Selected Northern Districts of Bangladesh." M.S thesis submitted to the Dept. of Cooperation and Marketing, Bangladesh Agricultural University, Mymensingh, May 2000.

Beierlein, J. G. and Woolverton, M.W)1991). *Agribusiness Marketing- The Management Perspective*, Prentice Hall , Englewood Cliffs.

GOB (2000). Mid –Term Review of the Fifth Five Year Plan 1997—2002, Planning Commission, Ministry of Planning, Dhaka

Kastrup D. (1972). Observation and Recommendation Regarding Development of Lahirimohanpur Plant, Pabna District, Bangladesh. DANIDA (Danish International Development Agency), Gulshan, Dhaka, Bangladesh. 18 pp.

K. Singh and R.S. Pundir (2001). Problems and Prospects of Smallholder Dairy Production and Marketing in South Asia: An overview paper presented in South – South Workshop on Smallholder Dairy Production and Marketing- Opportunities and Constraints, NDDB, Anand, India, 13-16 March2001.

Latif S. (1973). *Co-operative Dairy Complex Project*. (Official Project Document). BMPCUL (Bangladesh Milk Producers' Co-operative Union Ltd.), Dhaka, Bangladesh. 37 pp.

Miah,M.A. M and Mandal M.A.S (2002). *Small Holder Production in Peri-Urban Areas of Bangladesh: Empirical Findings and Policy Implications*, presented at the workshop on Policies and Institutions for Poultry and Dairy Development in Bangladesh, 13-14 October, 2002 at BARC, Dhaka.

Needham, D. (1973). *Economic Analysis and Industrial Structure*, the Gresham Press, Old Woking, Surrey, England.

Nielsen, P. (1973). *Survey Report and Recommendations—Lahirimohanpur and ASTO Dairies, Bangladesh.* DANIDA (Danish International Development Agency), Gulshan, Dhaka, Bangladesh.

Raha, S.K. (2001). Commercial Dairy Farming in Bangladesh: Some Issues, *Economic Affairs* Quarterly Journal of Economics, Vol. 46, Qr. 3 July-December 2001, pp. 173-180

Saha, G. C. (2002). A Case Study: *Milk Vita – The National Dairy Co-operative of Bangladesh,* presented at the workshop on Policies and Institutions for Poultry and Dairy Development in Bangladesh, 13-14 October,2002 at BARC, Dhaka

Saha,G. C.and Haque, S.A.M.A. (2001). Small-scale processing and marketing in Bangladesh including reference to micro-credit facilities (good market access)—Milk Vita: A case study. In: Rangnekar D. and Thorpe W. (Eds), *Smallholder Dairy Production and Marketing—Opportunities and Constraints. Proceedings of a South–South workshop held at NDDB, Anand, India, 13–16 March 2001*. NDDB (National Dairy Development Board), Anand, India, and ILRI (International Livestock Research Institute), Nairobi, Kenya.

Singh K. (1999). *Rural Development- Principles, Policies and Management, 2nd edition,* Sage Publications, New Delhi, India.

Commercialization of the Poultry Enterprise: The Case of Aftab Bahumukhi Farm Ltd.

M. Ahsanuzzaman*
S. M. Monwarul Islam*

1. INTRODUCTION

Bangladesh is a country with abundant and cheap labour force awaiting opportunities for gainful employment. People of either sex constitute a huge human resource. By utilizing these resources in befitting and dignified manner, a significant development can be achieved. One such promising avenue for income and employment generation is to develop commercial poultry farming in rural areas. An increase in poultry production will also help minimize protein gap in human diet, especially for the poor. With this end in view, the Islam Group, from its initial interest in the poultry sector, established Aftab Bahumukhi Farm Ltd. in 1991 (ABFL) and subsequently became active as a multidimensional conglomerate. Aftab Bahumukhi Farm Ltd. is located at Bhagalpur, an emerging picturesque village under the Bajitpur police station in the district of Kishoregonj. This paper presents a picture of the activities of the ABFL, particularly centering round production and marketing of poultry in the country.

2. DIVERSIFIED ACTIVITIES OF AFTAB BAHUMUKHI FARM LTD.

At present Aftab Bahumukhi Farm Limited is involved in the following fields of activities:

1. Hatching egg production, through own and contract grower farms by maintaining parent stock
2. Production of Day Old Chicks of commercial broiler
3. Commercial broiler production through contract grower farms
4. Poultry processing plant
5. Feed mill
6. Aftab Milk and Milk Products Ltd (now this is a seperate company)
7. Aftab Fisheries
8. Seed production

* The authors are currently Executive General Managers of Aftab Bahumukhi Farm Ltd.

2.1 Hatching Egg Production through Own Farm and Contract Growers Farms

Aftab Bahumukhi Farm Ltd. used to maintain about 13000 broiler and layer parent stock upto 1995 in its own 6 farms. In the year 1996, ABFL expanded its parent extension farms and it currently maintains about 32000 parent stock in its own farms. These stocks have been maintained by the professionals and ancillary staffs. With the success of own farm, the ABFL management decided to expand its hatching egg production programme through parent stock contract growers. Subsequently, it expanded its activities in nearby villages of Bajitpur thana and adjacent villages of Kotiadi, Pakundia and Hossainpur thanas of Kishoregonj district. Table 1 presents the scenario of parent stock contract farming.

Table 1: Scenario of Parent Farm Contract Farming during the year 1995-2003

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003
No. of Contract Parent farm	2	6	6	13	19	48	86	120	135
No. of birds housed/year	2000	8000	10000	26000	49000	111500	220000	360000	390000
Average Income (Tk.) per month	30000	30000	30000	30000	30000	30000	30000	30000	30000
No. of family directly benefited	4	12	12	26	38	96	172	240	270
No. of person directly benefited	20	60	60	130	190	480	860	1200	1350
No. of family indirectly benefited	2	6	6	13	19	48	86	120	135
No. of person indirectly benefited	10	30	30	65	95	240	430	600	675

Table 2: The number of own farm, contract growing farm and parent stock capacity during 1995-2003

Year	House No.			Bird housing capacity (Nos.)			Growth rate (%) of contract growers farm
	Own	Ext.	Total	Own	Ext.	Total	
1995	6	2	8	13,000	2,000	15,000	-
1996	9	6	15	20,500	8,000	28,500	200
1997	18	6	24	32,000	10,000	42,000	0
1998	18	13	31	32,000	26,000	58,000	117
1999	18	19	37	32,000	49,000	81,000	46
2000	18	48	66	32,000	111,500	143,500	153
2001	18	86	104	32,000	220,000	252,000	79
2002	18	120	121	32,000	300,000	332,000	40
2003	18	135	153	32,000	405,000	437,000	13

Source : Aftab Bahumukhi Farm Ltd. data base.

Table 2 indicates that ABFL expanded almost 94% of its parent stock maintenance programme through the contract grower system. The secret behind such a big success lies in meeting the special needs of poor and less educated farmers by providing costly Day-Old parent stock imported from Malaysia and France and distributing those on credit among the contract growers. The ABFL extends all credit support like fund for construction of farm house (through bank), medicine, vaccine, feed and by imparting technical know-how regarding bio-security, feed management, litter management, debeaking, vaccination, lighting programme etc. to the less educated farmers, who never thought that they could be able to rear parent stock and produce quality hatching eggs. Insurance companies are reluctant to cover the risk of parent stock farms. ABFL took the matter seriously and introduced an internal insurance scheme like security and safety scheme to cover the risk of loss and safeguard the interest of the contract growers in case of immature death of chicks by any diseases and other cogent reasons. On successful launching of this parent stock farming, nearly 5 families get work in each farm and thereby get productive employment. Each farm earns an average of Tk. 20,000 per month (300,000 per flock). The scenario of income generation and employment opportunities is shown in Table 3. ABFL also operates a contributory security fund which is realized after adjustment of ABFL loan at the rate of 7% over their income.

Table 3: The scenario of income generation and employment opportunities in parent stock contract grower farm in the year 2003

No. of farm	No. of bird in each flock	Average income per month	No of families benefited directly	No of persons benefited indirectly
135	3000	30,000	217	1350

2.2 Day-Old-Chicks Production

ABFL produces Day-Old-Chicks (DOC) of commercial broiler and layer birds from the hatching eggs produced in its own and parent extension farms. Hatching eggs are procured from own and contract grower farms at a guaranted price and incubated in its own modern hatchery. The DOCs are then distributed among the commercial broiler contract grower farms which are located in and around 10 km of Bhagalpur village of Bajitpur and Kuliarchar thanas of Kishoregonj district. The DOC's are also distributed among the agents of ABFL. The DOC production statistics during 1995/2003 is shown in the Table 4.

Tabel 4: Day-old-chick production statistics during 1995/2003

Year	Chick production / year	Average chick production/month	Growth rate B
1995	622,270	51,855	-
1996	105,963	88,330	70
1997	1,532,137	127,677	45
1998	2,172,496	181,041	42
1999	3,799,039	316,586	75
2000	6,071,153	505,919	60
2001	13,604,087	1,133,673	124
2002	19,970,230	1,664,185	47
2003	25,378,199	2,114,850	27

Source: ABFL Data base

2.3 Commercial Broiler Production through Contract Growers

In February 1994, an experimental extension programme was undertaken in which ABFL carefully selected 9 individuals from the willing farms. Extension training was imparted by the ABFL experts to the selected farmers at field level wherein different aspects of poultry farming, specially its operational and management techniques, were taught. There was a simple agreement between the farmers and ABFL. In accordance with the agreement, ABFL extended full credit facility to the farmers for supply of 100 nos. of Day-Old-Chicks, all vaccines, medicine, feeds, disinfectants along with supervision on regular basis and insurance scheme to safeguard the immature death of bird. ABFL also undertook the responsibilities for marketing their products. Apart from labour, a farmer had to build a covered shed at his own cost as per direction of ABFL expert, which ensured congenial and healthy environment for proper growth of the birds. The credit liability of the contract growing farm was adjusted against price of their products (price was generally fixed according to prevailing market price plus a premium).

On successful operation of these farms, the programme was extended to nearby villages of Bajitpur and Kuliarchar thanas of Kishoregonj district. Within a short span of time Bhagalpur turned into a centre of all activities of ABFL. It has positive effect on thinking and attitude of the rural people, especially young people of the area. They started taking interest in poultry farming and became eager to obtain its know how and take part in its commercial production. The Table 5 indicates the scenario of commercial broiler contract farming during 1994-2003. From 20 farms in 1994 it reached to 650 farms in the year 2003 and the number of birds housed increased

Table 5: Scenario of Broiler Contract Farming during the year 1994-2003

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
No. of Contract Broiler farm	20	50	75	100	150	200	350	458	598	650
No. of birds housed/month	12500	31250	46875	62500	93750	125000	218750	235000	500000	650000
Average Income (Tk.) per flock of 1500 birds	8000	8000	8000	8000	8000	8000	8000	10000	10000	10000
No. of family directly benefited	80	200	300	400	500	600	1050	1500	2800	3800
No. of person directly benefited	560	1400	2100	2800	3500	4200	7250	12600	23000	32000
No. of family indirectly benefited	20	50	75	100	150	200	350	600	1000	1600
No. of person indirectly benefited	100	250	375	500	750	1000	1750	3000	5060	7500

from 12,500 per month to 400,000 per month during the same period of time. ABFL recently marketed on an average 10,000 live birds through its Dhaka and Sylhet sale centres. The year-wise sale of live birds during 1994-2003 is shown in Table 6. Estimated profitability of contract broiler farms is shown in Appendix 1.

Table 6: Year wise sale volume of life bird during 1994-2003

Year	Quantity (Tones)	Growth rate (%)
1994	88	-
1995	140	59
1996	302	116
1997	435	44
1998	627	44
1999	823	31
2000	1573	91
2001	2395	52
2002	2764	15
2003	2456	-11

Source: ABFL data base

3. POULTRY PROCESSING PLANT

To meet the demand of the growing urban consumers, AFBL established a modern processing plant at Bajitpur with machineries obtained from the world famous STORK Company of Netherlands, with the capacity to process 1000 birds per hour. The processing unit has the latest technique and expertise in the poultry processing and it ensures quality and hygienic products. At present this unit processes about 3000 birds per day and markets in Dhaka sale centre through its own outlet. The year-wise sale of dressed and portion chicken during 1994-2003 is shown in Table 7.

Table 7: Year wise sale volume of dressed bird and portion chicken during 1994-2003

Year	Quantity (Tones)	Growth rate (%)
1994	74	-
1995	112	51
1996	191	71
1997	267	40
1998	285	7
1999	324	14
2000	419	29
2001	576	37
2002	602	5
2003	747	24

Source: ABFL data base

4. FEED MILL

With the rapid expansion of poultry related activities in the country as a whole, the need for balanced processed feed was felt by the company management. Accordingly, ABFL installed its first Feed Mill in 1994 (and subsequently another two) to meet its own requirement and growing demand of farmers. ABFL has been producing 7500 tones feed per month. It is worth mentioning here that currently ABFL is producing fish and cattle feed and marketing throughout the country. The sales volume of poultry, cattle and fish feed is shown in Table 8.

Table 8 : Annual sale volume of poultry, cattle and fish feed during the year 1996-2003

Year	Tones	Growth rate (%)
1996	2,230	-
1997	7,715	246
1998	13,303	72
1999	18,842	42
2000	46,992	149
2001	75,415	60
2002	87848	16
2003	78367	-11

* Source: ABFL data base.

ABFL also established a new feed mill with 20 ton capacity / hour at Rupshi, Narayangonj and has been producing about 3000 tones feed/month. The capacity utilization is approximately 33% only.

5. WAY FORWARD

The ABFL has so far expanded its poultry programme numerically to involve as many rural enterprenures as possible. The company is now proceeding to consolidate its experiences gained over the years. ABFL is emphasizing more on efficiency than on production only. For this, ABFL is working towards bringing more and more commercial attitudes among the contract farmers. It has already introduced inputs for cash, replacing inputs for credit, system so that farmers become efficiency conscious.

Appendix 1

Aftab Bahumukhi Farm Limited
Bhagalpur, Bajitpur, Kishoregonj

Profitability of Contract Parent Farmer Considering (3000 Parent Stock)		
1	Total no of Contract Farm	135
2	Total Parent Stock	405000
3	No of Parent Stock/Farm	3000
4	Total no of egg Prod./Flock	437250
5	Cost of Production/egg Tk.	7.5
6	Procurement Price/egg Tk.	8
7	Total Profit/Flock (16 months) Tk.	200000
8	Profit/month (Approx)	12500
9	Support Provided by ABFL	
	a) DOC	✓
	b) Feed	✓
	c) Medication/Vaccination	✓
	d) Technical Support	✓
	e) Guaranteed buy back of Hat. egg	✓

Profitability of Broiler Contract Growers		
1	No of Farm	650
2	Total no of Broiler	645000
3	a) no of Broiler Sold/day	13000
	b) No of L.Broiler Sold/day	10500
	c) No of Dre.Broiler/day	2000
	d) No of Pro. Chicken Sold/day	500
4	Production cost/kg	47-52
5	Average income/kg	52-57
6	Profit/kg	5
7	Support provided by ABFL	
	a) DOC b) Feed	✓
	c) Medication/Vaccination	✓
	d) Technical Support	✓
	e) Guaranteed buy back of Hat. egg	✓

Feed Production statistics		
1	No. of Feed Mill	03
2	Capacity/Hour (Tons)	23
3	Production/ Month (Tons)	10000

Day old Chicks Prod. Statistics		
1	Egg Production / day	60000
2	Egg setting capacity/week	672000
3	Hatching capacity/week	672000
4	DOC production/week	336000
5	DOC Prod. Capacity/week	537000

Production and Marketing of Goat and Goat Meat in Peri-Urban Areas of Bangladesh

M.A. Monayem Miah**
M.A. Sattar Mandal***
S.M. Munzur Murshed***
M.A. Akbar***

1. INTRODUCTION

Goats play a vital role in the subsistence economy of smallholders in Bangladesh. Among the countries in Asia, Bangladesh has the second highest population of goat, numbering about 34 million heads (FAO, 1997). More than 90% of goat population in the country comprised the *Black Bengal* (BB) goats having some variation in colour and size, the remainder being Jamunapari and their crosses (Huq and Devendra, 1988). Goat generates income and employment, and meets up capital shortage, especially for the rural households in Bangladesh. The employment opportunities for the family members through goat enterprise are much higher than that of crop enterprise (Chauhan *et al.*, 1993). It contributes greatly to the poverty stricken rural people, especially to small and marginal farmers and landless labourers holding less than 2 acres of land (Husain *et al*., 1998; Das, 1996; SAIC, 1995; Bokonyi, 1976). Goats are generally reared in traditional backyard system allowing them to graze mainly surrounding homestead or open fields and are kept tethered with a short rope from morning to evening. Besides, leaves of different trees, rice polish and wheat bran are also given to goats as feed (Hoque, 1995).

The current production of meat in the country is 0.620 MMT which increased by an average annual growth rate of 3.53% during 1985/86 to 1997/98. The per

---

* This paper is derived from the first author's Ph.D. thesis and was presented at the regional seminar on *Promotion of Agribusiness and Agroprocessing in Bangladesh*, December 17, 2003 at BAU, Mymensingh.

** Scientific Officer, Agricultural Economics Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. E-mail*: monayem03@ bdonline.com*

*** Professors of Agricultural Economics, Bangladesh Agricultural University (BAU), Mymensingh. *E-mail:asmandal@sdnbd.org*

capita availability of meat is estimated to be 21.33 gm/day during 2010 and the corresponding figure for per capita requirement is 120 gm/day (Miah, 2002). The increase in demand for meat up to 2010 is 3.8% as against 1.6% increase in human population (Amin, 1997). In this situation, the country has to face a big shortage of meat and is required to import a large number of beef cattle every year.

Therefore, the production of goat meat has to be increased manifold to meet the increasing demand of the country's population. If livestock sector has to play the role in poverty alleviation, it is essential that smallholder producers have to have access to the expanding urban markets for their produces. The present goat and goat meat marketing system in Bangladesh is handled mainly by the private marketing intermediaries and is carried out in an unorganised manner. The smallholder goat farmers are deprived of fair price of their produce due to inefficient marketing system. The achievement of all these targets depends upon balanced livestock development policies relating to technology, institution, and other supporting mechanisms in the country. In this context, peri-urban goat production offers ample opportunities for higher income generation for smallholders due to the proximity to urban markets (Miah, 2002).

A sustainable goat production and an efficient marketing system can ensure producers' benefit and meet the increasing demand of urban people. The present study will add new dimensions to the existing level of understanding on goat development related issues, opportunities and constraints in peri-urban areas of Bangladesh. The results of the study will indicate possible areas of technological and policy interventions by the government and non-government organisations involved in livestock development. The overall objective of this paper is to highlight development issues for peri-urban goat production and marketing to find out potentials, constraints, and the areas of possible intervention for sustainable goat development in Bangladesh.

2. METHODOLOGY

2.1 Economics of Goat Production

The study was conducted in peri-urban areas of the three municipal towns of Pabna, Mymensingh and Sylhet representing the poorest, medium wealthy and wealthiest towns in Bangladesh, respectively. A farm survey was conducted to examine the profitability of goat production in peri-urban areas. At first, a total of 30 *Mauzas,* taking 10 *Mauzas* from each town, were randomly chosen from the list of peri-urban *Mauzas*. Secondly, a total of 150 goat farmers, taking 50 farmers from each town, were randomly selected for interview. The sample farmers were selected proportionately from each category of farmers (128 small & marginal, 42

medium and 10 large category farmers). Farmers having less then 1.012 ha of land were considered as marginal and small; those having 1.012 to 3.036 ha of land were considered as medium, while farmers having more than 3.036 ha of land were identified as large, following the standard official definition (BBS, 1998).

Production data were collected by the researcher himself and trained enumerators from peri-urban goat farmers using structured and pre-tested interview schedules during September to October 1997. The collected data were analyzed using different statistical measures. Break-even and functional analyses were also done.

2.2 Marketing of Goat and Goat Meat

In order to give an insight into goat and goat meat marketing system, a number of case studies were carried out in and around urban areas of two nearly similar towns namely Mymensingh and Sylhet during the period from June 1998 to May 1999. At first, some marketing channels were identified through which goat and goat meat moved from peri-urban areas to the urban markets. Two main urban markets in each of the selected towns were chosen for the study. Peri-urban markets were chosen according to product flows rather than ease of access although it was probable that they were located at the same place. These markets were used throughout the case study. After validation of marketing channels, 8 traders (4 from Mymensingh and 4 from Sylhet) were chosen for the study. The data for the present study were collected weekly from goat and goat meat traders through personal interview by trained enumerators using structured interview schedule. Furthermore, a total of 62 *Beparis* and 58 butchers were also interviewed during September to October 1997.

There are several measures for measuring marketing efficiency of a commodity. Each of these measures has some values and limitations in measuring market performance, but no single one tells the whole story. Therefore, the following six performance indicators were considered for measuring the efficiency of goat as well as goat meat marketing system (Rajagopal, 1986). The indicators were: (i) producer's share in the final product price, (ii) relative marketing cost, (iii) level of middlemen margin, (iv) deviation between the minimum and maximum prices, (v) peak period seasonal price variability, and (vi) lean period seasonal price variability. Some analytical tools for measuring above performance criteria are briefly discussed below.

The producers' share was derived by the ratio of gross/net price received by the producers to the weighted average selling price of goat meat. It was calculated with the following formula:

$$Ps = (Pp\ Pr)\ 100$$

Where, Ps = Producer's share to the consumers price (%)
Pp = Producers' selling price
Pr = Retailers' selling price

The costs of marketing were worked out on the basis of marketing channels and on per unit of goat meat. The marketing channel involving lower cost was ranked as one. Following the same approach, the channel involving lower margins for middleman was ranked as one. On the other hand, the channel with lower deviation between the maximum and minimum price of goat meat was ranked as one. Average price deviation was calculated by using the following formula:

$$Dp = \Sigma di \div N$$

Where, Dp = Average price deviation
di = Price deviation in i^{th} month (i = *January ……..December*)
N = Number of total months (12 months)

The lean and peak season price variability was measured by applying the following standard deviation () formula:

$$\partial = \sqrt{(1 \div T)\ \Sigma Wt\ (Pt - P)^2}$$

Where, ∂ = Seasonal price variability index
P = Average price of the whole season (12 months average)
Pt = Average price for a particular period
T = Total months (12 months), and

$$Wt = \frac{\text{Quantity sold through a particular channel during the month (St)}}{\text{otal quantity sold during the month in all channels (i t Sit)}}$$

A lower value of implies that the price of farmer was not affected by seasonal change and vice versa. The channel with lower standard deviation was ranked as one. The final ranking of all the six indicators for all the channels was computed by the following index formula:

$$R = (Ri\ Ni)$$

Where, Ri = Total value of ranks of all indicators
Ni = Number of indicators

3. ECONOMICS OF GOAT PRODUCTION

3.1 Pattern of Input Use

Goats were given very small amount of feed, especially in the rainy season. They were allowed to graze about 7 hours per day in the open field or roadside. In all categories of farmers, the average amount of green leaves, wheat bran and oilcake given to each goat per year were estimated to be 32.13, 14.56 and 3.29 kg, respectively. Veterinary care for goats was found to be very negligible in the study areas. A positive relationship was found between farm categories and amount of feed used in the study areas. In case of wheat bran use, larger category farmers ranked first followed by medium and small category farmers (Table 1).

3.2 Human Labour Use (Employment Generation Potentials)

Involvement of human labourer was not crucial in goat rearing because goats were reared in the traditional backyard system. On an average, a goat generated 6.03 man-days of employment per year of which the shares of family and hired labourer were 86% and 14%, respectively. It was observed that a notable extent of female and child labour was utilised in goat rearing. The involvement of child labour was for outside grazing, while female labour was mainly involved in stall-feeding (Table 2). Nearly 44% of human labour was involved in stall-feeding, 24.9% in goat shed cleaning, and the remainder in taking goat in and out of goat-shed for grazing (Miah, 2002).

3.3 Cost of Goat Production

In all categories of farmers, the annual costs of production per goat were Tk. 803, Tk.315 and Tk. 266 as full cost, variable cost and cash cost respectively. The share of fixed and variable cost to total cost was 61% and 39%, respectively. The highest variable cost was incurred for wheat bran (12%) and hired labour (12%), followed by green leaves (5%) and oilcake (3%). The highest share of total fixed costs was incurred for family labour (Table 3). A positive relationship between farm category and the cost of production was found in the study areas. Cash expenses were found to be higher in large category farmers and lower in small category farmers.

3.4 Returns from Goat Rearing

The annual gross return per goat was estimated at Tk.1,056; Tk.1,092 and Tk.1,186 for small, medium and large category of farmers respectively. The goat farmers in the study areas received, on an average, nearly 97% return from farm inventory change (Table 4). The percentage share of inventory changes to the total return was found mostly to be similar in different categories of farmers. The average net return per goat was estimated to be Tk. 274; 762 and Tk. 812 on full

cost, variable cost and cash cost bases respectively. The small farmers received the highest net return per goat than the medium and large farmers due to lower cost[44] Das (1996) found similar results in his study conducted in Mymensingh areas. In his study, the small farmers received the highest net return per goat (Tk. 735), followed by medium (Tk. 655) and large farmers (Tk. 166).

The benefit cost ratios in all categories of farmers were 1.34, 3.42 and 4.06 on full cost, variable cost, and cash cost bases respectively, which were nearly double the ratios observed for cattle rearing (Miah, 2002).

3.5 Break-even Size of Goat Production

Table 5 shows that the goat farmers in the study areas reared goats profitably as the break-even size of goats was much lower than the actual number of goats reared by them. A herd-size of at least 3.50 numbers of goats for the study areas was required to cover the cost of production.

3.6 Factors Affecting Goat Production and Resource Use Efficiency

Different socio-economic factors like family size, farmers' income, education level, level of experience in goat rearing, and size of land holding had positive impacts on the production and management practices of goat (Huq, 1990; Prabharan and Thirunavukkarrasu, 1994). Multiple linear regression analysis showed that the co-efficient of human labour (X_1), green leaves (X_2), wheat bran (X_3), oilcake (X_4) and veterinary care (X_5) were positive and significant at 1% and 5% levels, implying that one taka increase for these inputs, keeping other factors constant, would result in an increase of annual gross returns per goat by Tk. 0.475; Tk.0.714; Tk.1.084; Tk.1.482 and Tk.3.529, respectively. Wheat bran and other cost (X_6) had significant influences on goat production in all the study areas.

Y =	389.68+	$0.48X_1$***+	$0.71X_2$**+	$1.08X_3$***+	$1.48X_4$***+	$3.53X_5$***+	$8.64\ X_6$***
	(47.670)	(0.072)	(0.345)	(0.134)	(0.275)	(1.230)	(1.398)

R^2 = 75, F- value = 71.97*** N = 150

The MVP of wheat bran, oilcake, veterinary care and other cost were greater than one and positive, indicating less amounts of inputs used in goat production. Therefore, there were ample opportunities to increase gross return or output by using more of these inputs. Besides, the MVP was less than one and positive for human labour and green leaves implying the inefficient use of these inputs. In that case, the goat farmer could decrease production cost, keeping gross return constant, by decreasing the cost of labour and green leaves, through using scientific methods and improved technologies of goat production.

4. MARKETING OF GOAT AND GOAT MEAT

Marketing of live goat and goat meat in Bangladesh is traditional and is mostly handled by the private entrepreneurs. A number of middlemen are involved in the process of goat and goat meat marketing in the country. In India, different types of intermediaries existed in the chain of marketing of live goats and goat meat (Bhasin and Devendra, 1988). The marketing systems of live goat and goat meat in the study areas are discussed below.

4.1 Marketing Channels

Two types of transactions, direct and indirect, were found between farmer and buyer in goat and goat meat marketing. The farmer sold goats directly to final consumers under direct transaction, whereas *Bepari* and butchers were involved in the indirect transaction. The direct transaction was found mostly in various social and religious occasions. The sample butchers in the study areas bought goats from farmers and *Beparis,* and sold meat to general customer, restaurant and bakery. More than 96% goats in Mymensingh and 86% goats in Sylhet were sold by *Beparis* to butchers (Fig. 1 & 2). The smallholder goat farmers in Sylhet sold more goats to butcher compared to the farmers in Mymensingh. The following major channels were identified in the study areas for goat and goat meat marketing.

In Mymensingh,	Channel	I= Farmer? Butcher? Consumer
	Channel	II= Farmer ? *Bepari?* Butcher? Consumer
In Sylhet,	Channel	I= Farmer ? Butcher? Consumer
	Channel	II= Farmer ? *Bepari*- Butcher? ConsumerChannel
		III= Farmer ? *Bepari?* General Customer

Fig. 1: Flow diagram for goat meat marketing in and around Urban areas of Mymensingh

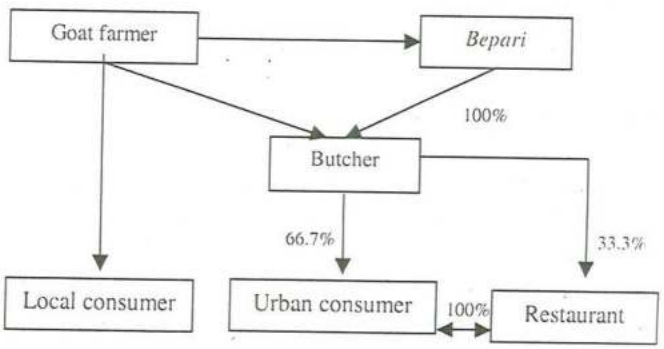
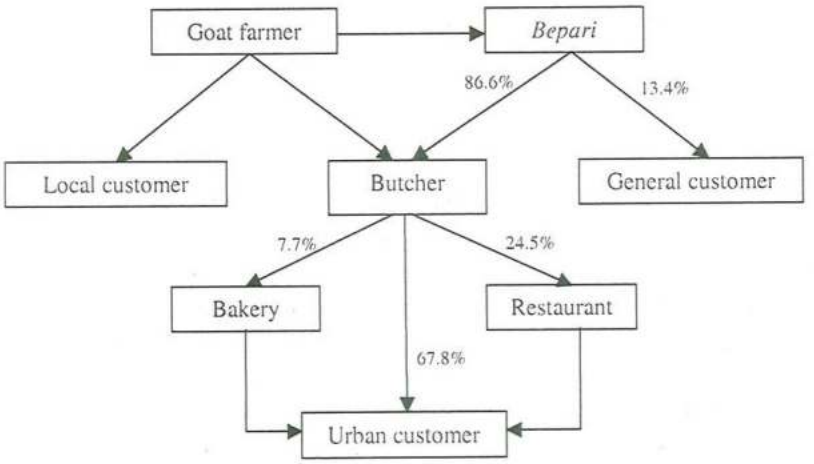


Fig. 2: Flow diagram for goat meat marketing in and around Urban areas of Sylhet



Although the final consumer was the most important and prominent customer of goat meat in all study areas, the general public was one of the most important customers of live goats in Sylhet. The reason was that many visitors from different parts of the country visited the *Dargah* (grave) of Hazrat Shahjalal (R) and sacrificed many goats in the name of *Allah*. Some butchers of Sylhet supplied goat meat to restaurants and bakeries regularly.

4.2 Number of Goats Traded

During the study period, the number of goats, on an average, traded by a *Bepari* of Mymensingh and Sylhet were 1194 and 880 which were equivalent to 5,557 kg and 5,527 kg of meat, respectively (Table 6). The average size and body weight of goats was much higher in Sylhet, compared to Mymensingh.

The volumes of goats and goat meat were influenced by different factors. The most significant reasons were the fluctuations in demand for goat as well as goat meat and the availability of goats in the market. The most important factors behind increased demand for goat meat were wedding ceremony, picnic, *Eid* festivals, and other social and religious occasions. On the other side, weather, flood, financial capabilities of goat farmers and *Eid* festivals were responsible for the variation of the goat availability in the market. The traders in both the study areas traded the highest volume of goats and goat meats during the period March to April and the lowest from August to September.

4.3 Seasonal Variations in Prices

Price of goat meat varied from season to season due to fluctuations in consumers' demand. Graphs 1and 2 revealed that the prices of goat meat varied from Tk.101.30 to Tk.131.00 per kg in Mymensingh and from Tk.105.90 to Tk.121.90 in Sylhet. The overall trends of prices were found to increase in the winter and decrease in the summer. The sample traders got the highest prices during March-April and the lowest during August-September. The reasons for the rise in prices were that the overall demands for goat and goat meat went up in the above period because the general customers bought goats in larger quantities for slaughtering in the *Eid* festival. Nevertheless, the supply of substitutes like chicken and fish were also very low in that period, and farmers could not find enough time to sell goats due to their engagement in harvesting crops. On the contrary, they received lowest prices during the period from August to September due to larger supply of chicken in the market and their cheap prices, leading to decrease in the demand and price of goat meat.

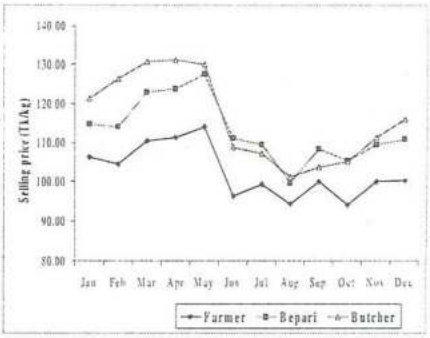


Fig. 1. Selling price of goat meat for farmers and traders of Mymensingh during June 1998 to May 1999

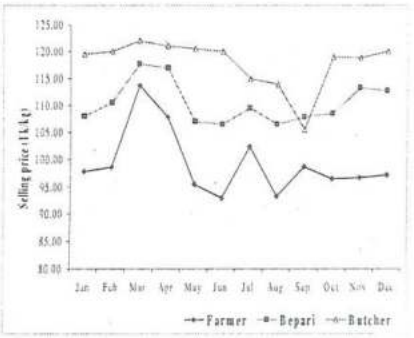


Fig. 2. Selling price of goat meat for farmers and traders of Sylhet during June 1998 to May 1999

4.4 Efficiency in Goat Meat Marketing System

The following two major marketing channels were considered for measuring the efficiency of goat meat marketing for both the study areas.

Channel I = Smallholder goat farmer? Butcher? Consumer
Channel II = Smallholder goat farmer? *Bepari?* Butcher? Consumer

Producers' share in the consumers' price: Producers' share was found highest in channel-I and lowest in channel-II in both the study areas (Table 7). It means that the smallholder goat farmers got the highest benefit when they sold their

produce to butchers instead of *Beparis*. Therefore, channel-I in both study areas was ranked one. The shares in all channels received by Mymensingh farmers were lower than the shares received by Sylhet farmers due to higher difference between producers' price and consumers' price.

Marketing costs and margins to the middlemen: The important cost items reported in both the study areas were shop rent, labour, taxes, personal expenses and transportation (Table 8). Some costs like subscription to the religious institutions, cost of goat storage, cost of electricity and licence fee were found to be paid only by the traders of Sylhet. The marketing of goat meat in channel-I involved lower cost, compared to channel-II in all areas and hence, it was ranked as number one. The goat meat traders got highest margin in channel-I and lowest in channel-II both in Mymensingh and Sylhet. Table 8 further reveals that the traders in Sylhet got lower margin in all channels than the margins received by Mymensingh traders due to lower goat meat price.

Price deviation: Price deviations in different channels did not show any specific pattern (Table 9). However, in channel-I the higher price deviations were found in the peak season and the lower deviations in the lean season. Furthermore, the overall deviation between maximum and minimum prices was lower in channel-I than in channel-II in both areas. Price deviation mainly depended on the availability and demand for goats in the market. In the peak season the demand for goat was found to be very high on the one hand, and availability of goats in the market was found to be low on the other. These might be due to the reasons that the price deviations were high in the peak season and low in the lean season.

Peak and lean period seasonal price variability: Peak season price variation in channel-I was lower, compared to the variations found in channel-II in both the study areas (Table 10). On the contrary, the lean season price variations was lower for channel-I in Mymensingh and channel-II in Sylhet. The overall price variations in peak and lean seasons were much lower in Sylhet than in Mymensingh.

The efficiency of different marketing channels based on the ranks of different performance indicators (Table 11) revealed that channel-I in Mymensingh had the highest marketing efficiency followed by channel-II. It was indicated that the farmers as well as butchers marketed their produces efficiently in channel-I than in channel-II. A different scenario was apparent from the final ranking of the efficiency of marketing channels in Sylhet. In Sylhet channel-I and II both had the same marketing efficiency.

4.5 Production and Marketing Problems

The peri-urban farmers in the study areas faced various socio-economic problems in goat farming. The highest percentage of farmers mentioned that wild animals like jackal, fox sometimes took their kids. The lack of working capital was stated as the second most important problem of goat farming. The other important problems encountered by the farmers were scarcity of green fodder; lack of quality breed; presence of middlemen in the market; and inadequate extension services (Table 12).

The traders involved in live goat and goat meat marketing also faced served problems (Table 13). These were lack of working capital; inadequate marketing facilities; higher market toll/tax; lack of transport facilities; scarcity of goat; and credit sale. Among these problems, the top ranking problems for *Beparis* and butchers were lack of working capital and inadequate marketing facilities.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The study revealed that goat farming under traditional system was a profitable venture, because a goat farmer earned Tk. 812 as net return per year from a goat. It also created a substantial number of employments for the unused family members. The goat farmers in the study areas could not use inputs efficiently. Therefore, they had ample opportunity to increase their income by more use of green leaves, concentrate feed, veterinary care and human labour for goat production. They faced several socio-economic problems in goat farming. The most serious problem was the attack goat by of wild animals like jackal and fox.

The efficiency of goat meat marketing system revealed that channel-I (Goat farmer*?* Butcher*?* Consumer) had the lowest score indicating highest marketing efficiency. Higher producers' shares, lower marketing cost, lower margin for middlemen and stable price for the consumers were ensured in this channel throughout the year. The goat and goat meat traders encountered different problems in doing this business. Their main problems were the lack of working capital and inadequate marketing facilities.

It emerges from the preceding discussion that goat development in peri-urban areas depends on many factors. Among different factors, five critical areas deserve priority: genetic stock, feed supply, animal health and disease control and economic environment. Considering all these factors together with suggestions made by sample farmers and personal observations, a set of policy guidelines for goat development in peri-urban areas have been made for policy makers, researchers, extension workers and NGOs.

- The government or NGOs should provide short-term loan (2-3 years) with lower interest rate to the goat producers seeking to expand beyond subsistence level to undertake small-scale goat farming in the homestead areas on a commercial basis. The loan recovery system should be easy and consistent with their income flows.
- Wherever possible, demonstration farm for improved grass (e.g. napier, para, ipil-ipil) cultivation should be established in each *Upazila,* and seed, seedling and cuttings of those grasses should be initially introduced to enthusiastic farmers. Extension work must be strengthened to popularize grass cultivation among farmers.
- Farmers should be encouraged to use BLRI developed improved feed mixtures and other locally available low cost feed and fodder as goat feed.
- The disease diagnostic services have to be strengthened. Adequate number of veterinarians and veterinary technicians should be employed in each livestock hospital for prevention of diseases and treatment of diseased animal.
- With emergence of NGOs and other stakeholders, the core activities of DLS should be built around developing its professional skills and capacity in two major areas, e.g. veterinary medicine and animal health. The organizational restructuring around these core functions needs to focus on several key areas like regular monitoring on animal diseases, maintaining disease investigation/control laboratories, check-up and disease control at the borders, enforcing quarantine arrangements, and training to create a pool of private well-trained para-vet workers.
- The goat farmers in the rural and peri-urban areas have to be trained properly on intensive goat farming and improved goat management practices (proper housing and feeding, improved grass cultivation, sanitation, simple first aid, and early diagnosis of disease).
- The level of coordination and linkage among different organizations and institutions working for livestock development, education, research and extension should be strengthened so that the improved livestock technologies can be disseminated to its ultimate users within the shortest possible time.
- To improve marketing system for live goat and goat meat, government should provide marketing facilities like water supply, sewerage, sanitation, hygiene, security, and market place improvement. The local government authorities should be involved in the management and maintenance of markets, utilizing local resources as much as possible.

References

Amin, M.M., 1997. Challenges and opportunities of agricultural development in Bangladesh in the 21st century- livestock sector. Symposium article presented in National Conference 1997 held on 10-11 April 1997. Krishibid Institutions Bangladesh, Farmgate Dhaka.

BBS, 1998. Agricultural Census 1983-84. Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka, Bangladesh.

Bhasin, N.R. and Devendra, C., 1988. Marketing of goat meat in India. Proceedings of a workshop on *Goat meat production in Asia* held in Tando Jam, Pakistan, 13-18 March, 1988. International Development Research Centre, No.IDRC-268e, pp.112-119.

Bokonyi, S., 1976. Nature 264: 19-23. In: *Goat production*. Academic Press, London, by C.Gall, 1981.

Chauhan, A.; Singh, A.K. and Karim, M.R., 1993. Problems and prospect of crop farming with goat enterprise for weaker sections of rural community. *Journal of Farm Economy*, 9 (Conference issue):50-58.

Das, D.R.N., 1996. A socio-economic study of farmers rearing Black Bengal goat in some selected areas of Mymensingh district. Un-published M.S. thesis, Dept. of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

FAO, 1997. FAO Statistics on Livestock Population of Countries in Asia Pacific Region. FAO Quarterly Bulletin of Statistics, Rome, Italy.

Hoque, M., 1995. Nutritive values of tree leaves and bran commonly offered to goats. Un-published M.S. Thesis, Department of General Animal Science, BAU, Mymensingh.

Huq, M.A. and Devendra, C., 1988. Goat meat production in Bangladesh. Proceedings of a workshop on *Goat meat production in Asia* held in Tando Jam, Pakistan, 13-18 March, 1988. International Development Research Centre, No.IDRC-268e, pp.112-118.

Huq, M. A., 1990. Evaluation of the meat production characteristics of Black Bengal goats under control and field condition. An un-published M.Sc. thesis, Dept. of General Animal Science, Bangladesh Agricultural University, Mymensingh.

Husain, S.S.; Amin, M.R. and Islam, A.B.M.M., 1998. Goat production and its breeding strategy in Bangladesh. Proceedings of a first national workshop on *Animal Breeding* held at Bangladesh Agricultural University, Mymensingh, 29 November, 1998. pp.17-36.

Miah, M.A.M., 2002. Production and marketing of livestock and livestock products in selected peri-urban areas of Bangladesh. Ph.D. thesis submitted to the Department of Agricultural Economics, BAU, Mymensingh.

Prabaharan, R. and Tirunavukkarasu, M., 1994. Factors affecting goat herd size: a functional analysis. *Indian Veterinary Journal*, 71 (6): 577-579.

Rajagopal, 1986. Economic efficiency of paddy marketing system in Madhya Pradesh: A case study. *Ind. Jr. of Agri. Econ*. 41 (4): 583-590.

SAIC Newsletter, 1995. A publication of the SAARC Agricultural Information Centre, Vol.5, No.2, June 1995.

Table 1: Average quantity of inputs used per goat per year

Input	Small farmer	Medium farmer	Large farmer	All category
No.ofgoats/household	*5.23*	*5.64*	*6.80*	*5.45*
Green leaves (kg/yr)	30.82	34.27	36.01	32.13
Wheat bran (kg/yr)	11.50	17.75	31.15	14.56
Oilcake (kg/yr)	3.18	2.90	6.09	3.29
Outside grazing (Hour/day)	6.80	6.57	6.60	6.72
Veterinary cost (Tk/yr)	21.30	21.68	18.54	21.22
Human labour (Man-day/yr)	6.08	6.19	5.15	6.03

Table 2: Employment generation potentials of goat

Labour category	Male labour	Female labour	Child labour	All category
Total labour (Farm/year)	10.16	17.95	4.78	32.88
Family labour	6.56	17.38	4.47	28.40
Hired labour	3.60	0.57	0.31	4.48
Total labour (Goat/year)	1.86	3.29	0.88	6.03
Family labour	1.20	3.19	0.82	5.21
Hired labour	0.66	0.10	0.06	0.82

**1 man-day = 8 hours (for male)= 12 hours (for female)= 16 hours (for child)*

Table 3: Annual cost of goat production under different categories of farmers

Costitem	Small farmer		Medium farmer		Large farmer		All category	
	Tk/farm	%	Tk/farm	%	Tk/farm	%	Tk/farm	%
Number of head	*5.23*		*5.64*		*6.80*		5.45	
A. Fixed cost	2868	70	2341	50	1976	33	2661	61
1. Family labour	2405	59	1788	38	1350	23	2162	49
2. Depreciation on goat shed	318	8	391	8	395	7	344	8
3. Depreciation on goat value	145	4	162	3	231	4	155	4
B. Variable cost	1214	30	2341	50	3987	67	1718	39
1. Hired labour	237	6	981	21	1383	23	522	12
2. Green leaves	210	5	247	5	309	5	227	5
Home supplied	208	5	245	5	309	5	225	5
Purchased	3	0	2	0	-	-	2	0
3. Wheat bran (purchased)	378	9	676	14	1522	26	538	12
4. Oilcake (purchased)	109	3	103	2	350	6	123	3
5. Veterinary service	99	2	117	2	133	2	106	2
6. Transport	18	0	18	0	33	1	20	0
8. Interest on operating capital	34	1	71	2	124	2	51	1
9. Miscellaneous	129	3	128	3	133	2	131	3
C. Total cost (A+B)	4082	100	4682	100	5963	100	4379	100
D. Total cash cost	980		2025		3553		1447	
E. Total cost (Tk/goat/year)								
Full cost	780		830		877		803	
Variable cost	232		415		586		315	
Cash cos	187		359		523		266	

Table 4: Annual return and profitability of goat rearing by category of farmer

Particulars		Small farmer	Medium farmer	Large farmer	All category
A	Return from inventory change	5325	5953	7795	5667
	Dung quantity (Ton/year)	6.89	7.45	9.15	7.20
	Dung price (Tk/kg)	0.55	0.54	0.57	0.55
B.	Return from dung	195	206	267	203
C.	Gross return (Tk/farm/year)	5522	6159	8062	5870
D.	Gross return (Tk/goat/year)	1056	1092	1186	1077
E.	Net return (Tk/farm/year)				
	Full cost1	440	1477	2099	1491
	Variable cost	4308	3818	4075	4152
	Cash cost	4542	4134	4509	4423
F.	Net return (Tk/goat/year)				
	Full cost	275	262	309	274
	Variable cost	824	677	599	762
	Cash cost	868	733	663	812
G.	Benefit cost ratio (BCR)				
	Full cost	1.35	1.32	1.35	1.34
	Variable cost	4.55	2.63	2.02	3.42
	Cash cost	5.63	3.04	2.27	4.06

Table 5: Break-even analysis of goat production in the study areas

Particulars	No.of goat	Fixed cost	Variable cost	Gross cost	Total return	Net return
Average herd size	5.45	2661	1718	4379	5870	1491
Break-even size	3.50	2661	1103	3764	3770	6

Table 6: Volume of goat and goat meat traded by intermediaries during June 1998 to May 1999

Particulars	Mymensingh				Sylhet			
	Quantity		Live weight		Quantity		Live weight	
	No.	%	kg	%	No.	%	kg	%
A. *Bepari*								
1. Quantity bought by	1194	100	5557	100	881	100	5527	100
a. Farmer	1149	96.2	5344	96.2	473	53.7	3018	54.6
b. *Bepari*	45	3.8	213	3.8	408	46.3	2509	45.4
2. Quantity sold by								
a. General customer	-	-	-	-	121	13.7	743	13.4
b. Butcher	1194	100	5557	100	760	86.3	4784	86.6
B. Butcher								
1. Quantity bought by	1279	100	6735	100	3888	100	25147	100
a. Farmer	300	23.5	1529	22.7	668	17.2	4397	17.5
b. *Bepari*	979	76.5	5206	77.3	3220	82.8	20750	82.5
2. Quantity sold by								
a.General customer	-	-	4490	66.7	-	-	17050	67.8
b. Restaurant	-	-	2245	33.3	-	-	6171	24.5
c. Bakery	-	-	-	-	-	-	1926	7.7

Table 7. Producers' share in the consumers' prices under different goat meat marketing channels

(Tk/kg)

Particulars	Mymensingh		Sylhet	
	Chain-I	Chain-II	Chain-I	Chain-II
A. Producer				
Selling price to butcher	107.50	-	102.11	-
Selling price to *Bepari*	-	102.47	-	99.37
B. *Bepari*				
Selling price to butcher	-	113.07	-	110.40
C. Butcher				
Selling price to final consumers	132.85	132.85	125.09	125.09
Producers'share to consumers taka				
	80.92%	77.13%	81.63%	79.44%
Rank (I_1)	(1)	(2)	(1)	(2)

Table 8: Marketing costs and margins of butcher under different goat meat marketing channels

Particulars	Mymensingh				Sylhet			
	Chain-I		Chain-II		Chain-I		Chain-II	
	Tk/kg	%	Tk/kg	%	Tk/kg	%	Tk/kg	%
1. Transport	0.59	10	0.26	5	0.30	4	0.20	3
2. Market tools and taxes	1.03	18	0.95	17	0.41	6	0.25	4
3. Personal expenses	1.16	20	1.12	21	1.20	16	1.14	16
4. Labour	0.84	14	0.84	16	2.98	41	2.98	43
5. Rent	1.21	21	1.21	22	1.92	26	1.92	27
6. Slaughtering	1.00	17	1.00	18	-	-	-	-
7. Cleaning	0.05	1	0.05	1	0.10	1	0.10	1
8. Subscription	-	-	-	-	0.07	1	0.07	1
9. Storage	-	-	-	-	0.24	3	0.24	4
10.Licence fee	-	-	-	-	0.01	-	0.01	-
11. Electric bill	-	-	-	-	0.08	1	0.08	1
Total marketing cost	5.88	100	5.43	10	07.31	10	06.99	100
Rank (I_2)		2	1		2		1	
Margin to butcher		25.35	19.78		22.98		14.69	
Rank (I_3)	2		1		2		1	

Table 9: Deviation between maximum and minimum prices in different goat meat marketing channels

(Tk/kg)

Month	Mymensingh		Sylhet	
	Chain-I	Chain-II	Chain-I	Chain-II
January	-	14.26	-	4.10
February	-	2.42	-	9.60
March	11.90	8.38	10.00	15.80
April	12.88	19.43	9.00	8.20
May	4.67	3.38	2.00	8.00
June	4.00	2.50	8.00	8.70
July	9.50	12.00	-	6.00
August	4.37	8.00	4.00	8.60
September	2.25	4.07	5.00	11.50
October	-	5.57	5.00	16.40
November	-	1.81	-	7.80
December	-	14.10	-	2.90
Σd	49.57	95.92	43.00	107.60
N	7	12	7	12
D	7.08	7.99	6.14	8.97
Rank (I_4)	(1)	(2)	(1)	(2)

Table 10: Seasonal price variability in peak and lean seasons under different goat meat marketing channels

Month	Mymensingh		Sylhet	
	Chain-I	Chain-II	Chain-I	Chain-II
Peak season:				
March	5.153	8.420	0.643	4.609
April	1.331	10.955	1.826	4.189
$\Sigma W_t (p_t - p)^2$	6.484	19.375	2.469	8.798
T	2	2	2	2
δ	1.881	3.112	1.111	2.097
Rank (I_5)	(1)	(2)	(1)	(2)
Lean season:				
August	3.699	5.385	0.735	0.531
September	0.187	0.630	0.492	0.155
$\Sigma W_t (p_t - p)^2$	3.886	6.015	1.227	0.686
T	2	2	2	2
δ	1.394	1.734	0.783	0.586
Rank (I_6)	(1)	(2)	(2)	(1)

Table 11: Final ranking of the efficiency of different goat meat marketing channels

Performance indicator	Mymensingh		Sylhet	
	Chain-I	Chain-II	Chain-I	Chain-II
Producers' share (I_1)	1	2	1	2
Marketing costs (I_2)	2	1	2	1
Margin to middlemen (I_3)	2	1	2	1
Price deviation (I_4)	1	2	1	2
Peak period seasonal price variability (I_5)	1	2	1	2
Lean period seasonal price variability (I_6)	1	2	2	1
Composite index (Ri ÷ Ni)	1.33	1.67	1.50	1.50
Final ranking	(1)	(2)	(1)	(1)

Ri = Total value of the ranks of performance indicators
Ni = Total number of performance indicators

Table 12: Problems and constraints faced by peri-urban goat farmers and traders

Types of problem	% of response
1. Lack of care	19
2. Lack of working capital	71
3. Lack of quality breed	51
4. Lack of high yielding buck	14
5. Lack of grazing land	13
6. Scarcity of green fodder	58
7. Lack of improved feed preparing know-how	12
8. Inadequate extension services	35
9. Incidence of disease	17
10. Lack of security	19
11. Problem of insects/wild animals	82
12. Presence of middlemen	50
13. Higher sale tax	10

Table 13: Problems faced by peri-urban goat and goat meat traders

Types of problem	*Bepari (n=62)*	Butcher *(n=58)*
1. Lack of working capital	81	60
2. Inadequate marketing facilities	68	90
3. Fluctuations in demand & prices	42	60
4. Higher market toll/tax	48	41
5. Lack of transport facilities	58	24
6. Scarcity of goat	34	43
7. redit sale	16	22
8. Other	34	50

Promotion of Agro-Processing Industry in Bangladesh: Potentials Constraints and Policy Issues

Narin Tongsiri
Shamsul Alam*

I. Introduction

Agro-processing is identified as a thrust sector in Bangladesh. Since Bangladesh can grow diversified crops and with surpluses of horticulture crops, it is imperative that value addition is necessary. Farmers do not get good price when their crops grow in plenty because most of the agricultural produces are perishable. Processing of product can help preservation, ensure quality 'value addition' and creates immense of form and time utilities for consumption.

There are many advantages to the economy if agro-processing is encouraged. Some of the pertinent advantages are mentioned below:

Higher prices of crops: If the surplus agricultural produces can be processed by processing entrepreneurs, the demand for the agricultural produces will remain higher due to the effects of increased derived demand for product inputs and helping the farmers get high prices even in times of surplus production.

Increased work opportunity for women: Currently there is limited opportunity for women to work at home. So, if they can process some fruits and vegetables at home they can keep these products for their own consumption and if they have a surplus to sell they can earn some income. This could be a very good method to help women to generate additional income from their own home. The home processed products could be pickles, chutneys, squashes, dried vegetables, mangoleathers, banana chips etc. At present, less than 0.5 per cent of total Bangladesh horticultural production is processed.

---

* The first author is Ex-Dean, Faculty of Agro-industry, The University of Chiang Mai, Chiang Mai, Thailand, Email address: . The second author is a Professor at the Dept. of Cooperation and Marketing Bangladesh Agricultural University, Mymensingh and currently working as Marketing Specialist, FAO, Dhaka (on lien), E-mail address: . This paper was presented at the regional seminar of the Bangladesh Economics Association held at Bangladesh Agricultural University, Mymensingh on 17th December 2003. Views expressed in this article are of authors entirely, and in no way reflect their positions held in any organization.

Value added to agricultural crops: A rough estimate shows that by spending Tk. 10 for 10 raw bananas and by processing them into banana chip, villagers should be able to sell those for Tk. 20 – 25. The same can apply to other crops. If one can export the product, they might get Tk. 35 or more. This is the biggest advantage of processing activity. Value addition activity can increase employment and diversified use of produces.

Quality storage: The major difficulty of production of agricultural crops is marketing due to perishability of such produces. Processed products can be kept in good quality for longer time. Growers will have more barganining power in off-season sales and seasonal high fluctuation of prices will also be reduced if 'form utility' of products is created by processing activity.`

Earning more foreign exchange: If food processors can ensure quality to meet international standard, the new entrepreneurs can export the processed products to earn foreign exchange. Thus, this can help diversify source of earning foreign exchanges for the country. For sustained economic growth and prosperity, export earnings must be greater than the import spending. PRAN has opened a new vista in this regard by exporting agro-processed products in Middle East and African countries.

Increased employment: All value addition activities (processing, storage) create employment opportunities. Increased agro-processing activities may create forward linkage (selling, distribution retailing etc.) and backward linkage services (remolding, transportation, sorting/grading etc.). All these activities require simple / affordable techniques and technologies.

2. Constraints of Agro-Industrialisation

No explicit national policy on agro-industry development in Bangladesh: there is any concrete national policy on agro-industry development for Bangladesh. This limits the expansion of agro-industry; the entrepreneurs find no policy guidelines for investment in the sector.

No proper government organization to work at the national level: There are some organizations, which need to work on the development of agro-industry. Post-harvest Technology Division of Bangladesh Agricultural Research Institute (BARI) has done some work on the training of women. There is Food Technology and Rural Industry Department at Bangladesh Agricultural University (BAU), Mymensingh. Appropriate Technology Development Programme (ATDP) Phase II is also endeavoring to facilitate development of agro-processing and entrepreneurship in the country. But there is no central agency to prompt agro-processing in coherent manner.

No national committee on agro-industry development: Many ministries are involved with agro-industry development e.g. Ministry of Agriculture (involved with the supply of raw materials), Ministry of Industry (involved with how to set up small scale food industry), Ministry of Public Health (involved in implementing Food and Drug Act (FDA), Ministry of Finance has to provide fund and Ministry of Commerce has to help in developing marketing system etc. The BSTI has to announce appropriate 'food-code' of the processed foods relieving public fear on health and hygiene. To get these ministries to work together, there is need of a very strong and efficient National Committee.

Inadequate supply of raw materials for processing: Although Bangladesh can produce a lot of agricultural crops, most of those crops are for fresh consumption and not aimed for processing. A classic example of this is tomato. This country grows lot of tomato for only table consumption, but there is not enough supply for processing to make tomato paste. For paste making, one needs the variety, which can give high solid content and red colour.Another good example is baby corn, one need to have proper variety of baby corn for canning. One cannot use animal feed corn as a substitute for baby corn. Alfanso mango or a nearest alternative needs to be produced in large-scale for extracting pulp for juice drinks.

Lack of well-trained human resource in food processing: There is a serious dearth of trained human resource in food processing activities. There are only one or two food science or food technology departments in the Universities in this country. One is with Dhaka University, Food Science and Nutrition Department and the other is not exactly Food Science or Food Technology, but Food Engineering at the Bangladesh Agricultural University, Mymensingh. In contrast, Thailand has 36 Food Science or Food Technology Department and another 4 Faculty of Agro-Industry, consisting of Food Science or Food Technology Department, Food Engineering Dept., Biotechnology Dept., Agro-product Development Dept. and Packaging Technology Department. For market promotion of such products even there is no Department of Agricultural Marketing and Agribusiness in any of the Technical & Science University. Opening of Agri-business MBA in one of the private universities recently is a very right step forward for development of human resource towards management of agro-enterprises. In many instances, public universities are loathed, rigid and reluctant to re-shape, redesign courses embracing the changing need of the economy.

Inadequate research and development: There are four or five organizations that carry out research and development on agro-industry but with limitation of budget and skilled-human resource. Not much research work has so far been done in this country, particularly on processing and packaging development. We need a

lot more of empirical research and development in this field, including development of marketing systems for the up-coming processed products.

Not enough intermediate technology development: Since not enough was done on research and development, Bangladesh is lacking proper intermediate technologies to give momentum for the processing activities. Processing revolution requires appropriate production and handling technologies for many agricultural produces in Bangladesh.

Food processing equipment are in short supply: Most of the food processing equipment are not produced locally and are mainly imported. These equipment need to be designed and produced locally (also this will help creation of job opportunities). Local production of equipment will ensure easy availability at an affordable price. There is dearth of lug-capped bottles, jars and canning facilities in the country.

Not many investors in food processing industry: There will be more industrial investment in food industry if the Government is serious in promoting agro-processing industrialization in the country. However, currently, there are not many interested entrepreneurs in agro-processing industries. Tax incentives and medium to long term loan facilities have to be provided to prospective agro-processing industrialist.

No special programme for institutional loan for food processing: For new entrepreneurs including food technology and agricultural marketing/agribusiness graduates, special soft-loan programme with low interest should be provided so that they can start their processing business and marketing in the well connected raw materials producing areas.

3. Policy Issues for Agro-Industrialisation

For rapid agro-industrialization in Bangladesh, the constraints mentioned above have to be overcomed. Some recommendations are put forward here for attaining momentum in agro-industrialization in the country.

Frame national policy on agro-industry development: It is a must for the government to prepare and announce a well thought out agro-industrial national policy. The government should bring every organization involved with agroi-industry to work together and lend support to all activities on agro-industry development. Specialist support/advice from countries in the region, like Thailand and Malaysia, can be availed for this.

Set up an organization to work for agro-industry: An Agro-industry Development Division may be established within the Ministry of Agriculture or Ministry of Industry. This Division will serve as a coordinating body on behalf of the National Committee. All the planning budgeting, monitoring should be implemented by this Division.

Set up a national committee on agro-industry development: Members of this committee would come from different Ministries. Agro-industry Division will accommodate this committee and should be responsible for organizing the meeting and act as a Secretariat. This committee will be responsible for planning, allocating budget, monitoring, evaluation and formulating policies on Agro-Industry Development of the country.

Solve problem of raw materials: This task totally belongs to the Ministry of Agriculture. But the idea of producing for marketing fresh product has to change also to produce enough for industrial market. Experiments have to be carried out with research organization on which crop or which variety will be fit for processing. Contract farming system may also be introduced to link up farmers and agro-enterprises.

Create well-trained human resource for agro-industry development: The proposed National Committee on agro-industry development has to study how many well-trained human resource is needed for Bangladesh and then ask the government to support universities, which have potential to produce graduates on food science, food technology and agribusiness according to the need of the country. Many universities in Bangladesh have science subjects, which can be the basic sciences for these students. Some facilitation to these students in agro-industry and related subjects will help accelerate creation of good human resource locally for agro-industry development.

Increase fund for research and development: Some research institutes in Bangladesh have been equipped with very sophisticated equipment (eg., BCSIR) but they are short of personnel and fund to carry out research and development studies. If Government provides them with enough skilled human resource and allocate fund for the research institutes, this problem can be solved.

Develop proper intermediate technology: If research institutes and universities carry out research and development projects on agro-industry/agro-businesses in the country, the results can be applied by private sectors and small entrepreneurs. They can build up high quality products to meet demand of local and international markets.

Increase local production of food-processing equipment: This problem is a difficult one, because to produce food-processing equipment locally one needs to

have a number of personnel on food engineering. These people can design equipment and can advise private sector to build equipment for food processing. The Food Technology and Rural Industry Department of Agricultural University at Mymensingh has initiated food engineering courses (four year graduation study) recently. Hopefully these students can be a great help to the country if they are well trained. But we need a lot more of this kind of courses, including studies in agricultural marketing and agribusiness. Other universities should also initiate courses towards this end.

Encourage more investment in agro-industry: Private sector is interested to invest money if there is adequate incentive. The government must extend assistance in terms of soft loan , relax tax and duties on import of food processing equipment, assist in marketing convenient to exporting etc. In such a policy environment new entrepreneurs will surely invest more money in the processing industries. Small entrepreneurs may flood in agro-processing business if appropriate physical and social environment is ensured. Improving market information and marketing systems as well as identifying the mechanisms for acquiring technology is required for agribusiness development. The main problem of industrial investment in this country is deteriorating law and order situation which must be improved at any cost.

Channel soft-loan for agro-industry: Government coult set up a special soft-loan programme to support all activities involved with agro-industry development. International donors are interested to support this kind of activities because it can also help the vulnerable women group in a developing economy like Bangladesh.

Value Added Agro-processing Opportunities in Bangladesh

Mujibur Rahman Khan*

1. INTRODUCTION

One of the major constraints for Bangladesh agriculture is a lack of essential linkages amongst production, processing and marketing of agricultural produce. Keeping this issue in view, the Ministry of Agriculture and FAO envisaged a strategy to provide incentives for establishing rural agribusiness, agroprocessing and agrobased labor-intensive industries in Bangladesh.

Both the Industrial Policy 1999 and the National Agriculture Policy (April 1999) have put emphasis on creating opportunities for establishing agro-processing and agro-based industries in the country. The Industrial Policy 1999 has identified agro-based industries as number one out of 16 select thrust sector industries. It envisions to raise the share of these industries in the GDP to at least 25 percent, within a decade, from a low base of ten percent prevailing over the last two decades.

Assuming the contribution of agriculture to remain constant at around 29 percent, the contribution of the industries sector is expected to more than double. In that case the contribution of services/other sectors will be reduced to below 50 percent from the previous level of above 60 percent. If the projection holds good, Bangladesh economy is expected to stand on stable and sustainable development based on both agriculture and industry.

The industrial policy also identified a vibrant and dynamic private sector as the prime actor in the industrial arena of the country to implement the policy. The primary goal of the National Agriculture Policy is to modernize and diversify the agricultural system through the initiation and implementation of a well organized and coordinated development plan. It has identified the agricultural commodities that have relative high value adding capacity when compared with non-agricultural commodities. paper are author's own.

---

* The author is the Managing Director, Rajshahi Krishi Unnayan Bank.

The global economic environment is in the process of undergoing radical changes - movement is toward a world market economy. The Uruguay Round Agreement on Agriculture (URRA) has created a new regime for growth based on liberal trade policies. There are opportunities for restructuring our economy on a sound footing. **"**Agroprocessing industries offer opportunities for value addition to products — both for local markets (import substitution) and export markets, The URRA has certain advantages for Bangladesh agriculture. However, the advantages would not be automatically available — they should be seriously explored and exploited within our environment. Bangladesh has to promote a better export-import balance based on the country's comparative advantages. To be able to extract maximum benefit from our agriproduces, the country will have to stimulate processing for value addition.

The agro-climatic condition of Bangladesh is suitable for production of more than 200 crops in a year. Bangladesh is on the verge of attaining self-sufficiency in rice — the staple food crop of the country. However, due to heavy cereal based food habits and low production, other food items, such as fruits, vegetables, pulses, edible oils, eggs, meat and milk, are consumed less than what is required for physiological requirements.

There are production pockets for different food items. It is necessary to understand production trends and geographical potential for production of different food items which are suitable for processing and export. There are certain food items which are important not only from a processing point of view, but also for import substitution and/or export promotion, These activities will help farmers receive better prices for their products and will help eliminate market gluts.

The main objective of this paper is to highlight the present status and elucidate future potential of agro-processing industries in Bangladesh. In particular the paper has been designed to:

- focus on production of and requirements for different food items in Bangladesh
- identify production zones of food items for exploring processing opportunities and promoting exports
- highlight technologies related to the processing of cereals, fruits, vegetables, milk, poultry and fish under Bangladesh conditions
- focus on the investment status, constraints and opportunities in agro-processing

- identity bottlenecks and limitations to establishment or expansion of agro-processing industries in Bangladesh
- identify policy issues related to the promotion of agro-processing opportunities and suggest some policy recommendations.

2. CONCEPTUAL AND TECHNOLOGICAL ASPECTS OF AGRO-PROCESSING INDUSTRIES

2.1 Agro-processing Industries Defined

Agro-processing industries ran be defined under the broad spectrum of agrobased industries. James Austin (Austin 1983) defined an agro-based industry as an enterprise that processes agricultural products including ground and tree crops as well as livestock.

The degree of processing can vary tremendously ranging from the cleaning and grading of fruits to the milling of cereals, to the cooking, mixing and chemical alternation that create a textured vegetable food. Agro industries are the primary method of transforming raw agricultural products into consumable products and in the process, these are adding value to the raw materials. Agro industries often constitute, the base of a manufacturing sector, and their products frequently constitute the principal exports of the country. The food processing system which is a central part of agro industries, provides nutrition required by a nation's population.

Agro-processing may be defined as the processing of inputs for or outputs from agricultural production. One feature of agro-processing industries is that the processed products usually maintain high value addition and better storage and keeping quality compared to the raw materials used for the purpose. The processed agricultural products include frozen, dehydrated, pickled, canned, and bottled products.

2.2 Technological Aspects of Agroprocessing Industries

Quality control is a primary consideration in any food processing industry as its product is consumed by human. Quality control is measured in terms of standard specifications, codes of practices and good manufacturing practices. The food quality should meet the expectations of the consumers within the framework of legal requirements. The taste, smell, color and consistency of food value, ie, the wholesomeness is a part of quality control. The best quality foods are prepared in strictly controlled safe and hygienic conditions during all of the stages of food processing:

- Control of quality of raw materials
- Control of critical points in the processing
- Control of finished products

Food with high moisture like fruits and vegetables, fish, milk — commonly known as perishable commodities — require proper handling and processing for their preservation. On the other hand, food items with low moisture content such as cereals, pulses and oil seeds can be stored in ambient temperatures after proper drying and be processed during off-season.

The shelf-life of fruits and vegetables can be extended by preservation. Preservation of perishable fruits and vegetables is necessary for linking rural areas, the production centers, with the urban centers, the consumers. Market demand and government regulations will determine the quality of products. Scientifically and hygienically prepared high quality products may even qualify for export.

3. POTENTIALS OF AND CONSTRAINTS TO VALUE ADDITION THROUGH AGRO-PROCESSING OF SELECTED PRODUCTS

a) Rice

Production of rice increased to about 25.0 million MT in 2001-02. Nawabganj, Dinajpur and Sherpur areas are famous for production of fine and aromatic rice that have export markets.

Potentials

Rice mills of various capacities have grown throughout the country. The indigenous ‘dheki’ method of rice husking has been largely replaced by mechanized rice milling. However, mechanized rice milling in Bangladesh is itself a century old technology — known as the engel-berg huller system. The extent of processing and storage of paddy depend on locations: the farm for extended personal consumption, the village where producers and traders interact, and urban areas where storage facilities set up by public agencies are found.

There are 100.405 (100,000 engel-berg, 38 Chiness automatic and 25 large automatic) rice mills of different sizes and categories spread throughout the country. The engel-berg rice milling system is defective. About 20,000 engel-berg type rice mills are being established every year. These rice mini-mills have widely decentralized the rice milling industry. Over the years, some technological

improvements have been introduced, (a) including parboiling the paddy to conserve its vitamins, reduce the proportion of broken rices, (b) mechanical drying of paddy, (c) use of rubber roller sellers to minimizes grain breakage, (d) utilization of husks as fuel for boilers and dyers and as raw materials for products such as cement and (e) evolution of mechanisms to separate rice bran from husks to extract oil from rice bran. Rice bran is also used as good feed for fish and poultry. According to one estimate, about two million MT of rice bran (at 10 percent of the weight of clean rice) could be produced from about 20 million MT of clean rice in Bangladesh annually. Most of it is used as fuel for cooking purposes and/or in boilers (mixed with husks). Through slight modification in the existing engel-berg system, 200,000 MT of quality edible oil could be produced from rice bran. The rice bran oil could meet about 50 percent of total consumption. According to one estimate, 400 MT of rice bran oils are produced in the country. Rice bran oil is a good quality edible oil having balanced fatty acid composition and valuable micro components. Bangladesh is deficit in edible oil. Locally produced oil can hardly meet 30 percent of the country's total requirement.' The country spends over Tk. 10,000 million every year to meet import bills of edible oils. Rice bran oil produced from rice mills could substitute for a huge quantity of the imported edible oil every year.

Besides extracting oil from rice bran, there exists tremendous scope to export fine quality rice from Bangladesh to the EU and USA markets. However, this will need a comprehensive collaborative approach involving producers, millers, exporters and financial institutions. A number of incentive packages would be necessary to boost export of fine quality rice on a competitive basis with the neighboring countries. Rice processing devices in Bangladesh is shown in Table-2.

Constraints

- Large amount of post-harvest loss of rice and much poor quality milled rice due to the preponderance of a large number of old, traditional rice mills in the country.
- Mushroom growth of enger-berg huller rice mills (about 200,000 every year), which are not efficient in recovering bran from rice milling systems.
- Under utilization of modern rubber roll rice mills caused by short of supply of paddy due to want of working rice capital loans.
- Lack of drying facilities in the season resulting in poor quality of rice and ultimately poor quality rice bran for oil extraction.
- Frequent power interruption causing lower capacity utilization of rice

mills.

- Heterogeneous mixtures of paddy create problems in producing uniform quality and grades of rice.

Steps to be Taken for Production of Rice Bran Oil

- Installation of large number of commercial auto-rice mills (with 25 to 50 MT per day capacity). However, the investment for a large auto-rice mill is substantial at about Tk. 40 million per mill.
- Upgrading existing engel-berg huller mills by incorporating a rubber roll sheller in the system. Investmen t cost of such system is generally low (around Tk. 50,000 per mill).
- Setting up integrated bran oil plants near strategic rice mill areas so as to enable oil extraction from the bran within 24 hours to prevent deterioration of rice bran quality.
- Installation of "rice bran stabilizers" at strategic rice mill areas to facilitate storing of rice bran before milling. 'Stabilizing' is a process of heating rice bran at a temperature of 11 00C for 20 minutes to keep the FFA below 10 percent for 60 days at a storage temperature of 180C to 250C and relative humidity (RH) of 62 to 68 percent. By adopting this method. bran from the improved rice mills could also be used for extraction of oil.
- Discourage the mushroom growth of the age-old engel-berg huller method of rice milling -as is being done in India.
- Provide institutional credit support in the form of term and working capital loans to the private rice millers.
- Provide favorable tariff, tax and VAT structure to encourage the modernization rice mills.
- Create awareness about the food value of rice bran and its use in preparation of edible oil.

b) Wheat

Production of wheat nearly doubled in 1998-99 (1.91 million MT) from about 1.0 million MT in 1990-91. Sixty four percent of all wheat in Bangladesh is grown in seven former districts: Dinajpur, Pabna, Rangpur, Rajshahi, Jessore, Kushtia and Comilla.

Potentials

Wheat flour is widely used in bread and biscuit production. Wheat processing industries are growing fast in the country. The bread and biscuit industries range from small bakeries to automated factories. Bread and biscuits are marketed throughout the country. Bread and biscuits are recognized as convenient food (fast food item). There is scope to enrich bread and biscuits through fortification with soya-protein. There is ample scope to use soybean — a protein rich food crop with breads and biscuits to substitute protein deficient food items — based on cereals. Soya fortified breads and biscuits could be served as tiffin items to the school children to improve their nutritional status. This could, on the one hand, help the development of local bread and biscuit production industries and, on the other, increase the intellectual capacity of our rural population due to intake of protein rich food as our future manpower reservoir. This would also encourage more children to attend schools and would minimize drop-outs. It is also possible to produce cereal based baby foods in the country. Locally produced baby food items could be substituted for imports and even exported. Bangladesh could earn needed forex by exporting baby food items to neighboring countries.

Constraints

No accurate estimates of wheat flour based food items could be provided as the industries are scattered throughout the country. Due to lack of quality seed, suitable cropping pattern along with proper linkages between growers and buyers, production could not be maximized as per total requirement of the country. Due to lack of diversified usages growers can not get suitable market price.

Steps to be taken

Wheat processing industries are growing fast in the country. The bread and biscuit industries range from small bakeries to automated factories. We are to conduct statistics/survey on actual demand for wheat made products. As to meet up the demand more wheat processing industries are to be established. It is learnt that wheat processing industries are growing fast in the country, which is a very good and positive sign.

c) Maize

Production of maize is nearly 0.25 million MT in the country. Previously the total production was 3000 MT. The production has got much momentum in the recent years as the demand is growing fast.

Potentials

Poultry farms are flourishing in our country very fast, which creates great demand for animal feed. Flour can be produced from maize for preparation of different kinds of food and feed items. The soil and climatic conditions are congenial for boosting up maize production in the country. By boosting up production the deficit could be mitigated which would save a lot of foreign exchanges.

Constraints

With the growing need the total demand of maize is 1.0 million MT at present in the country, while total production is nearly 0.25 million MT which makes the deficit of 0.75 million MT. The deficit is mitigated by import. Due to lack of quality seed, suitable cropping pattern along with proper linkages between growers and buyers, production could not be maximized as per total requirement of the country. Due to lack of diversified usages growers cannot get suitable market price.

Steps to be taken

For boosting up production, high yielding quality seed has to be devised and used. Cropping pattern should be changed which may suit to maize production to a larger scale. Backward and forward linkages should be established among growers, buyers and entrepreneurs. Required number of feed mills are to be established for meeting demand of feed meals in the wake of flourishing poultry industries in the country. Maize flour can also be used in bread and biscuit production. For this maize processing- industries can also be established ranging from small bakeries to automated factories.

d) Soybean

Soybean is grown as a minor crop — production estimates vary from 600 MT to 15,000 MT annually. To feed over 52 million commercial poultry heads and the rapidly growing aquaculture and livestock industries, Bangladesh needs larger quantity of soybean.

Potentials

Soybean can be processed into soy milk, soya sauce tofu (soybean curd), yoghurt, soybean sprouts, tempeh (soya sheak) soya-flour and other products. Defatted soybeans can be used for the manufacture of proten isolates and concentrates for incorporation in baby food. Soybean is considered an industrial crop. Agro-climatic conditions of Bangladesh are suitable for production of soybeans in more than one season. Concerted efforts are needed to increase the production of

soybeans for meeting huge demands of edible oil, nutrition rich human food, baby foods and also animal feeds. Soybean is an environment friendly crop as it fixes biological nitrogen into the soil. Using soybean in crop rotation will enrich the soil in nutrients and save nitrogen fertilizer, which is key element in crop production.

Constraints

Unprocessed soybeans have an undesirable bitter flavor and contain the toxic proteins, haemaglutinin and antitrypsin. These substances must be destroyed or inactivated to make the beans palatable and digestible both for human and animal consumption.

Steps to be taken

Soybeans can be made palatable, early digestible and nutritious, by processing into various products. The most popular of which are tempeh, tofu, soya milk, soysauce and soya spouts. Soybean can be defatted by solvent extraction with hexane. The recovery of hexane for reuse is close to 99 percent. The smallest plant for solvent extraction should be of 50 MT per day for economic viability. Extruder type, small scale machinew that have the capacity to crush small quantity of different oil crops (with adjustable screw systems) need to be introduced into the rural sector. Samples of extruder machines are located at BSCIR, Dhaka.

e) Potato

Potatoes are the third staple food in the world, next to wheat and rice. The FFYP of Bangladesh had a projection to produce 2.43 million MT of potatoes in 2000-2001 from 1.85 million MT produced in the base year (1996/97). It may be mentioned here that in 1972-73 only 7.5 lac MT of potatoes were produced in the country while this figure increased to 27.62 lac MT in 1998-99 (32.15 lac MT in 2000-2001).

Potentials

It produces more food in terms of dry matter or calorie per unit area, and per unit of irrigation water. It represents 56 percent of total vegetables produced in the country. According to an estimate, Bangladesh has the potential to produce 4.5 million MT of potatoes in 2010, 7.4 million MT in 2020 and 12 million MT in 2030. It is the most opportune moment to start processing of potatoes in order to exploit the full potential to produce the maximum achievable quantities of potatoes in the country. Potatoes have tremendous potential to be used as

substitute for rice and as an industrial crop for export earning as well as import substitution. Per capita and total production of potatoes in the developed world is much higher than that in Bangladesh. Per capita potato production in our country is only 23.8 kg, whereas it varies from the lowest of 68 Kg in Argentina to the highest of 963 Kg in Poland. However, the trend of per capita consumption of potatoes in our country is gradually increasing every year. Tremendous potentials exist for production of the following value added potato products:

French Fries: Value added potato french fries can be produced from fresh potatoes for local elite consumers as well as for export markets. Some Bangladeshi potatoes have international demand and for some other varieties in demand can be grown. There exist scope for establishment of french fries production plants by local entrepreneurs as well as joint venture companies. The ingredients for french fries preparation are relatively simple: raw potatoes and soybean oil. Both local and imported machinery may be used to establish french fries plants. The french fries need processing of special variety potatoes as well as hygienic preparation to maintain the international standards in terms of color, taste and flavor. The packaging must also be of good quality to gain markets in developed country supermarkets. One kilo of good quality french fries is sold for Tk 40 at present in the local market.

Potato Chips: Potato chips also have domestic and foreign markets. Many local companies produce potato chips. Potato chips have captured good markets even in remote areas of Bangladesh. However, there is ample scope to improve the quality — especially the packaging of potato chips — for local elite markets as well "as for export. One kilo of potato chips is locally sold between Tk 50 to Tk 100, depending on the quality and the packaging materials.

Potato Flakes: Potatoes grown in Bangladesh are suitable for production of potato flakes (BCSIR, 1998). Potato flakes are produced from raw potatoes. Usually five kg of potatoes is required to produce 1 kg of flakes. Potato flakes have wide uses like preparation of bread and medicines. Potato flakes are "ready to use". Potato flakes have great international demand in developed countries like the UK, the USA, Germany, Switzerland and Italy. Demand for **potato** flakes in Italy alone has been projected at 25,000 MT per year. Potato flakes production technology is relatively simple and labor intensive. Generally, one kilo of potato flakes is sold for US$ 5 to US$ 6 in the overseas markets.

Constraints

According to some reports, 10-12 percent of the total production of the potatoes in our country is spoiled every year due to lack of proper preservation facilities. Price instability, particularly seasonal fluctuation of price discourage farmers to

make increased investment in potato production.

Steps to be taken

Potatoes are perishable goods. So proper and scientific methods of storage should be followed for its preservation. If we cannot store the potatoes properly, production of potatoes will be at stake. Storages facilities should be provided to the growers of the potatoes in the following manner:

Short-term storage facility: For day-to-day consumption the short-term storage facilities should be maintained at growers level. This type of storage facilities ought to be made and maintained at home by using local technology. Various types of indigenous system are seen in rural Bangladesh.

Long-term storage facility (cold storage): To sustain this type of storages facility, modern type of cold storages are required. Dhaka, Comilla, Bogra, Rangpur and part of Dinajpur are the major potato growing regions in Bangladesh. Cold storage facilities are established in the main production centers such as Munshiganj, Comilla and the northern districts. There are about 280 cold stores in Bangladesh with a capacity to store about 1.31 million MT of potatoes annually. There are 16 new cold stores under construction. Despite the large number of cold stores, a huge quantity of potatoes can not be stored due to lack of transport facilities and various socio-economic and technological problems.

f) Fruits

Bangladesh produces about 1.49 million MT of fruits annually. Banana is by far the single major fruit occupying 44 percent pf the total fruit production in Bangladesh. Jackfruit (18 percent) is the second largest fruit followed by mango (13 percent) and pineapple (10 percent). Rangamati, Rangpur and Barisal are the major zones where banana is grown. Dhaka, Sylhet, Tangail and Kushtia produce most of the jackfruit grown in the country. Rajshahi, Sylhet, Rangpur and Dinajpur are major mango producing regions, while Sylhet, Tangail, Rangamati Hill Tracts and Dhaka are the major pineapple growing regions.

Potentials

There are ample opportunities to earn foreign exchange by exporting fruits in fresh and processed manner abroad. There are lot of scopes to establish more fruit processing plants and/or modernize the existing ones.

Constraints

Fruits are perishable goods. It needs proper preservation and processing for future consumption. But there are only a few fruit processing industries in the country. The picture is quite disappointing in northern part of the country. In Rajshahi, Chapai-Nawabganj and Dinajpur area a lot of quality mangoes are grown but due to lack of proper preservation facilities, a huge quantity of mangoes are perished causing great loss to our resources. This is also happening in case of other fruits in different parts of the country.

Steps to be taken

- Establishment of agroprocessing industries in the private sector with a focus on processing perishable commodities that have large export demands (such as pineapple, guava, mango, banana and jackfruit).
- Establishment of agroprocessing industries in the areas of raw material production (for example, Madhupur and Sylhet for pineapple; Swarupkati and Barisal for guava: Rajshahi for mango, and Dhaka and Mymensingh for jackfruit).
- Development of appropriate packaging systems for the transportation of raw materials to factory processing sites and also for transport and marketing of exportable products abroad.
- Development of adequate infrastructure for transportation of raw materials and finished goods from the production centers to processors and from there to the market –both domestic and foreign.
- Rationalization of tariff and duty to encourage export.
- Access to the institutional credit for establishment of fruit processing industries and provisions for working capital.
- Linkages with extension, research and financial institutions, and private entrepreneurs for developing appropriate types and varieties of fruits through contract growing systems.
- Exposure of the private entrepreneurs, bankers, policy makers, researchers and extension workers to the advanced production, processing and marketing systems related to fruit processing industries.

One estimate reveals that purchase and sale price of fruits and vegetables stored in the micro-cold-storages are as under:

Fruits/vegetables	Purchase price (Tk/KG)	Sale price (Tk/KG)

Grape	30-40	100-120
Apple	20-30	55-56
Orange	20-25	50-70
Mango	15-25	50-70
Pine Apple	3-5	15-20
Litchi	20-40	100-120
Black-berry	5	25-40
Banana	3-6	12-20
Papaya	1-2	10-15
Guava	4-6	15-20
Lemon	10-15	35-40
Jack fruit	3-5	12-20
Okra	3-4	10-20
Carrot	2-4	10-15
Pumpkin	2-3	8-15
Cucumber	3-4	10-15
Cauliflower	2-3	15
Brinjal	2-3	8-15
Cabbage	2	5-10

Note: Some of the stored fruits and vegetables can also be processed for more value-added food items during peak season and also during off-season. Part of the fruits and vegetables can also be exported at still better prices

g) Livestock

According to the 1983-84 Census, cattle population in Bangladesh stands at 21.49 million. Cattle holding is inversely related to the size of farm households-the smaller households have relatively larger number of cattle holding than the medium and large farm sizes. Important livestock products are as below:

Milk is processed on a commercial scale for production of pasteurized milk which is sold in sealed packets. Milkshake, cheese, butter, yogurt are made of milk. There are only a few milk processing plants in the country.

Necessary steps to be taken for promoting milk-processing centers:

- Linking the milk production zones with a central milk processing plant (for example, the 'Arong' milk processing plant of BRAC, Milk Vita - a plant run by milk producers' co-operative society)
- Establishment of chilling centers in milk production zones where milk is collected for transportation to processing centers through chilling vans.

Meat is the most important source of animal protein in the country. Chief sources

of meat are cows, buffaloes, goats and sheep, Hides of the slaughtered animals are one of the important export items of the country. Black Bengal goats have worldwide demand for its high quality leather.

Poultry entrepreneurs of Bangladesh can be grouped into micro and macro scale operators. The micro operators have a wide range of farm-size having 25 to 2000 birds, the average being around 1,000 birds. They include commercial layers, broilers and dual purpose birds. The micro poultry operator program is a good program. The macro operations can be classified as breeder farms, hatcheries, feed mills, commercial egg producers, large scale broiler or layer producers and poultry processing plants.

h) Fish

Fish is one of the most valuable food items of Bangladesh. Inland fisheries together occupy about 78 percent of total fish production, while the remaining 22 percent fish come from marine source. In recent years, the contribution of fish to the GDP increased to nearly five percent. Eight percent of total export earning comes from fish. Fish provides about 20 percent of the animal protein consumed by the nation. But unfortunately, though once abundant, fish has recently become a dear item. Among all the fishes, production and processing of shrimp have large potentials for expansion.

According to the World Shrimp Farming Report-1985, Bangladesh ranked 7th in shrimp production by aquaculture: Thailand (220,000 MT), Ecuador (100,000 MT), Indonesia (80,000 MT), China (70,000 MT), India (60,000 MT), Vietnam (50,000 MT) and Bangladesh (30,000 MT). The share of Bangladesh farmed shrimps constituted 4.21 percent of the total world production of farmed shrimps.

Potentials

Shrimp and prawns have been playing an important role as value addition activities in the economy of Bangladesh. In the coastal areas of Satkhira and Khulna districts, people make dykes or embankments along the banks of estuarine rivers and allow brackish waters carrying shrimp fry. or juveniles to enter wherein the shrimp would grow under natural conditions without any care, supplementary feed or stocking. As a result, production output has always been very poor. Shrimp production in the area rotated with paddy cultivation in a systematic manner. Bangladesh has developed a very impressive sea food processing and freezing industry over the last 25 years. There were only nine processing plants in the country with a total freezing capacity of f58 MT daily in 1971. From 1972 to 1976, only four plants with a combined capacity of 44 MT were commissioned.

The trend in installation of freezing plants has increased since 1977 and reached it climax during 1986-1989 period when 39 plants were commissioned in a three years period. During 1992 to 1997, another 26 plants were commissioned with freezing capacity of 507 MT/day. Thus, by 1997, there were 123 freezing plants with installed capacity of 1, 187 MT of which 698 MT was plate freezing, 393 MT was blast freezing and 96 MT was LQF products. The utilization capacity of the fish freezing plants is very low due to a lack of raw materials and the unwarranted growth of the industry.

Constraints

Shrimp as fish is perishable goods. This kind of fish is mainly produced for exports abroad as it is high priced. As a result, it is not commonly locally consumed. For exports, good and high quality of shrimps are to be produced for competing in the world market. But in our country some times producers/exporters cannot maintain world -class quality and standard due to lack of proper preservation and processing. Besides, there are lot of barriers in regard to transport and shipment.

Steps to be taken

- Bangladesh frozen food processing is mainly dependent on traditional block freezing of shrimp and prawns. Only 10 plants have entered into value-added products in the form of IQF, semicooked products,
- Value-addition in sea foods is the current requirement of developed nations like Japan, USA and Canada. Developing nations like Thailand, Singapore, Malaysia, South Korea, Saudi Arabia and Eastern European nations have also developed interest in the consumption of value-added seafoods.
- Value addition in the frozen foods sector is quite a new development in Bangladesh. It will be considered as a right step to increase export value of the frozen foods sector. Only five processing plants exported about 1,000 MT of value added processed foods in 1997-98. The share of value addition to frozen food exports was about 4.65 percent during that year.
- Exports of frozen foods (mainly shrimp) and other fishery products have been considered a non-conventional sector. In 1972-73, the export earnings from this sector was around US$ 3.06 million. It rose to US$ 37.04 million in 1979-80 and to US$ 147.75 million in 1989-90.

4. Recommendations Related to Agroprocessing Industries

- Agroprocessing units produce high quality food products using refined salt and sugar. Hence, import permission should be given for refined salt and high quality sugar for use in producing food products for export.
- A 50 percent exemption on the duty payable on imports to finished products in retail packaging from Bhutan should be either withdrawn or Bangladesh products should get a 50 percent duty exemption from the Indian and Bhutanese markets.
- One hundred percent export oriented agroprocessing industries which export the bulk of their production and use indigenous raw materials, should be allowed 100 percent tax exemption.
- To solve the problems of surplus horticultural produce, specialized storage facilities should be ensured across Bangladesh and specialized cargo facilities at different airports should be developed.
- To boost the horticulture and agroprocessing sector, VAT should withdrawn on local production and also on processed fruits and vegetables where the main materials are home grown.
- Under EPB or some other appropriate agency, a packaging institute specially for the agroprocessing sector should be set up.
- Activities of the recently formed agribusiness development Organization of Bangladesh (ADOB) should be geared up. The association should establish liaison with the proposed Agroprcessing Cells in The Ministry of Industries and Agroprocesing Credit Committee in the Ministry of Finance to assist in the identification of suitable entrepreneurs and promotion of agro-processing business.

Table-1 Value added agro-processing opportunities in Bangladesh

Fig. in lac

Item	Total production of Bangladesh	Location (production/ processing zones	Annual production (000 IVIT)	Processed products	Estimated no. of processing industries (small and medium scale: with 100 Ton capacity or more	Project Unit Cost	Total project cost.	Credit require-ment (60:40 debt equity ratio
Rice	19905	Rangpur, Kishoregong, Sylhet, Rajshahi, Jessore	3815	Whole grain milled rice fine & aromatic, doe bran & rice cake	30000	5	15000	9000
Wheat	1908	Uinajpur, Rangpur, Pabna, Rajshahi	983	Wheat flour bran etc.	3000	3	900	5400
Maize	250	Rangamati, Rangpur, Dinajpur, Bogra, Bandarbang, Rajshahi	150	Animal feed, concentrates for feed meals, maize flake	50	8	400	240
Oil seeds	448	FaFidpur, Dinajpur, Naokhali, Khulna	74	Oil, oil cake	500	10	5000	3000
Pineapples	146	Sylhet,Tangail (Modhupur), Rangamati HT, Chittagonj, Dhaka	117	Jam, marmalade, juice, sweet pungent pickles, sliced pineapples in syrup.	37	53	1962	1177
Guava	46	Dhaka, Barshal, Chittagong, Sylhet, Jessore	23	Jelly, juice and jam.	6	46	276	166
Jack fruit	267	Dhaka, Sylhet, Tangail. Kushfia, Rangpur	136	ck fruit candy and canning pods of jack fruit	19	60	1140	684
Lime and lemon	13	-S-y-l-het, Chittagong, Kushtia, Rajshahi, Rangpur	5	pickles, pulp and juice	3	56	168	160
mango	187	Rajshahi, Sylhet, Rangpur, Dhaka, Dinajpur,	104	Sweet pungent pickles, jam, green mango pickles, Mango juice drink.	30	53	1575	945
Banana	562	Barisal, Rangamab Ptuakhali, Faridpur, Rangpur	225	Banana chips, dried banana/other items.	19	62	1176	706

Item	Total production of Bangladesh	Location (production/ processing zones	Annual production (000 IVIT)	Processed products	Estimated no. of processing industries (small and medium scale: with 100 Ton capacity or more	Project Unit Cost	Total project cost.	Credit require-ment (60:40 debt equity ratio
Potatoes	2762	Dhaka, Comilla, Rangpur Bogra, Dinaipur	1766	potatoes chips, French fries, potatoes flakes	58	57	3317	1990
Cabbage cauliflower and other vegetables	195	Jessore, Khu lna, Rangpur, Dhaka, Comilla, Chittagong, Bogra,	95	Dehydrated vegetables, cauliflower pickles, pasta vegetable bake (pasta, tomato and cheese), fruit & vegetable drink.	11	59	650	390
Tomato	97	Chittagong, Dhaka, Comilla , Jessore, Sylhet	49	Tomato ketchup, tomato sauce	29	56	1625	975
Shrimp	88	Cox's Bazar, Khulna coastal belts, Satkhira.	62	Frozen foods	5	1716	8930	5360
White fish		Habiganj, Sunamganj, Chandpu and Barishal.		Frozen white fish	5	920	4600	2760
Poultry meat		Dhaka, Chittagong, Sylhet, Bogra		Frozen chicken and frozen chicken food, sausages, chicken sandwich, chicken burger, chicken breads	6	47	280	170
Mutton/beef		Dhaka,Joydebpur, Chittagang, Rajshahl, Pabna Mymensingh, Sylhet, Dinaipur		Processed mutton/beef and fast foods	16	17	270	160
Milk		Barisal, Dhaka, Manikganj, Sylhet, Pabna, Seragonjj		Pasteurized milk, ghee, cottage cheese, butter, baby food item	10	50	500	300
Mini cold storage (short term Vegetables/ Fruits processing)		Dhaka, Jessore, Norshingdi, Comilla, Faridpur, Mymensingh, Sylhet, Bogra, Rangpur, Rajshahi		Processing of onion, cabbage, carrot, cauliflower, tomato and other vegetables	10	88	880	530
Total					33914		48649	340

Source: 1999 Yearbook of Agricultural Statistics of Bangladesh

Table 2 : Rice processing devices in Bangladesh is shown below

	Milling Capacity of Different types of Rice Mills					
Type of Mill	Total No.	Installed Capacity (MT/week)	Actual Capacity (MT/week)	Period of Operation week/year	Potential Operation week/year	Remarks
Large automatic	25	336	202	16	29	60% running capacity
Chinese automatic	380	103	16	41	30	Running at 15% of installed capacity
Sub-total (improved technology)	405	-	-	-	-	
Engel-berg	100,000	91	30	24	43	33% of installed capacity
Grand Total	100,405	-	-	-	-	

Source: Survey report. FMPHT/BRRI, 1998.

Table 3: Production of major fruits by major producing region (1998-99)

('000' MT)

Fruit	Production ('000' MT)	Total production ('000' MT)	Percent of total	Major producing region
Banana	561	1,430	39	Barisal Rangamati, Patuakhali, Faridpur, Rangpur
Jackfruits	2	66	19	Dhaka, Sylhet, Tangail, Kushtia, Rangpur
Mango	187		13	Rajshahi, Sylhet, Rangpur, Dhaka, Dinajpur
Pineapple	146		10	Sylhet, Tangail, Rangamati HT, Chittagong, Dhaka
Melon	97		7	Rajshahi, Chittagong, Comilla, Barisal
Papaya	40		3	Dhaka, Jessore, Chittagong, Raishahi, Sylhet
Guava	46		3	Dhaka, Barisal, Chittagong, Sylhet, Jessore,
Total	1,343	1,430	94	

Source: 1999 Year Book of Agricultural Statistics of Bangladesh

Table 4: Production of important vegetables by major producing region (1998-99)

('000' MT)

Vegetables	Production ('000' MT)	Total production ('000' MT)	Percentage of total	Major producing region
Potato	2762	4218	65	Dhaka, Comilla, Rangpur, Bogra, Dinajpu
Radish	197		5	Comilla, Chittagong, Sylhel, Dhaka, Jessore, Rangpur
Brinjal	404		10	Jessore, Jamalpur, Rangpur, Rajshahi, Bogra, omilla
Aroid	96		2	Comilla, Barisal, Jessore, Khulna, Sylhel
Pumpkin	103		2	Comilla, Barisal, Jessore, Khulna, sylhet
Cabbage	115		3	Jessore, Khulna, Rangpur, Dhaka, Chittagong,
Tomato	98		2	Comilla, Chittagong, Dhaka, Jessore, Sylhet, Rangpur, Faridpur
Water Guard	84		2	Comilla, Noakhali, Dhaka, Barisal, Sylhet
Cauliflower	80		2	Comilla, Chittagong, Dhaka, Jessore, Rangpur, Khulna, Kushtia,
Total	3939	4218	93	

Source: 1999 Year Book of Agricultural Statistics of Bangladesh

References

Austin, J.E. (1983). Agro-industrial Project Analysis. John Hopkins University Press, Baltemore.

BBS (1999). Year Book of Agricultural Statistics. Bangladesh Bureau of Statistics, Ministry of Planning, Government of Bangladesh, Dhaka.

Ministry of Industry (1999). Industrial Policy 1999. Ministry of Industries, Government of Bangladesh, Dhaka.

Processing of Cassava for Improving Livelihood of Rural Communities*

Md. Shams-Ud-Din*
R.K. Talukder*

1. INTRODUCTION

Cassava (*Manihot esculenta* Crantz) root is an important dietary staple for possibly as many as 500 million people in the tropical countries of the world (Wenham 1995).The estimated world production of cassava is about 165.3 million tons from about 16.2 million ha (FAO, 1995). It is a native of tropical America from where it spread to other countries (Cock 1985). Cassava was introduced in this Subcontinent either by Portuguese during the 17 th century or brought from South America in 1840 (Srinavas and Anantharaman, 2000). Cassava is grown in about 95 countries of the world, and currently Nigeria, Brazil, the Democratic Republic of Congo, Thailand and Indonesia are the world's largest producers of cassava (Nair et al. 2000). Thailand is the largest exporter. In contrast, Africa doest not export much cassava because it is almost entirely consumed as food.

Increasing world population coupled with limited availability of energy in some countries has prompted a recent surge of interest in cassava, not only in its traditional forms as human foods and animal feed stuffs, but also for production of important industrial products such as normal and specialized starches, alcohol, glucose and other products. Cassava, mainly grown in diverse risk prone areas, plays a significant role in the livelihood of people living close to the subsistence level. As low cost energy producer, this crop has greater potential in meeting the food security of the small and marginal farmers. Farmers in Bangladesh are not aware of the importance of cassava and do not follow scientific production,

---

* The paper is derived from a report prepared under the REFPI project; Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh; funded by the DFID of the U.K.

** The authors are Professors, Department of Food Technology and Rural Industries, and Department of Agricultural Economics respectively of the Bangladesh Agricultural University, Mymensingh.

processing, preservation and management techniques. In Bangladesh, cassava is a neglected crop and is largely grown in Madhupur, Garo Hill and Chittagong Hill Tract areas.

Cultivation and marketing of cassava are mostly carried out by the poor tribal people, specially the tribal women in these localities. Cassava is a seasonal root crop and is available from late September to January. In Bangladesh, the estimated annual production is about 30,000 metric tons (Shams-Ud-Din 2002). Cassava, unlike potato and sweet potato, is subjected to rapid post harvest deterioration. Consequently the growers are bound to sell the crop at a very low price quickly after harvest and are deprived of the profit. About 20-30% of the total production of cassava is spoiled and wasted due to lack of post harvest storage, processing and preservation facilities in the growing areas. Introduction of appropriate and effective processing and preservation facilities in these localities to minimize post harvest losses is thus warranted. The local people eat cassava as boiled whole tubers like sweet potatoes. No other processed cassava products are available in the localities. Apart from rapid post harvest spoilage, another problem associated with cassava is that the cassava roots contain toxic component known as cyanogen. Thus the roots should be subjected to some form of processing, usually involving treatment by heat or fermentation before consumption in order to remove the toxic substances.

Processing of cassava into various value added products such as cassava flour, starch, breads, biscuits, cakes, rolls, toasts, vermicelli, chips, French-fries, pickles, sauces and animal feeds through development of small-scale enterprises have potential to increase income and improve livelihood of cassava growers (Shams-Ud-Din 2000). Moreover, increased utilization of cassava through processing into various products would ensure proper price of cassava to the farmers with resultant increase in yield and total production. This in turn will help improve the socio-economic status of the poor cassava growers. Many technologies are available on the processing of cassava elsewhere in the world. However, these are not suitable for direct adoption in Bangladesh due to socio-economic and cultural limitation. Further, due to least commercial intervention, the cassava is still to be available as different food products for commercial use in Bangladesh.

The purpose of this paper is to identify the production practices and utilization pattern of cassava, and examine the ways and means of increasing income generating activities of the rural poor through small-scale processing of cassava in a selected area of Bangladesh.

2. METHODS OF THE STUDY

This study was conducted under one of the component projects of the Research and Extension in Farm Power Issues (REFPI) program of DFID-Bangladesh. The duration of the project was 17 months starting from January 2002 and continued up to May 2003. During 1st phase of the project i.e. from January 2002 to December 2002 "Samannita Unnayan Seba Sangothan (SUSS)", Madhupur, District Tangail acted as the collaborating NGO of the project and during the 2nd phase i.e. from January 2003 to May 2003 'Bekar O Bettahin Samaj Unnayan Sangstha' (BBUS), Jalchatra, Madhupur, District Tangail was involved with the project as the 2nd collaborating NGO. The collaborating NGOs were committed to run the project by utilizing developed technologies, trained personnel and equipment/machineries after the expiry of the project. A Participatory Rural Appraisal (PRA) to assess the 'Potential of cassava processing in Madhupur Upazila' was conducted in Jalchatra, Pirgacha, Jainagacha, Beduria and Sadupara villages under Madhupur Upazila of Tangail District in January 2002.

2.1 Establishment of Cassava Processing Centres

Two cassava processing units were established each at the field sites of the collaborating NGOs located at Jalchatra and Dokhola of Madhupur Upazila. The units were equipped with brick-made baking oven (*Tondur*), locally fabricated cabinet drier, various bakery accessories and other low-cost food processing equipment. Each *tondur* had the production capacity of about 150-200 kg of bakery products per day. The purpose of the centres was to provide necessary training to the cassava farmers on cassava processing and manufacture of various value added cassava products through procuring raw cassava directly from the farmers. The concerned NGOs took the responsibility for marketing the processed cassava products.

2.2 Research on Product Development

Different formulations and processes for production of various value added cassava products were developed in the laboratory of the Department of Food Technology & Rural Industries of the Bangladesh Agricultural University, Mymensingh (BAU). The most important cassava-products developed were: dried chips, flour, breads, biscuits, cakes, rolls, crackers, vermicelli, fried chips, French-fries, candies, pickles, sauces, starch, sago and others. The composition analysis of the raw cassava and sensory evaluation of the products developed were also performed.

2.3 Skill Improvement Training

During the 1st phase of the project a training course on cassava processing was conducted in two batches for six days each at the field site of the SUSS in Jalchatra, Madhupur. Each batch consisted of 15 trainees of which 10 were female and 5 were male. During the 2nd phase of the project another training course was organized in two batches for 3 days each at the field site of the collaborating BBUS located in Dokhola of Madhupur Upazila. Each batch of the training progamme consisted of 15 trainees of which 10 were female and 5 were male. Necessary arrangements were made for regular field visits in the processing site and for technical supports in the field as per requirement. Seminar/workshop to share the experiences of the visits to cassava processing centres were also arranged.

3. PRODUCTION PRACTICES AND ECONOMIC IMPORTANCE OF CASSAVA PROCESSING

3.1 Production Practices of Cassava

3.1.1 Climate, Soil and Planting Season

Cassava grows better in warm and humid climate with well distributed rainfall. It can tolerate drought and grows on all types of soil; but saline, alkaline and ill-drained soils are not suitable. Cassava grows best on light sandy loams or on loamy sands which are moist, fertile and deep; but it also does well on soil ranging in texture from the sands to clays and on soils of relatively low fertility (Srinavas and Anantharamn 2000). In Bangladesh, it grows best on red clay soil of Madhupur region. Cassava can be planted at any time of the year, if grown as irrigated crop, but in Bangladesh it is usually planted in December-January.

3.1.2 Methods of Planting

Cassava can be planted using mound, ridge and flat method. However in Madhupur region the flat method is usually practiced. Cassava is propagated exclusively from cuttings. Cuttings are obtained from the stems of plants at least ten months old and 2-3 cm diameter. After harvesting, these stems are stored in a dry place until the next planting. Cuttings about 15-20 cm long are taken from the lowest 75-150 cm of the stem after the first 20 cm have been discarded. Cuttings from the upper part of the stem grows faster, but their final yield is less. The cuttings are planted in prepared land by hand vertically to 5 cm depth giving 75 X 75 cm spacing. Mechanical planters are also used elsewhere (Grace, 1977). The number of plants per hectare varies between 10,000 and 15,000. Fertilizers @

50:25:50 kg/ha urea, super phosphate and muriate of potash are usually applied in split doses. But for high yielding varieties the fertilizers may be as follows: NPK @ 100:100: 100 kg/ha with farm yard manure 12.5 t per ha (CTCRI, 2000). Water is essential until the plant is well established. In moist soil, sprouting takes place within the first week after planting.

3.1.3 Harvesting

The crop is harvested after 9-10 months of planting. With proper application of fertilizers the yield of cassava varies from 20 to 40 t/ha depending on the varieties. In Madhupur region the yield of cassava tubers range from 10-12 t/ha. Cassava crop is harvested by lifting the tubers from the soil. The soil around cassava stem is dug by a spade and the plant is then uprooted. The crop can also be harvested mechanically. The harvesting tools such as first order lever and second order lever type are used in many cassava producing countries (Balagopalan, 2000). The number of tuberous roots and their dimensions vary greatly among the different varieties. The roots may reach a size of 30-120 cm long and 4-15 cm in diameter, and a weight of 1-8 kg or more.

3.1.4 Cost of Cultivation and Return from Cassava

Information collected from farmers included cost of cultivation of cassava, for which the details are presented in Table 1. Total cost of Tk. 16,050 per hectare was incurred for cultivating cassava in Madhupur region. Labour component accounted for 77.26% (Tk. 12,400) of the total cost of cultivation, while material cost accounted for 22.74% (Tk. 3,650). About Tk. 1,337.50 was incurred for production of one ton of cassava tubers. Gross returns (@ Tk. 4,000 per ton), considering only tubers at an average yield of 12 tons per hectare, was Tk. 48,000. Thus farmers' net benefit was Tk. 31,950 from one hectare of cassava cultivation. The Benefit-Cost Ratio of cassava production was 2.99 (Table 1).

Table 1: Cost of cultivation and return from cassava (Tk. per hectare)

Activity/Item	Input	Quantity	Unit cost (Tk.)	Total cost (Tk.)
1 .Land preparation	Country plough	3 times	500	1,500
2. Planting materials	Stem cuttings	10,000	0.25	2,500
3. Plantation of stem cuttings	Labour	60 No.	50	3,000
4. Weeding	Labour	50	50	2,500
5. Fertilizers	Urea	50 kg	7	350
	TSP	25	12	300
	MP	50	10	500
	Labour	4	50	200
Sub-total:	-	-	-	1,350
6. Harvesting	Labour	80	50	4,000
7. Carrying	Van fares	12 tons	100	1,200
Gross cost of cultivation(A):	-	-	-	**16,050**
Total yield of cassava: **12 tons**				
Gross returns, @ Tk.4,000 per ton (B):	**Tk. 48,000**			
Net returns:	**Tk. 31,950**			
Benefit-Cost Ratio (B/A):	**2.99**			

3.2 Economic Importance of Cassava Processing

Cassava provides a major source of calories for poor families, because of its high starch content. With minimum maintenance, the farmers can dig up the starchy root of the cassava and eat it 6 months to 3 years after planting. Thus, people can cultivate cassava during times of war or natural disaster when no other food is available. In Africa, people also eat the leaves of the cassava as a green vegetable, which provides a cheap and rich source of protein and vitamins A and B (Bruinsma et al. 1985). Cassava is also cultivated for animal fodder. In many cassava growing countries, the crop is used as partial substitution for wheat flour, thus providing income to resource-poor farmers and saving foreign exchange for national governments.

Fresh cassava roots cannot be normally stored without spoilage for more than a few days after harvest. To overcome this difficulty in the marketing and utilization of cassava and to avoid heavy post harvest losses (20-30%), the roots need to be processed into shelf-stable products. Cassava is very cheap as compared to cereals

and pulses, other root and tuber crops such potato, sweet potato, yams, aroids and others.

Cassava tubers being rich in starch, is an important subsidiary food. It forms a raw material for starch and sago industry, and is a component of animal, fish and poultry feeds. Cassava starch has more purity than potato or maize starch, the tubers being practically free from non-starchy constituents such as protein and lipids and the extraction is easier and direct. Thailand and India are the major exporters of cassava starch in the international market where it is used as filler materials in paints, medicine and health drinks. Moreover, the starch and the products derived from it are used extensively in the food, brewing, pharmaceutical, paper, textile and adhesive industries. Recently it has found place in the manufacture of biodegradable plastic. It is processed into food products like flour, breads, biscuits, cakes, toasts, crackers, chips, sago, vermicelli, pappads, candies, pickles, sauces etc. Technology has been developed for economic production of alcohol from cassava tubers. Dried cassava chips are frequently used for the preparation of flour which is consumed in the same manner as rice. It also forms a major component in many animal feeds. Native and modified starches are important raw materials for many industrial uses such as in food processing, textile and adhesive manufacturing and in oil drilling industry. Starch is also raw materials for producing many derived sugar products, such as glucose, fructose, malto-dextrins and manitols, each of which has specific properties and uses in food, chemical or pharmaceutical industries (Balagoplan et al. 2000; Srinavas and Anantharaman, 2000). In industry it serves as a raw material for manufacturing starch, dextrin, glucose and ethyl alcohol.

Although nutritionists consider cassava an ‘inferior’ crop because of its low protein content (Table 2), it is advantageous to the producers and consumers for the following reasons (Bruinsma et al. 1985): (a) It is the most remunerative crop plant in the hot climates, yielding perhaps more starch per hectare than any other cultivated crop with a minimum labour (b) It has a high biological efficiency in the production of edible matter. In cereals a large part of the energy from photosynthesis is needed for building stalks to support the grains, whereas in roots and tuber crops such as cassava, there is no such requirement. Only 36-50% of the total plant mass of cereals is edible while 63-85% of root and tuber crops can be consumed by humans; and (c) Cassava is principally an energy provider and in many production areas it is considered a typical reserve food crop.

Cassava has a number of attributes that have made it an attractive crop for small farmers with limited resources in marginal areas. The attributes are: (a) It is one of the most efficient carbohydrate-producing crops; (b)It is tolerant of low soil fertility and drought; (c) It has the ability to recover from the damage caused by

most pests and diseases; (d) The roots can be left in the ground for long periods as food reserve and, thus, provide an insurance against famine; (e) The crop is well adapted to traditional mixed cropping agricultural systems and subsistence cultivation in which farmers seek to minimize the risk of total crop failure; and (f) Cassava is one of the most efficient producers of starch, which constitutes about 85% of the storage root tissue dry-matter content.

Table 2: Composition (per 100 gm edible portion) of some cassava products in comparison to other staple foods*

Components	Fresh tubers cassava	Cassava flour	Rice (Milled)	Potato
Water (g)	60	12	12	80
Energy (kJ)	658	1470	1522	322
Protein (g)	0.7	1.5	7.0	2.0
Fat (g)	0.4	0.01	0.5	0.1
Total Carbohydrate (g)	37	84	80	17
Fibre (g)	1.0	1.5	0.2	0.4
Starch (g)	28 – 32	-	-	-
Sugar(g)	3 – 5	-	-	-
Ash (g)	0.4 – 0.6	-	-	-
Thiamin (Vit.B_1) (mg)	0.07	0.04	0.06	0.1
Riboflavin (Vit.B_2) (mg)	0.03	0.04	0.03	0.03
Nicotinamide (mg)	0.7	0.8	1.0	1.5
Vitamin C (mg)	30	-	-	15
Calcium (mg)	8	55	5	10
Iron (mg)	1.0	2.0	1.0	0.7
Vitamin A (I.U.)	-	-	-	-

*Source: Leung et al. (1972)

The cassava roots are rich in carbohydrates (mainly starch) but they are low in protein, fat and mineral contents. However, the cassava roots, in comparison to rice and potato, contain higher amounts of Vitamin C, riboflavin (Vitamin B_2), iron, calcium and fibre (Table 2). As cassava is inferior in protein content to both rice and potato, animal or plant protein products are often used to balance the diet in cassava-consuming countries. Cassava tuber is known to contain antinutrient factor, cyanide (Padmaja, 1995; Cooke and Coursey, 1981; Cutting, 1978). Fortunately, the various processing steps involving treatment by heat or fermentation before consumption remove most of this toxic substance from the cassava roots.

4. PROMOTION OF CASSAVA PROCESSING ACTIVITIES

4.1 Participatory Rural Appraisal (PRA) Survey

A Participatory Rural Appraisal (PRA) to assess the potential of cassava processing in Madhupur Upazila was conducted in Jalchatra, Pirgacha, Jainagacha, Beduria and Sadupara villages under Madhupur Upazila of Tangail District in January 2002. A total of 9 PRA tools were used to collect information on existing cropping systems, time line of cassava production, productivity and fertilizer use, pattern of different crops etc. Wealth ranking was assessed by the participants considering the size of land holdings. Farmers of all five villages were categorized into three categories like rich, medium and poor. The Venn diagram of five villages showed that farmers used to get different information from the Missionaries. While the Caritas and World Vision provided education and health care services to the villagers, and the Directorate of Agricultural Extension provided services relating to crop production through the Block Supervisors. A total of 200 participants, 40 from each village participated in the PRA. The major findings of the PRA in relation to potential of cassava processing were as follows:

- The cultivation of cassava, for family consumption, started since 1948 by the tribal people of the locality with *jhum* cultivation;
- The local people used to eat cassava only by boiling the roots like sweet potato;
- Since 1971-72, farmers started to grow cassava commercially and used to supply cassava on contract basis to Messrs Rahman Chemicals Ltd., Dhaka for manufacture of starch from cassavas. However, this company subsequently stopped buying cassava from the farmers for unknown reasons. Consequently growers stated losing interest to grow cassava in large scale and the crop was gradually being replaced by pineapples, ginger, aroid, banana and sugarcane.
- Four varieties of cassava were available in the region and these were *Philippine, Nagra, Red* and *White* varieties. The highest yield was achieved with the *Philippine* variety of cassava followed by *Nagra, White* and *Red.* In terms of taste, the most popular variety was *Nagra* followed by *Philippine, White* and *Red variety.*
- The average highest yield of cassava was found to be about 12 ton per ha while the lowest average yield was about 8 tons per ha.

- The costs and returns of cassava , aroids, ginger and pineapples were calculated and it was found that the highest Benefit-Cost Ratio was obtained with ginger (3.22), followed by cassava (2.99), aroids (1.14) and pineapples (1.12).
- The farmers, mostly the tribal people, grow cassava for their family consumption in Madhupur region and a good number of farmers sell fresh cassava in the local markets in excess of their requirements for family consumption;
- Most farmers are interested to grow cassava on commercial basis if the facilities for marketing, storage and processing are available in the localities;
- Cassava appears to be the most economical and lowest risk subsistence crop for small farmers. However, the most striking problem associated with the utilization of the cassava is that the crop spoils very rapidly after harvest (within 2-3 days) and this calls for quick processing;
- Local people showed interest to increase their income generating activities through production and marketing of various value added cassava products on small scale basis;
- Literate and illiterate male and female youths showed interest for being trained on cassava processing.

4.2 Processing of Cassava Products

The various cassava-based food products (Table 3) were developed during the period of research on products development as well as during training programme of both phases of the project. Production of all these value added products involved simple equipment, recipes and procedures. In order to prepare various bakery products, the cassava flour was first produced using simple technology and forty percent of cassava flour was mixed with sixty percent of wheat flour in formulations of different bakery products such as breads, cakes, biscuits, soft rolls, toasts etc. The bakery products were manufactured with the help of brick-made baking ovens (*Tondur*) constructed one at Jalchatra and another at Dokhola in Madhupur Upazila. Most of the products were highly appreciated by the trainees and local people. The collaborating NGOs, SUSS and BBUS made all arrangements for selling the cassava products through their sales-agents In

addition to various bakery products other products like fried chips, French-fries, pickles, sauces, starch, sago etch were also processed from cassava.

Table 3: The products developed from cassava

Sl No.	Name of the Products	Sl No.	Name of the Products
1.	Dried Cassava Cubes	12.	Cassava French-fries
2.	Dried Cassava Slices	13.	Cassava Vermicelli
3.	Cassava Flour	14.	Cassava *Chanachur*
4.	Cassava Breads	15.	Cassava Candies
5.	Cassava Cakes	16.	Cassava Pickles in Oil
6.	Cassava Sweet Biscuits	17.	Cassava Sweet Pickle
7.	Cassava Cracker/Salted Biscuits	18.	Cassava Chutney
8.	Cassava Toasts	19.	Cassava Sauce
9.	Cassava Soft Rolls (Buns)	20.	Cassava Starch
10.	Dried Cassava Chips	21.	Cassava Sago
11.	Fried Cassava Chips	22.	Animal Feeds from Cassava

4.3 Procurement of Cassava and Value of Cassava Products: Some Evidence

During the 1st phase of the DFID supported project, the collaborating NGO SUSS procured 2,000 kg. fresh cassava from the farmers during the periods from May to June and from October to December 2002 respectively. These cassava roots were processed to produce 710 kg. of cassava flour by the NGO. Forty percent of cassava flour was mixed with sixty percent of wheat flour for production of various bakery products such as breads, cakes, biscuits, soft rolls, toasts etc. Thus 710 kg. of cassava flour was used with 1,065 kg. wheat flour to make a total of 1,775 kg. cassava-wheat flour mixture, and the production of various bakery products from this cassava -wheat flour mixture was about 4,000 kg. Total production of various bakery products (with or without cassava flour) was about 22,000 kg during the period from June to December 2002 for which the total value was about Tk. 880,000 (Table 4.)

Table 4: Procurement of cassava, production of cassava flour and sales proceeds of the bakery products*

Collaborst	Reporting period	Quantity of raw cassava procured (kg)	Producti on fo cassava flour (kg)	Production of cassava flour based bakery products (kg)	Value proceeds cassava flour based bakery products (kg)	Productio of wheat flour based bakery products (kg)	Total psroduc tion of bakery bakery products (kg)	Total value (Tk.)
SUSS: Samannita Unnayan Seba Sangothan	May 2002 to December 2002	2,000	710	4,000	160,000	18,000	22,000	880,000
BBUS: Bekar O Bettahin Samaj Unnayan Sangstha	February 2003 to March 2003	150	50	280	11,200	500	780	31,200
TOTAL:	-	2,150	760	4,280	171,200	18,500	22,780	911,200

* The major bakery products include: Breads, cakes, sweet biscuits, salted/cracker biscuits, soft rolls (Buns), toasts, vermicelli, *murali* etc.

** Formulations contained 40% cassava flour and 60% wheat flour

During the 2nd phase, the other NGO BBUS procured 150 kg. fresh cassava from the farmers during the periods from February to March 2003. These cassava roots were processed to produce 50 kg. of cassava flour by the NGO. Forty percent of cassava flour was mixed with sixty percent of wheat flour for production various bakery products such as breads, cakes, biscuits, soft rolls, toasts etc. Thus 50 kg. of cassava flour was used with 75 kg. wheat flour to make a total of 125 kg. cassava-wheat flour mixture and the production of various bakery products from this cassava - wheat flour mixture was about 280 kg. Total production of various bakery products (with or without cassava flour) during the period from February to March 2003 was about 780 Kg, valued at about Tk. 31,200. The management of the NGOs SUSS and BBUS made all arrangements for selling the cassava products through their sales-agents. Total production of various bakery products during phase I and II of the project was 22,780 kg with sales proceeds of Tk. 911,200.00 (Table 4.).

5. MANPOWR DEVELOPMENT AND LIVELIHOOD IMPROVEMENT

The following achievements were made centering round the cassava production and processing activities:

a. Sixty rural unemployed poor were trained in cassava processing – availability of trained manpower in cassava processing thus increased particularly in the production of cassava-based bakery products.

b. Income generation activities increased among the poor. A good number trained farmers showed interest for production of cassava-based value added products at small scale level. Different cassava-based food products specially bakery products were being manufactured and made available in the local market.

c. Utilization of cassava increased. The cassava farmers were benefited as they were getting better price. The collaborating NGOs procured 2,150 kg cassava from the farmers, produced 760 kg cassava flour and finally manufactured 4,280 kg cassava-flour based various bakery products worth Tk. 171,200.

d. Employment opportunity increased for local people. The collaborating NGO employed 16 staff including 5 cassava processing technicians, 7 sales-agents, 2 production supervisors, 1 Cashier-cum-accountant and 1 peon-cum-guard.

e. It has been demonstrated that there is a good prospect of home-based small-scale processing of cassava for production of value added cassava products in the Mahupur Upazila. Selection and demonstration of low cost cassava processing equipments for value added products have definitely encouraged farmers to set up small scale or household based cassava processing units to improve their livelihoods by adopting various cassava processing activities.

6. CONCLUSIONS

It has been evident through this investigation that cassava processing can make substantial value addition and thereby can contribute to development of livelihoods of the people of less developed areas, inhabited particularly by the tribal communities. Thus the production and processing activities can be geared to address livelihood development of selected target communities for whom cassava production and consumption has been an age-old practice.

The strategy for expansion of cassava production and processing should be based on linking the small scale producers with small scale processing activities. Decentralized small scale processing is an important strategy to resolve the problem of minimizing transport cost and post harvest deterioration of the bulky and low-cost crop like cassava.

The new entrepreneurs should be encouraged through provision of low-cost credit to develop/procure essential cassava processing equipment, especially the cassava chipping machine, peeling knives and pelleting machine. Besides, improved cassava processing technologies should be disseminated to farmers and small-scale food processors, and the products should be promoted among the target consumers by organizing food fairs and advertising through mass media.

References

Balagopalan, C. (ed). 2000. Integrated technologies for value addition and post harvest management in tropical tuber crops. Publisher: Central Tuber Crops Research Institute (CTCRI), Trivandrum 695 017, Kerala, India.

Bruinsma, D.H., Witsenburg W.W. and Wurdemann,W. 1985. Selection of technology for food processing in developing countries. Pub.: Pudoc Wageningen, Netherlands.

Cock, J.H. 1985. Cassava: New potential for a neglected crop. Westview Press, Colorado.

Cooke, R.D. and Coursey,D.G. 1981. Cassava - A major cyanide containing food crop. in: Cyanide in Biology. Academic Press. New York. 93-105.

CTCRI,2000. Tuber crops varieties released by the Central Tuber Crops Research Institute (CTCRI), Technical Bulletin Series No. 24, Trivandrum, Kerala, India.

Cutting, W.A.M. 1978. Cassava - a valuable food but a possible poison. Trop. Doc. 8: 102-112.

FAO 1995. Food and Agricultural Organization of the United Nations Production Year Book. 44: 94-98.

Grace, M.R. 1977. Processing of cassava. Publisher: FAO, Rome. FAO Agricultural Services Bulletin No. 8.

Leung, W. L., Butrum, R.R. and Chang, F.H. 1972. Food composition tables for use in East Asia. FAO of the UNO, Food Policy and Nutrition Division, Rome, Italy.

Okezie,B.o and Kosikowski,F.V. 1982. Cassava as food. DRC Crit. Rev. Food Sci. Nutr. 17: 259-270.

Padmaja,G.1995. Cyanide detoxification in cassava for food and feed uses. Critical Review in Food Science and Nutrition. 35 (4):299-339. CRC Press Inc.

Shams-Ud-Din, Md. 2002. Training manual on cassava processing. Dept. of Food Technology & Rural Industries, Bangladesh Agricultural University, Mymensingh. Published by: REFPI Project of the DFID -Bangladesh.

Shams-Ud-Din, Md. 2000. Processing and preservation of cassava. Dept. of Food Technology & Rural Industries, Bangladesh Agricultural University, Mymensingh. A Research Project Report: Sponsored by Bangladesh Agricultural University Research System (BAURES).

Srinivas, T and Anantharaman, M. (eds.). 2000. Status of cassava production, processing and marketing in Andhra Pradesh. Publisher: Central Tuber Crops Research Institute (CTCRI), Trivandrum 695 017, Kerala, India.

Wenham, J.E. (ed.). 1995. Post-harvest deterioration of cassava: A biotechnology perspective. Natural Resources Institute (NRI), UK. Publisher: FAO, Rome. FAO plant production paper No. 130.

Market-led Initiatives for Seed Production and Product Processing in Bangladesh

Lutfur Rahman*
Samina Luthfa*

1. INTRODUCTION

The growth of the market-oriented agriculture is dependent on the sustainable growth and development of an organized production, processing and marketing system. The farmers are usually not organized as groups of specialized agricultural producers. Therefore, the producers of different agricultural products need stable markets to sustain production using more and more advanced technology. In organizing the agribusiness aiming at sustainable development of agriculture one has to plan for organized production of the commodity within an appropriately diversified production system (Rahman, 1977, 1995, 2001). This will help development of a processing and marketing system for a product in any given area with ensured price.

Agricultural production system is highly dependent on quality seeds. This is the sub-sector where we are in extreme disorder and totally dependent on a concept that importation of seeds can do the best, a concept that does not support the agricultural production system of Bangladesh in the years to come. It is possible to have this sector organized to help development of sustainable agriculture in Bangladesh. We have a very resourceful plant genetic base in this country, which are eroding fast due mostly to unplanned development of infrastructures, houses, population pressure, over exploitation of plant species for medicinal business, etc.

With the spread of high yielding varieties of crops, a market for improved quality seed has emerged. Side by side with the growth of seed trade in the private sector, farmers took up production of quality seeds in response to market demand. Despite notable initiatives towards seed production at a commercial scale, farmers face constraints in respect of processing, preservation and marketing of seed. Lack of quality control and efficient seed certification arrangements often put the

* The authors are respectively Professor, Department of Genetics and Plant Breeding, and Lecturer, Department of Rural Sociology, Bangladesh Agricultural University, Mymensingh.

farmers at disadvantage. Farmers do not necessarily get higher prices for better quality seeds. This paper attempts to discuss the seed development issues with emphasis on farmers' initiatives to take up seed production and plant nursery development as commercial ventures. The paper also discusses the issues related to processing of soybean, a high value oilseed crop that has huge market potential.

2. SEED BASE AND THE BUSINESS

There are more than 163 cultivated crop species in Bangladesh (Rekhi et al. 1996), the seeds of which are in fact very important ones in the system of production. The yields and the quality of the agricultural commodities are highly dependent on the quality of the seeds, be that a plant variety, or a tree species or livestock and poultry birds or the fish species. The crop seed production and supply in Bangladesh as shown in the Table 1 clearly indicates that there is high demand and very low supply of high quality seeds of the varieties under cultivation, with exceptions to imported seed items of vegetables and high input crops like maize, and hybrid rice. The issues of sustainable development of agriculture do consist of development and maintenance of different varieties of crops in different areas of the country as practiced in China. The demand and supply situation indicate that the scope for organized business with quality seed production and marketing even at regional level is high provided effective monitoring of the market is done as per seed rules and laws of the country.

The basic problems in seed production, processing and marketing in Bangladesh are that the production system is not organized, the contract growers are not trained as required, the private sector companies and traders lack commitment of maintaining quality, dealers control the quantity in the market thereby the price of the seeds and packaging are not appropriate. There is no protection for the farmers against any unscrupulous activities of the seed dealers or companies. Moreover, government has no effectively organized control systems for seed market price, general product price and purchase system after the harvest. These result into low price of the products produced using high price seeds as well as inputs and labour. Considering these issues the farmers need to save and their own seeds for four major reasons. These are:

(i) They know the variety, the characteristics of the seed, their own system of processing and preservation and they also know that it may be difficult to get such quality seeds from the market at the time of their sowing.

(ii) The organized competitive seed markets have not been developed, so the price and the variation in quality found during the sowing season could cause difficulties in getting seeds of the crop for which they have planned

(iii) During sowing season they can market the extra quantity of their seeds for a good price.
(iv) The low seed replacement rate is also due to the lack of availability, affordability and accessibility of high-quality, dependable seeds.

A large portion of the agricultural population of Bangladesh is directly and indirectly involved in the seed production and marketing system. There are farmers producing seeds for own use, for BADC, NGOs and Private companies as contract growers. Therefore, many of the farmers do know about the seed crops, their production and processing systems. It is interesting to note that when the farmers use their own seeds or sell their seeds to relatives / neighbours, the germination is better and the crop is good than when seeds from the general markets are used (Rahman et.al., 1992). In a study of BRAC (Hossain et al, 2002), it was observed that the rice yield of 5.5 tons/ha was obtained with the farmers' saved seeds while yield from private company seeds, BADCs seed, DAEs seed and fellow farmers' seeds were 5.24, 5.86, 5.23 and 5.6 tons per ha. This indicates that the farmers own saved seeds are in no way less productive than those of others. Then why not we train more farmers to produce high quality seeds for their own use and encourage development of small-scale seed market within their neighbourhoods.

3. PRIVATE SEED INDUSTRY DEVELOPMENT ISSUES

The private seed sector needs to grow faster so that it can play a major role not only in producing and marketing quality seeds to satisfy the demand (Table 1), but also in conducting seed-related research and development activities in Bangladesh with participation of the farming community. It is a challenge for any country to develop a demand-driven seed industry capable of timely production and marketing of a perishable product such as seed. But for Bangladesh, the challenge is even more complex than in developed countries. Here, seed industry pioneers face many problems like:

i) A hot and humid climate, usually not suitable for quality seeds of many varieties/crops.
ii) Land fragmentation, which limits the amount of large agricultural landholding available at the private level.
iii) A lack of contract growing groups with capabilities of growing quality seeds on their own.
iv) Inadequate govt. policies for supporting seed processing and marketing groups.
v) Dominance of economically disadvantaged small and medium farmers, and sharecroppers in the farming community.

Table 1: Total quantity of seed need of different crops, quality seed supply and recommendation for supply for 2003-2010 (Task force report 2003)

Sl. #	Crops & Ecotypes	Acreage* 000	Total Demand Seed (Toal)*	Total seed supplied (T)*	Supply as % of demand	% Seed supply recommended
1	Rice Total	10243	434340	12518	**2.89**	4-8
	Modern Varieties	5832	174960	12518	**7.16**	8-15
	Aus Total	1495	117790	633	**0.54**	1-2
	Modern Varieties	453	13590	633	**4.66**	5-10
	Aman Total	5627	222920	5416	**2.43**	3-7
	Modern varieties	2503	75040	5416	**2.71**	9-16
	Boro Total	2131	93630	6469	**6.91**	8-78
	Modern Varieties	2876	86280	6469	**7.49**	9-20
2	Wheat	786	94320	19758	**20.95**	22-26
3	Maize	9	270	800	**185.17**	100
4	Jute	486	3888	963	**27.06**	30-48
5	Oilseeds	511	11609	301	**2.59**	4-8
	a. Mustard/Rapeseed	338	6760	152	**2.25**	3-5
	b. Sesame	71	567	2	**0.35**	1-2
	c. Linseed	56	672	0	**0.00**	1-2
	d. Groundnut	35	3500	105	**2.99**	5-12
	e. Sunflower	-	110	22	**20.00**	70-100
6	**Pulses**	**655**	**25740**	**335**	**1.30**	**1.4-2.0**
	a. Grass pea	221	8840	0	**0.00**	0.05-0.10
	b. Lentil	198	5940	60	**1.01**	1.34-1.85
	c. Chickpea	71	2840	36	**1.27**	2.0-2.8
	d. Black gram	57	1710	14	**0.82**	1.57-2.63
	e. Mung bean	55	1650	22	**1.33**	2.42-3.90
	f. Field pea	18	1250	3	**0.24**	0.30-0.40
	g. Soybean	35	3500	125	**3.57**	4-5
7	**Vegetables**	**509**	**1923**	**814**	**42.31**	**50-65**
	Total true seeds		572090	36550	**6.39**	7-11
8	**Potato Total**	**178**	**231608**	**9969**	**4.41**	**6-17**
	Modern varieties	107	160344	9969	**5.94**	9-24
9	**Sugarcane Total**	**174**	**850000**	**206000**	**24.23**	**25-32**
	a. Mill Zone	94	45000	205740	**4572**	41-56
	b. Non-Mill Zone	80	400000	260	**0.07**	0.75-2.0
	Grand Total		**1653698**	**252569**	**15.28**	**16-30**

*All data are based on the average of 5 years from 1995 to 2000)

Some of the challenges can be addressed directly; others will require some intermediate development activities. For example, farmers can be provided with training in high quality seed production technology, and can be organized by

private seed industries to become contract seed producers. But individuals, groups and NGOs trying to produce and market quality seeds are doing their works in isolation leading to questionable quality and aiming at variable profit margins. They will need to be brought under one national organization having capability to monitor and control quality. This will coordinate the collective efforts of the companies involved in the seed business along with extending help to plan and execute the programmes of quality seed replacement system. Otherwise, the possibility of low quality - high priced seeds inundating the market cannot be avoided.

It appears that the development of a true private sector seed industry from a collection of seed trading houses is taking long time since the process began in 1990, when a new seed policy was developed and adopted in 1993 to liberalize the regulatory environment surrounding private seed production and marketing. So, the Seed Industry, as we call them, still consists mostly of traders who import high-value low-volume seeds in large quantities and sell them in the market with high profits. This they do considering that the farmers' seed base is likely to remain the biggest source of crop seeds for some more years to come. This attitude is creating dependence on imported seeds. This is why an effective planning for establishing a successful seed business in Bangladesh is necessary. Any business venturing to establish and develop a stable market niche in the seed industry in Bangladesh will need careful study and monitoring of the seed base, and develop a well-defined variety replacement schedule using the techno-managerial knowledge and skills. Based on the situation prevailing now, the following support will be needed to encourage investment in private seed industry development:

i) Land leasing
ii) Longer tax holidays
iii) Maintenance of Plant Genetic Resources (PGR)
iv) Support for plant variety rights as per rules framed by Bangladesh
v) Support for breeders' and foundation seeds
vi) Support for research and development of production technologies
vii) Support of public sector experts for advancing the technology even by using Biotechnology
viii) Organizing training on seed technology
ix) Promotional activities on seed use for farmers
x) Support for visits to other countries to get experience for stages of development
xi) Support for establishing effective linkage between farmers and market for product marketing at good price to help stable seed demand.

For a number of years there have been a number of donor-supported and loan-funded programmes to support seed industry development in Bangladesh. Many of their activities are complementary, however, some avoidable duplications of effort exist. There is no organized center through which the information on seed sector industries can be obtained. To avoid these gaps the government has very recently established 'seed industry development project' with support from the DANIDA. This programme is required to help understanding the needed activities in developing an appropriately designed Private Seed Industry with capabilities of effective technical, managerial and physical facility to serve the seed sub-sector. But any attempt of developing seed industry and not helping better price of the products or ensured market at fixed price will not stand the test of time.

4. WHY FARMERS' SEED?

The Bangladeshi seed industry is evolving within the context of a traditional agrarian society. Ninety-four per cent of the seeds used for crops are collected, processed and preserved at the household level. Unfortunately, many of the traditional methods used not only fall below the commercial production standards, but are also sometimes deleterious to the farmers' own crops. The overall quality of seeds has been deteriorating over time. The Bangladesh government has been aware of the need for organized seed production, processing, storage and marketing of quality seeds. They have been trying for the past 30 years through BADC to find ways to ensure the wider availability of high quality seeds at a reasonable cost. Bangladesh Agricultural Development Corporation (BADC) is in the forefront of these efforts. Despite these efforts, their production levels have consistently fallen short of the increasing needs of the farmers. They have never been able to meet more than six per cent of the country's annual seed needs.

If more market research with self-produced seeds could be conducted, we could better determine how to encourage faster adoption of not only hybrids and open pollinated varieties, but also of different varieties of the same crop developed especially for specific Agro-Ecological Zones. It may also encourage greater investment in the seed industry. The efforts of self-production are contrary to the intention of the farmers purchasing seeds from companies but with effectively organized programme, which may be integrated into industrial production system with appropriate training and motivation to maintain quality. This situation is common in many developing countries (Tripp, 1995). Even in India, the amount of truthfully labeled seeds being used has increased only to a limited degree, and that also only recently.

Currently, farmers are replacing about 5.8 per cent of their seeds each year. Some nearby countries such as Pakistan have a similar rate of replacement. India's replacement rate varies between one and 62 per cent; major crop seeds vary within the range of 7 to 35 per cent (Asian Seeds 5 and 6, 1994). Seed replacement rates in Indonesia are 0.8 per cent for maize, but 24.7 per cent for rice (Asian Seed 5, 1994). In UK, during late '80s, about 30 per cent of seeds used were of farmers' own saved ones (Kelly and Bowing, 1990). In the USA, more than 50 per cent of the wheat, barley and oats sown are from farmers' saved seeds (Jafee and Srivastava, 1994). In many tropical countries, however, the proportion of farmers' saved seeds is much higher, reaching up to 90 per cent (Goosman *et al.,* 1990). This is the case in Bangladesh too. And the quality of the farmer' saved seeds are also not bad as has already been observed through studies (Rahman, et al 1992 and Hussain et al, 2002)

Table 2: Growth and characteristics of rice seeds from different sources (Asian seeds 4(1): 4, 1997)

Indicators	Government seed	Farmer's seed	Miller's Grain
Quality of seed samples	98.05	96.30	90.65
Germination (%)	99.52	94.35	93.91
Vigor (%) 93.10	90.00	87.30	
Inert materials (%)	0.48	5.64	6.09
Moisture content (%)	11.85	12.13	12.38
Off-types (%) Nil	2.13	4.26	
Growth rate: Number of Tillers/hill	14.10	13.64	12.31
Panicle/m^2	166.41	147.20	157.60
Yield and yield components			
Number of good seeds/panicle	144.0	122.00	113.00
Weight of 100 seeds (g)	2.63	2.62	2.59
Yield (Kg/ha)	5.01	4.59	4.51
Off types (%)	0.01	4.92	6.96
Rice quality: Head rice (%)	45.40	42.80	42.00
Amylose content (%)	14.90	16.28	16.42
Gel consistency (%)	89.00	84.40	82.60
Disintegration lye (mm)	7.00	7.00	6.98
Level of aroma (0-4)	1.80	1.80	1.60
Selling price: Miller's price ($/ton)	222.80	219.40	218.40
Gross income ($/ton)	1,119.00	1,008.00	984.00

A comparative study on the performance of the seeds of government, farmers and mill sources indicate that the variations are not much in respect of yield, quality and returns from the products (Table 2). Rahman *et al.* (1992) also found that farmers' retained seeds tested as good as BADC's seeds – but only when those were used by the farmers themselves or their relatives and not when that was purchased/ sold through general market and used as seed. The information given in the Table 1.2 clearly indicate that giving necessary training to the farmers for production and maintenance of quality seeds.

The farmers of different areas can be trained on crops of their interest along with the endangered ones for seed production, processing and storage in small to large quantities for making those available at the market during the period of need. This pattern will also make available quality seeds closest to the farming community and thereby; the uses of such seeds will increase in short space of time. And replacement rate of quality seeds will be higher. This will increase the production by increasing the yield per unit of area where data suggest very high gaps between the average national yield and the potential yields obtained by some farmers in some years (BBS 1992, FAO 1992, Hamid 1993). This will also ensure high quality products of similar nature over years so that commercialization of the crop producing become easier. The action plan should include participatory breeding, training for easy seed production, development of attitudes of sharing the good seeds in time of the needs, extending facilities for production, processing and storage of seed crops in different areas of the country, the bank support for quality seed production, seed crops, as well as helping the farming community in getting good price of their products produced using high tech and high quality seeds.

5. VILLAGE NURSERIES: A BUSINESS AND SUSTAINABLE PGR MAINTENANCE

5.1. The Potentials

There are about 5000 angiosperm species of Plant Genetic Resources (**PGR**) in Bangladesh (Khan 1994), many of which are being eroded due to population pressure, alleged development processes, unplanned housing and industrialization, unscrupulous business of herbal medicines and many other factors. In the recent past, during 1987-88 Swiss Development Cooperation (SDC) in collaboration with NGOs and Bangladesh Agricultural University (BAU) introduced plantation in crop fields, roadsides, homestead and other community places. This attempt did raise the awareness about the development of a system whereby the villagers got interested in nursery business. They were helped to develop nurseries of many different species wherefrom the villagers

could get the seedlings of their choice for planting, including developing woodlots and orchards. They were trained to take care of different issues related to agro-forestry and nursery. Through this programme, BAU did participate in developing the model and appropriate methods to raise seedlings of diverse species and those of endangered type.

Gradually, the nurserymen of various areas of the country started realising that the species of endemic nature are also valuable and can fetch better price; while the commercial types are required in large numbers and can be produced to support large scale needs of timbers, fruits and other needs. Now, these nurseries are the safe places for diverse plant types and their preservation areas. These are also the collectors of many different species including those, which many a times are considered to be weeds in crop fields, but are highly valued for medicinal purposes and also needed to be preserved for the sake of protection of the eco-system. If and when the plant species of special purposes or of one particular purpose are grown in large numbers in one or the other areas, the potentials of their higher market facilities grow. This is more important to sustain the programme as well as help commercialisation of the production system leading to increasing the income of the people involved in the process and in the area without undermining the natural resource base. The study (Rahman and Siddique, 1997) observed that most of the NGOs working in the agro forestry programmes of SDC have raised and marketed a large volume of seedlings in most of the northern zones of the country.

Table 3:Yearwise number of tree saplings marketed by the nurseries of BSF Mymensingh belt (BSF annual report 2000 7p)

Year	Homestead	Crop Field	Woodlot	Orchard	Total
1994-5	78728	21819	8725(76)	1235(31)	1,10,614
1995-6	69372	21772	14114(109)	6108(62)	1,11,537
1996-7	74662	58284	12230(87)	6215(47)	1,51,525
1997-8	2,72,952	2,18,551	96763(416)	10822(135)	5,99,630
1998-9	3,25,201	2,66,139	97434(412)	11765(126)	7,01,077
1999-2000	5,32,992	4,28,396	1,49,256(642)	40325(517)	11,50,969
Total	13,53,907	10,14,961	378522	96470	28,23,860
Sale outside					8,57,780
Stock 2001					22,76,379

Annual turn over @ Tk 5/sapling for ’99-‘00 was >20,00,000 =Tk.100,00,000 by about 125CF

Without much serious attention or approach by the government there has been considerable change in the patterns of production of vegetables, fruits and timber

trees in the areas lying on either sides of the highway from Mymensingh to Dhaka. This indicates that the market facilities opened with the opening of the highway and the fresh agricultural products and inputs have opened the possibilities of the farmers to do the production. They were however, motivated and trained for taking up programmes of vegetables, fruits and timber trees of special type by the Bangladesh Agricultural University as well as the Bangladesh Seed Foundation (BSF) during the period from 1987 to 2000. After the completion of the BAU's programme on agroforestry, there has been serious emphasis by BSF, on village based nursery development in Mymnesingh belt with support from the SDC. During the end year of the project intervention (1999-2000), a total of 9 Upozilas of Mymensingh (Sadar, Trishal, Bhaluka, Muktagacha, Fulbaria, Phulpur, Gauripur, Iswarganj and Gafargaon) were covered by Agro-forestry programmes of BSF. In these areas it covered 1606 Mouzas of 118 unions, where there were 422 DAE blocks through 125 Village and Farm Forestry blocks. They directly served through training and motivation of 12,700 farm families in these areas with 125 nurseries.

However, the spillover effects of the nursery system were much higher than expected. In 1999-2000 alone there were plantation of 11,34,644 saplings in Bariland, crop fields, and wood lots in different unions of 9 Upazilas (Table 3). The rate of plantation increased by67.55 percent over that of the previous year, where the number planted were 6,88,782 with a survival rate of 83.02. These indicate that the people have realized the importance of tree plantation not only in homestead, but also in crop field (Khetland) and making orchards and woodlots in their land area available. This was also visible during the last Tree Fair 2003 in Mymensingh town hall area, where except for the government nurseries; all others were established in this profession by intervention of BAU and BSF in this area. Just to note that in the year 1999-2000, the 125 nurseries of the area sold a total of 16,76,659 saplings and had a nursery stock of 22,76,379 for the next year. These information indicate that a huge business can be done by many of the people of the villages at their own level while serving the cause of sustainable development of the area, agriculture and the preservation the Plant Genetic Resources of high value of the country and they can easily be supported by the experts like us. The data in the Table 3.1 indicate that the resource may be limited but the potential is high. The need is the devotion and sincerity of purpose. This effort does not only help generation of employment at the rural level, but also help the development of the area through participation of women in great number and thereby many endangered species can also be protected by sharing the genetic materials available in the area or from outside.

5.2. Measures to be Taken to Exploit the Potentials

There are some specific problems of these nurseries that need to be addressed by both GO-NGO initiatives in the sector. A few of the important ones are given below:

i) The owners of the nurseries need to be given adequate credit facilities to organize the programmes and to collect and preserve more of the species that are becoming lost in the process of development;

ii) They need coordination of their programmes so as to share materials of interest for the country and of the region;

iii) They need training and motivation to keep themselves in the line of their activities with networking of nurseries for achieving better market facilities with ensured price from those buying seedlings in large volumes for different programme areas; and

iv) They need research and development support of the organizations like the BAU and the NARS, DAE as well as the large NGOs, (who would help the small NGOs) to organize local area based nurseries where more of the endemic materials can be preserved.

6. PRODUCTION AND USE OF SOYBEAN: AGRO-PROCESSING PERSPECTIVE

6.1. Introducing the Issue

The experience with soybean in Bangladesh in respect of production research, production, product utilization research, development studies, process leasing, technology testing and transfer are manifold as were obtained through field research starting from 1975. In fact the crop has its third time presence in Bangladesh since 1975 when the BARC organized a coordinated research project covering 11 departments of 7 organizations of four ministries. This time the introduction was made with short duration photo-insensitive soybean varieties that can be grown round the year, taking about 100-130 days depending on areas and seasons. Within 1981-82 the major thrust on both adaptive and some basic research works were completed with release of two varieties. Subsequently, the BAU and MCC took up the major works and by the year 1992-93, Crop Diversification Project (CDP) came into the programme with production and promotional activities on soybean.

Usually, a crop like soybean has many diverse uses ranging from use in the traditional food chain of the human being to the highly industrialized items like

the meat analogues, oils and proteins as well as high quality phospholecithins for medicinal uses. Because of the relatively longer time required in the adaptation process, the crop took almost 20-25 years to reach acreage of 35,000 (average of 1996-2000) as reported by MOA (Task Force, 2003). Today's position with soybean has been possible because of the consistent approach for its expansion of production and use in the country by the BAU, MCC, NGOs like the BSF and private companies like Shilpee, NAPL, AFTAB and Paragon and many others who always tried to stabilize the market. The present coverage of the acreage is not sufficient for soybean requirement for human food, poultry and fish feed, so, many business houses are importing oil meal from India. The potentiality of extracting oil in Bangladesh is also high and there should be some one coming for this program with in-country produced soybean In addition to the present large scale production in Noakhali, Comilla and Mymensingh, intervention in other areas are required. The present price is about Tk.15/00 per kg fresh soy grains and seed price of Tk. 30-35/00 per Kg may help development of good seed business also. Considering that the production per hectare is about a ton only, which is a low level of yield, current total production may be as high as 35,000 tons.

The grain price of soybean is about Tk.10-11 per kg. at farmers' leveland about Tk14-15 at Aratders level. The price starts to increase from August and continue upto October every year due to low production period and storage by Aratders. The crop was first planned for use as pulses for making nutritious biscuits, breads, flours, etc. This was followed by plan and action for large-scale use in the poultry feed. With the increasing use in poultry feed, there has been the start of using these in the human food in large volumes. The suggestion was made to the WFP for using 5% soyflour in the biscuits of the school feeding programme. This is now being modified to include 10% soy fortified wheat flour in the general market. There has been the technology and tests done at the Phulpur station of the BAU-USDA soybean project for such soy fortified wheat flour and found to be good for taste and much better for nutrition. Now the technology is available with the BAU for transfer to any one interested in such production and marketing. The very recent use of soybean as could be traced out is that during 2002-2003 WFP alone planned to purchase more than 30,000 tons of biscuits with 5% soyflour that would require 1500tons of soyflour in 2003 alone. This is in addition to its large scale use in poultry feeds and the recent use in fish feed. However, the issues are getting changed with larger involvement of producers of soybean in different areas of the country. The crop has the following potentials, which automatically help development of sustainable production programmes at the rural level and also help the poor and poorer farming community with possible nutrient-rich grains to be available at the homestead level for any time use in their food chain.

6.2. Potentials of Soybean in Bangladesh

1. The crop is highly liked by farmers of many areas as their soil improving cash crop of short duration.
2. The by-products are not only suitable for livestock feed, but also for production of high quality composts.
3. The farmers can have cash flow better in soybean than in rice during the crisis periods because of its higher price round the year.
4. The yield of grains, high quality oil and protein per unit area is higher than that of rice, but the cost of production is much lower than rice.
5. Production of soybean does not require irrigation that saves water and improves both soil and general environment.
6. The crop is highly valued for having many different uses including production of Bio-fuels, high quality phospholecithin for medical purposes, as well as binding materials of human food and different feedstuffs.
7. The crop can be grown in any land types in different times of the year. Less fertile soil type can be improved by growing this crop.
8. The products like; soy milk the only substitute for cow's milk, milk beverages, milk products of different names and types, soy oil, soy protein isolates of various names and types, the feeds with soy high protein grits for poultry and fish have all been tested and found to have potentials for use.
9. The products that can be made using the grains of soybean are important not only for internal consumption but also for export.
10. The crop is highly valued for its diversified commercial potential all over the world (Rahman, 1978 and 2001).

7. CONCLUSIONS

The issues that we want to impress upon the policy makers of this country on the sustainable development of agriculture are that there must be small to medium level commercialization of agriculture- an approach where organized market facilities for quality crop seeds, grains and products of different agricultural activities are present. There exists a strong case for developing network of nurseries not only for commercially important species, but also for endangered species to help sustain the development process without damaging the natural resource base. In the field of intensive cropping programme there is need for crops to sustain the soil fertility along with provisions for nutritious food for the farm families at their household level. The issues that are more important for commercialization of agriculture are maintaining sustainability of the production system and productivity of the small and medium farm holders at rural level.

References

BBS, 2002. 2000 Statistical yearbook of Bangladesh, 21st Edition, Published by Bangladesh Bureau of Statistics, GOB.101p

Hanson, J. 1994 (Ed) Seed Production by Small Holding Farmers. Proc. ILCA/ICARDA Res. Workshop held at ILCA, Addis Ababa, Ethiopia, 13-15 June, 1994.

Hossain, M. A. Janaiah, M. Husain and F. Naher, 2002.The rice see delivery system in Bangladesh: Institutional and Policy Issues. Center For Policy Dialogue, January 8, 2002

MoA. 2003. Ministry of Agriculture, Taskforce on requirement and supply of seeds, Seed wing, MoA.

Rahman, L. 1977. Crop production, human Nutrition and status of production and research on oilseeds and pulses in Bangladesh. Proc. Sem. on Sci. & Techn. in Agric., BARC, 49-63pp.

Rahman, L. 1978. Soya Protein Foods, in Bnagladesh and potentials and an analysis of prospects and constraints. International Soya Protein Food conf. Held in Singapore. January 23-28, 1978. 13-17pp.

Rahman, L. Eco-sustainable commercial agriculture for Bangladesh: Impact of Breeding Horticultural Crops (Theme Paper). 5th Annual Conf. Plant Breeding and Genetics society of Bangladesh, May 2001.

Rahman, L. 1995. Sustainability of growth and development in Agriculture. Bangladesh Journal of Political Economy Vol XIII No. 2. 139-152.

Rahman, L. and A.R. Siddique. 1997. Participatory maintenance of plant genetic resources at rural homestead level:NGO Experiences. Proc. Nat.workshop on Plant Genetic Resources. Plant Genetic Resources-Bangladesh Perspective 26-29 August, 1997, BARC, 219-226pp.

Rahman, L. 2001. Fight hunger to reduce poverty: Strengthening nutritional security through non-staple food items (Theme paper) World food Day, 16 October 2001, BARC.

Redcliff, M. 1983. Production Programmes for Small Farmers “Plan, Pueblo as Myth and Reality”. Economic Development and Cultural Change 31: 343-347.

Rekhi, S.S.; G.M. Moyeenuddin and L. Rahman 1996. Country Report: Bangladesh Seed Sector, Presented in Asian Seed Conf. Held in Jakarta, Indonesia October 1996.

Tripp R. 1995. Seed Regulatory Frameworks and Resource Poor Farmers: A Literature Review. ODI, Network Paper 51, January, 1995.

Salahuddin, K. 2002. Mainstreaming Gender in Agriculture Sector: Bangladesh Perspective and other essays. Dhaka: Palok Publishers & Women Writers Association.

Ziegler, R. 1986. Application of a System Approach in a Commodity Research Programme. Burundi Highland Maize. Experimental Agriculture, 22: 319-328.

Backward and Forward Linkages of Power Tiller Technology: Some Empirical Insights from an Area of Bangladesh

G.M. Monirul Alam*
Md. Saidur Rahman**
M. A. Sattar Mandal**

1. INTRODUCTION

In recent years, the use of power tiller (PT) for land preparation has risen significantly at farm level. In the year 1988, the government withdrew duties and sales taxes on PTs and also standardization restrictions were waived, opening the import of all makes and brands of diesel engines, which resulted in a rise in the number of PTs. In the meantime PTs were upgraded with operators' seat, rear wheels and adjustable multiple implements. All these modifications improved the acceptability of PTs to the farmers. As a result, the sales of PTs increased from 3,000 in 1988/89 to over 15,000 in 1989/90 (GOB, 1990). Private sector was importing PTs at a rate of over 20,000 per year and about 100,000 PTs were being used in the country by 1995. However, according to Sarker (1997) under the test relief provision, private sector had been importing over 25,000 PTs annually. The number of PTs in Bangladesh from 1988 to 1998 is shown in Table 1. The total number of PT in the field exceeded 175,000 (Sarker, 1997). A rough estimate shows that there are about 350,000 PTs currently operating in the country. In addition to tillage operation, PT utilization has also created diverse work opportunities through its backward and forward linkages.

This paper is based on the master's thesis of the first author submitted to the Department of Agricultural Economics, Bangladesh Agricultural University (BAU), Mymensingh, 2003.

* M.S. Graduate of the Department of Agricultural Economics, BAU, Mymensingh.

** Assistant Professor and Professor respectively, Department of Agricultural Economics, BAU, Mymensingh.

Table 1: Power tiller Number in Bangladesh (1988-1998)

Year	Number
1988	3000
1989	7000
1990	10000
1992	35000
1994	60000
1998	150000

Source: Adapted from Sarker (1997)

There are many actors involved in the PT service market. Generally, the importers act as wholesalers within the country. They sell it to retailers or agents who distribute these at the local market levels. The retailers sell PT to the farmers directly with some assurance/guarantee and after sale services. In some cases, they sell it against partial payment while they charge a little higher price than usual. A power tiller requires the service of a driver to operate it, mechanic to repair it and support services from workshop to repair and produce the necessary spare parts. Diesel, mobil shop/petrol pumps are also the actors in the power tiller service market. The main and ultimate actors of PT are the owners who are also the users of PT and those who are not the owner of PT but rent in PT services on payment. The present study mainly attempts to understand the business of PT service providers and assess the backward and forward linkages of the technology.

Keshabpur upazila of Jessore district, which experienced intensive use of PT, was selected purposively for the present study. The data were collected from a cluster of five villages of Keshabpur upazila. For selecting the sample, at first a complete list of 46 PT owners, 55 drivers and 11 mechanics from the selected villages were prepared by the author. Fifteen workshops were also listed from village markets and upazila markets of Keshabpur upazila. Then, 30 PT owners who were also the users of PT, 20 drivers, 10 mechanics and 10 workshops were selected randomly from the list for the present study. In addition, 30 PT user farmers who did not own PT but rented in PT services on payment were purposively selected from a para (sub-village). The data were collected from January to May, 2003. Many farmers of the sample especially PT users, mechanics and PT drivers cultivated very small area. Therefore, for meaningful presentation of data, farm sizes and other indicators were measured in terms of acres. Four case studies were conducted to understand the PT business more intensively.

2. CHARACTERISTICS OF PT SERVICES MARKET

In rural areas many farmers do not have the ability to buy PT but they buy and operate PT through mobilization of capital from bank and other sources. They generally operate and sell PT services for cropland cultivation on commercial interest. The main characteristics of PT services market for cropland preparation in the study area are given below.

2.1 No Fixed Command Area of PT

It was revealed from the study that PT had no fixed command area for its utilization. It varied from PT to PT. About 83% of PT owners reported that they went beyond their locality to cultivate others land in addition to ploughing land in their own locality. Average distance of places where an individual PT moved to cultivate land varied from 5 to 40 kilometers. The main reasons included maximizing utilization of PT, earning cash income and ploughing relative's land. It was observed that PTs command area could be quite extensive depending on communication facilities and density of PT in the area.

2.2 Small and Medium Farmers in PT Business

It is generally thought that those who buy and operate PT are the large farmers and that they get the maximum benefits from PT use. It is also argued that small farmers cannot buy PT due to their insolvency. It can be seen from Table 2 that about 30 per cent of PT owners were small farmers, 57 per cent medium farmers and only 13 per cent were large farmers. Thus, it is important to recognize that small and medium farmers got increased access to PT ownership through purchase and that they also benefited from PT service market.

Table 2: Categories of PT owners and users according to farm size

Categories of farmers	No. of respondent	PT owners Percent	No. of respondent	PT users Percent
Small	9	30	19	63
Medium	17	57	11	37
Large	4	13	—	—
All	30	100	30	100

Source: Alam, 2003

On the other hand it can also be seen from the same Table that among the PT users about 63 per cent were small farmers and 37 per cent were medium farmers and

there was no large farmer. The findings indicated that although some small and medium farmers in the society had no financial ability to buy and use their own PT, they hired the services of it. Details of costs and returns from PT operation are given in Case Study 1.

Case Study 1: Power Tiller Owner (Ganob Mollah)

Md. Gonab Mollah (40) is a PT owner. He lives at Mongolkote under Keshabpure upazila in Jessore. His family consists of 4 members and possesses 125 decimal lands. In 2003 Boro season, he alone bought a new PT with the help of an agent on condition that he (Mollah) has to pay the full price of PT in 15 installments within the 2003 Boro season. He provided about 50 percent of purchase price of PT from his own source and with loan from local Shamiti and relatives. He mortgaged out his 42 decimals of land to buy diesel and mobil in cash at a time. He collected the service charge of PT from the farmers after the harvest of paddy. For this reason, most of the farmers in his area used the services of PT from him. Although he can drive his PT, he has hired a driver to assist. According to him, he bought the PT mainly for commercial purpose. In 2003 Boro season, he ploughed about 106.26 acres of land (two times) of which 1.26 acres was his own land and 63 decimals were rented from others. His annual income earned from crops plus vegetables plus poultry was Tk. 12500.00. The gross margin for PT operation in 2003 Boro season was Tk. 47075.00. Costs saved from own use of PT for tillage operations have been considered in calculation of total variable cost. Again costs saved from own driving of PT have been considered in calculating total cost. The usual rate charged for ploughing is Tk. 476.00 and for laddering Tk. 143.00 per acre (two times) of which 10 per cent goes to PT driver. In this Boro season, he did not require any repair charge and spare parts for his PT.

Cost and return of PT operation in 2003 Boro season

Land type	Area (acres) (Tk.)	Earnings (Tk.)	Diesel cost (Tk.)	Mobil cost (Tk.)	Driver cost (Tk.)	Total cost (Tk.)
Owned land	1.26	779.94	126	110	78	314
Others land	105.00	64995	10496	1390	6499.5	18385.5
All	106.26	65774.94	10622	1500	6577.5	18699.5

Source: Alam, 2003

Total returns, variable costs and gross margin of PT

Item	Amount (Tk.)
Total Return	65774.94
Variable Cost	18699.50
Gross Margin	47075.44

Source: Alam, 2003

Case Study 2: Contract Farmer (Rafiqual)

Md. Rafiqual Alam (30) is a contract farmer from the village Kalagachi under Keshabpure. His family consists of five members. His main occupation is farming/day labourer. In 2003 Boro season, he contracted a PT owner in Mongolkote. The name of the PT owner is Md. Mohasin Golder,who lived about 20 km. from the residence of Rafiqual Alam. The contractual arrangement was that Rafiqual would pay the PT owner Tk. 170.00 per bighas (42 decimals) for two cross ploughings. How much he could collect from the PT user farmers was not the concern of PT owner. He collected money from the farmers at the rate of Tk. 200.00 and Tk. 195.00 per bigha for two cross ploughings. He provided meal and accommodation to the driver who was paid by the PT owners. He would be responsible for protecting the PT or any parts of PT from theft or any damage to PT. His duty was to collect money from the user farmers and negotiate with other farmers for cultivating their land by his contracted PT. In 2002 Boro season, he also contracted the same PT owner on the same conditions and cultivated about 70 acres land. In 2003 Boro season, his contracted PT ploughed 15 days and cultivated about 125 bighas (52.50 acres land) including his 4 bighas rented-in land for which the charge was the same. The reason for ploughing less land area this year was that few other farmers also hired/contracted PT in his area, meaning increased competition. His income was about Tk. 9500.00 by this activity.

2.3 Emergence of Contract Ploughing in PT Services Market

The contract farmer emerged as a new actor in the PT services market for negotiating and organizing ploughing by PT. For going outside areas to cultivate others land depends on the availability of contract farmers. Contract farmers usually finds out the PT owners from distant places, sometimes even outside the districts. In this case he is paid cash or a share of total income from PT use (usually 10 %) or ploughing his own land free of cost. His duty is to collect money from the user farmers, keep the PT in his disposal, provide meal and accommodation to the driver. In absence of actual PT owner, he acts as the de facto owner of PT and negotiate with other farmers intending to cultivate their land by the PT (details of contract farmer is given in the Case Study 2).

2.4 Enabling role of different Institutions for the Expansion of PT

Table 3 shows that about 50 per cent farmers purchased the PTs by borrowing from NGOs (Grameen Bank, ASHA) and local Shamities. Findings indicated that local Shamities and agents were playing crucial role for the expansion of PT, because without their assistance small farmers would not be able to buy it. NGOs provide loan to the female members for business purpose. The NGOs had no concern about whether the farmer bought PT with the borrowed money or used it for other purposes. They tried to ensure regular weekly installment from the loan

receiver. Repayment system of borrowed capital varied from institution to institution. For local Shamities and agents the terms and conditions usually depend on the proportion of capital provided by the farmer. On the other hand, the percentage of total purchase price of PT borne by the owner largely depends on the goodwill and personal relation of the owner with the institution.

Table 3: Sources of capital for purchasing the PT

Source	Percentage of total purchase price borne by the owner and institution		Number	Percentage
	Own	Institution		
Own	100	—	9	30
NGOs	50	50	8	27
Local Shamities	40	60	6	20
Agents	45	55	7	23
Total		30	100	

Source: Alam, 2003

2.5 PT Owners Renting in others PT for Land Preparation

Not all the PT owners were able to cultivate their total Boro land by their own PT. They had to cultivate on an average 36 decimals of land (13% of their total cultivated Boro land) by other PT and the charge was the same as they would charge from others. About 80% of the PT owners reported that the reason for using other PT service were to catch up with the proper time of cultivation. About one-fifth PT owners reported that their land was too far and too small in size to justify using their own PT for tillage.

2.6 Poor Rural Youths as the PT Driver

The socioeconomic characteristics of PT drivers showed that little educated rural youth were getting the opportunity to become PT driver. They had no formal training on PT driving. They were the members of small and poorer farm families. They were playing crucial role to increase their family annual gross income by driving PT for only 48 days of which 65 per cent came during Boro season. Their family had got better access to rent in more land; about 51 per cent of their total cultivated land was rented in. PT driving was the extra sources of income of their family. (Details are given in Case Study 3).

Case Study 3: Power Tiller Driver (Suzzat)

Sazzat is one of the PT drivers in Mongolkote. He is a young man of 17 years and has primary schooling. His father's name was Oziar. Suzzat is a member of a large family consisting of 6 members. He is not the only earning member of his family. His main occupation is working as a day labourer. His family possesses 20 decimal lands. In this Boro season his family cultivated 84 decimal lands, renting in additional 54 decimals. Annual gross income of his family from crops plus vegetables plus poultry was TK. 13500.00. Although he did not receive any training on PT driving, he learnt it from other PT driver by his own efforts. In this Boro season he ploughed about 84 acres land (two times). He gets 10 per cent of the earnings. He could plough 336 decimal lands (two times) on an average in a day (12 hours). He ploughed about 28 days in this Boro season. PT owner bears all costs for his illness and accident. He enjoys PT driving because people call him a driver, a skilled technical person and he accepts it as a social honour. He also drives PT in other seasons of the year. From July to December 2002, he ploughed only 15 days. His earning from PT driving for a total of 43 days was Tk. 7269.00.

Income from PT driving from July 2002 to Boro season 2003

Period	Days ploughed	Earning of drivers
In Boro season 2003	28	5199
From July to December, 2002	15	2070
Total	43	7269

Source: Alam, 2003

If he were a farm labour, his income from 43 days would be at Tk. (50×43)= 2100.00. Extra income from PT driving was Tk.5109.00.As a day labourer his annual total income besides 43 days of PT driving was Tk.16,100 (365-43=322 × 50).

2.7 Mechanics from Poor Households

Findings related to socioeconomic characteristics of mechanics showed that they came from poor households cultivating 1.18 acres of land. Most of them had no formal training on their job but had some form of education. About 26 per cent of annual gross income came from PT repairing services of which 60 per cent came from Boro season. Their owned and rented in land accounted for 45 per cent and 39 per cent, respectively of their total cultivated land. The system of rendering PT services was mainly by cash and sometimes by cash and credit. In addition to cash income, the mechanic had other benefits, i.e. preferential access to STW irrigation, PT hire services, etc. This actually allowed the mechanics to increase their cultivated land through renting in more land than before. (Details are given in Case Study 4).

Case Study 4: Rural Mechanic (Ayub Ali)

Ayub Ali (28) is an engine mechanic from Mongolkote village in Keshabure upazila. Ayub Ali's family consists of 4 members. Agriculture is the main occupation. He cultivated 84 decimals rented lands in this Boro season. He took up engine repairing work as a subsidiary occupation. He learnt engine-repairing work from a upazila workshop by working there as an apprentice for two years. Usually he has to go to owner's house or field for repairing work (PT, STW). He has contract with 3 STW owners that the STW owners will pay the repair charge in cash at the end of the Boro season. He has no contract with any PT owner. They usually pay the repair charge in cash. In this Boro season he repaired 5 PTs and earned about Tk 5000.00. The repairing charge varied from Tk. 250.00 to Tk. 600.00 per PT. He reported that repairing services varied from season to season, but were available throughout the year. According to Ayub Ali, he earned total of Tk. 30000.00 from repairing services last year, of which about 35 per cent came from PT repairing services. In this Boro season he earned less from PT repairing services due to his personal inconvenience. His annual income in 2002 was Tk. 71,530.00.

Annual incomes of rural mechanics

Items	Income (TK)	Percentage
Crops	10020	24
Vegetables	1510	4
Poultry	500	1
Repairing Services	30000	71
PT	10500	25
STW	19500	46
Total	71530	100

Source: Alam, 2003

2. 8 Competition in the PT Services Market

There was competition among the PT owners for cropland cultivation. Every PT owner tried to cultivate more land by his PT because they bought the PT for commercial purpose. They always tried to keep good relation with the farmers. In some cases they cultivated farmers' land on condition that the farmers would give him the service charges after the harvest of crop. This allowed him to cultivate more land. There was also competition among the contract farmers because they tried to cultivate more land by their contracted PTs. Sometimes they did not collect the services charge of PT from the farmers uniformly.

2.9 Profitability of PT Business

To assess profitability of PT owners for tillage operation gross margin (GM) analysis was used. Total variable cost per PT for selling services (own + others) were calculated at Tk. 20612.39 and total return was estimated Tk. 49427.00. Thus GM was estimated at Tk. 28815.00 per PT for Boro season and return per taka investment (variable cost basis) was Tk. 2.65. Driver cost and diesel cost were the main cost components which were 23 per cent and 26 per cent respectively (Alam, 2003). Case study 1 presented above illustrated cost and return of an individual PT owner.

3. BACKWARD LINKAGES

Different actors linked with PT technology in the study area create various backward linkages of the technology. Actors involved with PT technology in the study area are given in Figure 1.

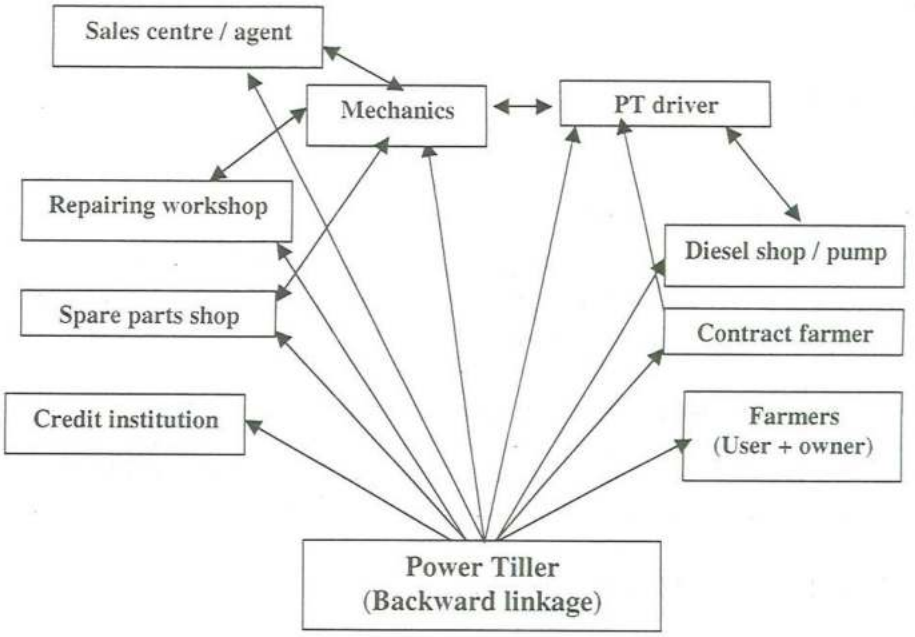


Figure 1 Actors involved with PT technology in the study area

3.1 Contractual Linkages

Number of PT owners, drivers, mechanics, diesel shops and spare parts shops were increasing significantly over the nineties (Table 4). PT owners are directly linked with sale centers, mechanics, repairing workshops, spare parts shops, credit institutions, drivers, diesel shops, contract farmers and farmers (user + owner) for

different purposes. Mechanics have a relation with sale centers, spare parts shops and repairing workshop because farmers often go to mechanics to get their help and advice to buy PT, spare parts and for repairing PT. In this case mechanics get benefit from both the parties. Some times contract farmers bridge with PT driver. It is not possible for PT owner to send PT in that area if PT owners do not have contract farmer. Contract farmer tried to convince PT drivers assuring good meal and accommodation. Sometimes PT driver helps the PT owners to decide about where to buy diesel and mobil from. So, the diesel shopkeepers try to keep good relations with PT drivers/mechanics.

Table 4: Comparison of growing PT owners, drivers, mechanics, diesel shops and spare parts shops in the study srea

Types	Number		
	Before (1990)	*In 2003*	*Change (%)*
PT owners	2	46	2200
Hired drivers	2	55	2650
Mechanics	1	11	1000
Diesel shops	3	9	200
Spare parts shops	0	3	300

Source : Alam, 2003

3.2 Growth of Local Workshop

With the increasing demand of agricultural machinery, especially PTs small workshops are rapidly growing (Table 5). An account of increasing agricultural workshops in the upazila market and study village market are given below:

Table 5: Comparison of growing agricultural workshops in the study area

Location of market	No. of workshops		Change %
	Before (1990)	In 2003	
Upazila market	3	8	166
Village market in the study area	0	1	100

Source: Alam, 2003

Most of the workshops were involved in manufacturing and repairing spare parts of PT, STW, threshing machines, etc. In the study area PT owners get the services of workshop within 1 to 2 km distance. To repair PT, the PT owners usually bought the following spare parts from the workshop: Injector nozzle, Cylinder head, Gasket, Piston ring, Cylinder liner, Piston and Fuel filter. The local workshop is now capable of fully servicing small diesel engines, PT etc. They can make major spare parts of PT.

Approximately 50 PTs were linked with the local workshops. The mechanics took 25 percent commission of their earnings from workshop. The owners of the workshop received the repairing costs of PTs in cash but in some cases in cash plus credit. It was observed that most of the workers in the local workshops had shifted from the traditional farm work. They were mostly illiterate and had no formal skill training at all. They had acquired knowledge and skill through apprenticeship at workshops. In the first year of apprenticeship they did not get any money from the workshop, but later on they got some income for their work in the workshops.

4. FORWARD LINKAGES

4.1 Growth of Agro-based Industries

It was revealed from different studies (Ahmed, 1992 and Gill, 1981) that PT had significant positive contribution to increasing production. Gill (1984) noted that PT can increase production by permitting timely planting and faster turn around between a crop, which in turn facilitates increased yield, greater cropping intensity and the possibility of introduction of new crop rotations. When production increases, more agro-based activities also are developed. As a result more opportunities for productive work are created. Figure 2 shows the growing small-scale agro-based industries in the study area. These small scale agro-based industries as a result of large-scale use of PT and other technology create forward linkages. It offers great scope for capital investment by the individual entrepreneurs, which will open up new employment avenues for the ever growing rural people. For the development of these growing agro-based industries continuous supply of raw materials should be ensured. To ensure the supply of raw materials we have to augment our production faster than before with our limited land resources. A list of growing agro-based industries in the study areas is given below (Table 6).

Table 6: Comparison of growing agro-based industry in the study area

Activities	Number		Change (%)
	Before (1990)	In 2003	
Paddy & wheat milling	3	7	133
Paddy parboiling	2	4	100
Chira making mill	0	1	100
Oil seeds crushing mill	2	3	30
Total	7	15	—

Source: Alam, 2003

A number of people (men and woman) were employed (permanently and casually) in agro-based industries and earned more income than before (according to their opinion). The processing and marketing of primary agricultural products created forward linkages and enhanced profitability of crop production through value addition.

4.2 Growth of Rural Non-farm Activities

The growth of the rural economy is the key to support accelerated growth of agriculture. PT technology coupled with other technology has contributed to the growth of agriculture and linkage between agriculture and rural non-farm sector. The whole range of activities created by backward and forward linkages of power tiller technology are characterized as rural non-farm activities. These linkages increase the employment opportunity and income of the rural people, which in turn has contributed to the reduction of poverty. Nevertheless, at the present stage of development of Bangladesh agriculture and given the constraints in resource availability, the priority is to ensure productivity growth.

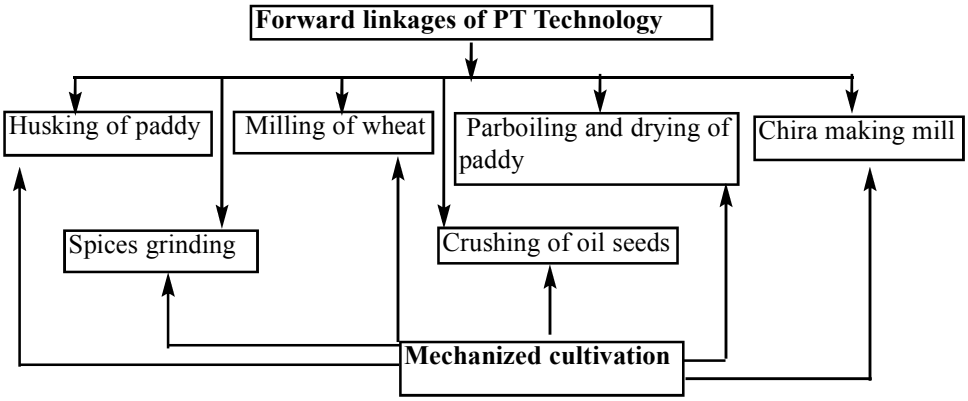


Figure 2: Growing small scale agro-based industries in the study area

5. CONCLUSIONS AND RECOMMENDATIONS

PT contributes to accelerating rice production by increasing cropping intensity and changing cropping patterns. It also increases demand for human labour in non-farm activities. From the study it can be seen that PT together with other technology has opened up new opportunities of non-farm activities for rural labourers through its backward and forward linkages. Hence, the present stage of farm mechanization along with irrigation, fertilizer and other technologies can be treated as complementary to employment generation. The people who have

initiatives, risk bearing ability and a reasonable entrepreneurship, are taking up PT technology as a business. So, the blame against PT for causing labour displacement, widening income distribution and imbalances in rural economy of Bangladesh does not stand up to empirical test. The government policy on selling PTs through the open market operation should be continued so that farmers can purchase PT from local markets at competitive price. Credit facility to the farmers should be provided on easy terms and conditions so that they can purchase PT on their own and make the business more competitive, which will eventually lead the operation cost to come down. Formal training arrangements on proper operation and maintenance of PTs can be made available for PT owner, driver and mechanics through private sector workshops. Therefore, steps could be taken in this regard by government and private organizations. Government should ensure enabling environment i.e. physical infrastructure, electricity, etc to ensure quality of locally manufactured spare parts. Private sector workshops should be encouraged to provide training on their job. Government should ensure necessary assistance and help to private entrepreneurs for capital investment in the new portfolios created by the backward and forward linkages of PT technology. Considering the impact of PTs, extension workers, NGOs and private sector should come forward to encourage farmers to adopt PT and go for mechanization.

References

Ahmed, K. (1992), The economic impact of power tiller on productivity and employment at farm level. A study in Comilla District of Bangladesh, M. Sc. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Alam, A.M. (2000), Impact of mechanization on livestock farming and their contribution to primary cultivation. Journal of Agril. Mach. and Mech. 4(1).

Alam, G.M.M. (2003), Backward and Forward Linkages of Power Tiller Technology in an Area of Bangladesh. M.S. thesis. Dept. of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Azam, A.H.M.M. (1999), A field level study on employment generation due to growth of Agricultural Workshop in two Thanas of Natore District. M.S. thesis, Dept. of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh.

BBS (2000), Statistical Yearbook of Bangladesh, Ministry of Planning, Dhaka.

Bhutton, M.S. (1999), The impact of power tiller on productivity and employment in some selected area of Sherpur District. M. Sc. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Gill, G. H. (1981), Is there a draught power constraints on Bangladesh Agriculture, The Bangladesh Development Studies, Vol.9.No.3.

Gill, G. J. (1984), Tractorisation and rural employment in Bangladesh. In farm power and employment in Asia: performance and prospects, proceedings of a regional seminar held at the Agrarian Research and Training Institute, Colombo, Sri Lanka, October, 25-29, 1982 AGRTI, Colombo and ADC, Bangkok.

Hassain, M and Bose, M.L. (2000), 'Growth and Structural Changes in Bangladesh Agriculture; Implication for Strategies and Policies for Sustainable Development' in Mandal, M. A. S (ed), Changing Rural Economy of Bangladesh, Bangladesh Economic Association, Eskaton Garden Road, Dhaka.

Mandal, M.A.S. (1997), Tractor Mechanization in Bangladesh. ADAB News, 1V (May 1977).

Miah, T. H. (2000), Impact of power tiller utilization on crop yield, income and employment of farmers in rural Bangladesh in Mandal, M.A.S. (ed) Changing Rural Economic of Bangladesh, Bangladesh Economic Association, Eskation Garden road, Dhaka.

Rahman, A.K.M. (1999), An economic study on diversified uses of power tillers in a selected area of Nilphamari District, M. Sc. thesis, Department of Agricultural Economics and Rural Socilogy, Bangladesh Agricultural University, Mymensingh.

Saadullah, M. (1995), Working animal production and research in Bangladesh with special reference to working cows. The Second International Conference on Increasing Animal Production with Local Resources LAPLR / China, October 27-30, 1995.

Sarker, R. I. (1997). Agricultural Mechanization in Bangladesh. Selection of Technology. Join, International Conference on Agricultural Engineering and Technology Exhibition, 1997. Dhaka. 1:pp. 1-12.

Salokhe, V.H and S. G. Ilangantileke, S. G. (1990). Agro business Potential in Agricultural Machinery Manufacturing. Preceding of internal Agricultural Engineering Conference and Exhibition, Bangkok, Thailand. pp. 405-414 (Abst).

Drying of Paddy in Wet Season by Mechanical Dryer for Improving Farmers Income*

Md. Akteruzzaman**
Jesmin Parvin**

1. INTRODUCTION

Although Bangladesh is about to attain foodgrain self sufficiency, there is a threat from post harvest loss which accounts for a significant proportion of harvest. (Akteruzzaman, 2003). Of the three types of rice (Aus, Aman and Boro) grown by the farmers, Boro has become the main rice crop which occupies about 50 per cent of total rice production in Bangladesh. Unfortunately, the harvesting time of Boro (mid April to mid June) falls in the rainy season which severely causes problems of drying of the harvested paddy. Boro paddy requires moisture remedial measures at a faster rate to avoid loss during subsequent handling and storage. In most cases, lack of drying facilities compels the small farmers to sell their wet paddy immediately after harvest at a very low price.

Because of insufficient drying, rice grains get broken during husking by rice huller and if stored, pest infestation occurs which reduces the quality of seed/grains and thereby affects market price. In addition, shortage of drying space in the homestead also causes insufficient drying of grain and post harvest loss. Insufficient drying also induces post harvest loss of grains and degrade quality of rice which decreases farmers' income from rice production. Introduction of modern and scientific power operated drying machine can substantially minimize the enormous post-harvest losses ensuring quality of rice. During the rainy season, the prices of paddy decrease and rice price increases. In this period, quick drying of paddy using mechanical dryer and selling husked rice ensures additional benefit particularly to those farmers who need immediate cash income.

---

* This paper is derived from the 2nd author's Masters Thesis done in the Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

** The authors are respectively Associate Professor and former MS Student in the Department of Agricultural Economics, Bangladesh Agricultural University (BAU), Mymensingh - 2202.

Keeping in view the above issues Rangpur-Dinajpur Rural Services (RDRS) initiated mechanical dryer project with the financial assistance from the Research and Extension on Farm Power Issue (REFPI) project and technical assistance from Bangladesh Agricultural University, Mymensingh, Bangladesh Rice Research Institute (BRRI) and the University of Agriculture and Forestry, Vietnam (UAFV). The main purpose of the project was to familiarize the dryer machine to the farmers and to examine the performance of different types of dryer and find out the most appropriate technology from socio-economic and technical point of view in the context of Bangladesh. It is argued that if dryer facilities can be made available to the farmers there is possibility of improving farmers' income from rice production. However, the type of mechanical dryer suitable for the small farmers of Bangladesh is a matter of thorough investigation. This study was undertaken with the following specific objectives:

(i) to investigate the market price variation of Boro paddy and rice over time and the benefit derived by the poor farmers from the devices of mechanical dryer.

(ii) to analyze and compare financial profitability of different types of dryers from the point of view of the investors in dryers.

2. METHODOLOGY

Boro harvesting season of 2002 was considered for conducting this study. RDRS installed three types of dryer in the mainland of Lalmonirhat as well as in Char areas of Kurigram district in mid May 2002. The names of the three types of dryer are: (i) Flat Bed Dryer (FBD) (ii) Alim Batch Dryer (ABD) and (iii) STR-1 Dryer. The main characteristics of these devices are described in Table 1. One FBD was installed in Tushbhander Federation of Kaliganj Thana of Lalmonirhat. One ABD was installed in Mohendranagar Federation of Lalmonirhat Sadar thana in the village of Singadar and three STR- 1 dryers were installed in different areas of Rowmari thana of Kurigram district.

Two sets of questionnaires were developed, one for collecting information from farmers (users of dryers) and another for collecting physical, technical and cost-return data of the different types of dryers from the operators of the dryer. In total 100 farmers who used dryer services were interviewed by using the developed questionnaire from May to August 2002.

Table 1: Purchase cost and capacity of different types of sample dryer

Specification/Capacities	Unit	Flatbed dryer	Alim batch dryer	STR-1 dryer
Capacity				
ϖ Per batch	Quintal	40	3.2	4
ϖ Per day	Batch	1	4	2
Drying time/batch	Hour	8	3	5
Fuel used	-	Rice husk	Wood	wood
Fan operated by	-	Diesel	Diesel	Electricity
Sample households	No.	12	28	60
Purchase cost	Taka	135,000	135,000	7000

Moreover, secondary data were collected from different organizations such as BRRI, RDRS, and BAU/ REFPI project office. The collected data were compiled, tabulated and analyzed in accordance with the objectives of the study. In addition to tabular method, the project appraisal technique was followed to find out the profitability of mechanical dryer from owner point of view.

3. PRICE VARAITION OVER TIME AND BENEFIT DERIVED BY THE DRYER USER

3.1 Quantity and Prices of Boro Paddy Harvested and Sold over Time

The quantities of Boro paddy harvested under weather conditions is presented in Table 2. It was found that more than 20 percent of the Boro paddy was harvested during the rainy weather when drying emerged as an acute problem. Interestingly, it was observed that about 60 percent of the B*oro* paddy was harvested during the period of 2nd week of May to 4th week of May in the studied households of which only about 8 percent (313 quintal) were dried using the mechanical dryers (Table 2).

The total amounts of Boro paddy and rice sold were respectively 730 quintals and 116 quintals during the 2nd week of May to 4th week of August. It is evident that one-fourth of the harvested paddy was sold after immediate harvesting of Boro paddy during the month of May and almost every household sold paddy at home. Overall one third of the marketed Boro paddy was sold at home and the remaining amount was sold at market places.

The prices of Boro paddy were Taka 525 per quintal in the rainy day and Taka 563 in the sunny day during the 3rd week of May and these prices were found Taka 650 and Taka 725 respectively during the end of July (Table 3). The prices of paddy were 7.24 percent higher in the sunny day than in the rainy day during the 3rd week of May while the variation was observed 11.54 percent during the 4th week of July

between rainy and sunny day (Table 3). The prices of paddy were 25 to 30 percent higher over the period of time irrespective of rainy and sunny day.

Table 2: Quantity of Boro paddy harvested and sold under different weather condtions over the wet season 2002

Time of Harvested	Quantity harvested (quintal			Percent of total		
	Rainy Weather	Sunshine Weather	Total	Rainy Weather	Sunshine Weather	Total
1st week of May	32	176	208	15.38	84.62	4.94
2nd week of May	233	827	1060 (97)	21.99	78.01	25.17 (1.12)
3rd week of May	212	1014	1226 (112)	17.32	82.68	29.11 (4.08)
4th week of May	343	1110	1453 (104)	23.62	76.38	34.48 (2.47)
1st week of June	42	218	260	16.18	83.82	6.16
2nd week of June	0	6	6	0	100	0.14
Total harvested	862	335	4213 (313)	20.48	79.52	100.00 (7.67)
Total sold	-	-	729.60	-	-	17.32

Note: Figure in the parenthesis indicate the amount and percentage of paddy dried by mechanical dryers in the studied households.

It was observed that the average price of rice increased by3.29 per cent in the rainy day compared to the price in sunny day. The average prices were Taka 1255 per quintal in the rainy day and Taka 1215 on sunshine day and the highest difference (5.20 percent) was observed in 4th week of June when the prices were respectively Taka 1275 and Taka 1212 per quintal (Table 3). In the case of paddy, situation was reverse. Thus farmers were getting higher returns from sale of paddy by using the mechanical dryer.

3.2 Micro View of the Prices of Boro Paddy and Rice over Time and Locations

An investigation of the prices of Boro paddy and rice were done together considering the area, period of time and point of time in this study. It was found that the price of Boro paddy at Mohendranagar was the highest (Taka 670) due to the nearness of this area to district headquarters (Table 4). The prices of Boro paddy in Kaligonj (Taka 630) largely differed with that of Mohendranagar due to

distant location of this area from the district headquarters. Kurigram being a remote and backward area, lacked easy communication with district headquarters. As a result, any commodity can not gain easy access in or out for marketing. Thus prices of any commodity are much higher in this area and the price of Boro rice also showed the similar trend (Table 5).

Table 3: Selling price of Boro paddy and rice over time and weather in the study areas

Time of sold	Price of Boro paddy (tk./			Price of boro paddy (Tk./quintal		
	Rainy day	Sunny day	% higher in sunny day	Sunny day	Sunny day	% higher in rainy
3rd week of May	525	563	7.24	-	-	-
4th week of May	550	600	9.09 1150		11953.91	
1st week of June	575	663	15.30	1200	1250	4.17
2nd week of June	588	650	10.54	1225	1250	2.04
3rd week of June	588	655	11.39	1225	1262	3.02
4th week of June	593	663	11.80	1212	1275	5.20
1st week of July	625	713	14.08	1225	1275	3.92
2nd week of July	625	713	14.08	1225	1262	2.04
3rd week of July	638	725	13.64	1225	1250	3.07
4th week of July	650	725	11.54	1237	1275	3.47
Average	596	667	11.91	1213	1255	3.29

Source: Field Survey (Wet season, 2002)

An attempt was made to observe the amount of paddy sold within a certain period. It was observed that only 14 percent of paddy was sold within 7 days while 31 percent within 30 days, 38 percent within 60 days and the rest 17 percent was sold within 90 days of harvesting paddy. The prices of both paddy and rice had an upward trend (Tables 4 and 5) with the passage of time. The price of per quintal Boro paddy was Taka 563 within 7 days and it increased to Taka 750 within 90 days and in case of rice, the corresponding prices were Taka 960 and Taka 1240 respectively. The prices of both rice and paddy increased by about 30 percent with the passage of time. It was also found that the Boro paddy prices decreased with the occurrence of consecutive rainy days while the price of Boro rice increased substantially. Evidence showed that the Boro paddy price decreased by about 7 per cent while the rice prices increased by about 6 percent (Table 4 and Table 5).

Table 4: Price of Boro paddy by location, period and point of time during the wet season of 2002

Location	Price per quintal (Tk.)	Period of Time	Qty sold (%)	Price per quintal (Tk.)	Point of Time*	Price per quintal (Tk.)
Kaligonj	630	Within 7 days	14	563	1st rainy day	675
Mohendranagar	670	Within 30 days	31	625	2nd rainy day	655
Kurigram	663	Within 60 days	38	695	3rd rainy day	638
All	655	Within 90 days	17	750	4th rainy day	630

* Data generated from Tarakanda of Fulpur in Mymensingh during 18-25 July 2002.

Table 5: Price of rice by location, period and point of time during the wet season in 2002

Location	Price per quintal (Tk.)	Period of Time	Price per quintal (Tk.)	Point of time*	Price per quintal (Tk.)
Kaligonj	1085	Within 7 days	960	1st rainy day	1200
Mohendranagar	1143	Within 30 days	1053	2nd rainy day	1230
Kurigram	1133	Within 60 days	1155	3rd rainy day	1255
All	1120	Within 90 days	1240	4th rainy day	1268

* Data generated from Tarakanda of Fulpur in Mymensingh during 18-25 July 2002.

3.3 Benefit Accrued to the Users of Mechanical Dryer

In this section an attempt has been made to impute the cost and return from drying paddy. Normally the price of paddy decreased on consecutive rainy day. All the costs were computed and presented in Table 6. It was found that after imputation of all the processing costs the benefit derived from such paddy market was about Taka 81.00 per quintal in addition of post-harvest losses. For example, if a petty rice trader buys one quintal of paddy in the rainy day at Taka 675 and then he processes the paddy such as parboiling, drying, milling and carrying etc., then all the costs stood at Taka 775 (Table 6). It was assumed that one quintal of paddy would be converted to 67.50 kilogram of husked rice which can be sold at the rate of Taka 12.68 per kilogram, that is Taka 1268 per quintal. Thus, the total return from one quintal of processed paddy would amount to Taka 865. Hence, a total of Taka 81 will be the net return/benefit from one quintal of paddy. In this way, a dryer could be used for such kind of business motive which was found very

common in Vietnam market (Hien, 1999). If the loss of post-harvest operation can be reduced, the derivable benefit will be more than the estimated benefit value. The small and marginal farmers can take it as a business motive.

Table 6: Imputation of benefit derived from Dryer as alternative source of income to the farmer

Cost items	Cost in Taka	Percent of total
Purchased price of paddy in rainy day (Taka per quintal)	675.00	87.02
Parboiling cost	25.00	3.27
Cost of drying	37.50	4.83
Cost of milling	25.00	3.27
Carrying cost	12.50	1.61
A. Total cost	775.00	100.00
B. Return from selling rice @0.675x100 kg = 67.5 kg x 12.68	856.00	
Total gain from per quintal paddy in addition to reducing post harvest loss	81.00	

Source: Field Survey (Wet season, 2002)

4. RETURN ON INVESTMENT TO MECHANICAL DRYER OWNERS

The aim of this section is to analyze what happens to financial profitability under different types of dryer from the view point of investors. The sensitivity analysis also was worked out in this section to examine the change of profitability with the changed circumstances. The gross cost and gross benefit of the mechanical dryer were calculated to see the return on investment in mechanical dryer operation.

4.1 Measuring Gross Costs

Cost items were classified into two major groups e.g. capital cost and operational and maintenance cost. There together equaled total cost. The capital cost consists of the purchase cost of different types of dryer which varied with their characteristics and discussed earlier in Table 2. Operation and maintenance cost varied with the type of FBD, ABD and STR-1 dryer machines. The operation and maintenance cost consists of costs of diesel, cost of husk, carrying cost, cost of electricity, cost of charcoal, cost of firing wood, and casual labor cost. All the costs were calculated during the period of dryer operation in the year of 2002. Table 7 demonstrates the per quintal paddy operation cost of drying under

different types of dryer which were Taka 27.30, Taka 32.12 and Taka 29.25 respectively for FBD, ABD and STR-1. The cost of FBD was lower than that of the STR-1 and ABD. The cost of ABD was the highest for drying paddy in the wet season. In the case of FBD, the cost of charcoal/wood and husk constituted about 47 percent of the total cost while the costs of diesel was about 5 percent higher in ABD. The lower cost resulted from economic use of the higher capacity utilization. Electricity was used only for STR-1 but diesel was used for both FBD and ABD. So, the average cost of STR-1 was moderately higher than FBD cost.

Table 7: Operation and maintenance cost of different types of dryer practiced for drying *Boro* paddy in the study areas

Cost items	Flat Bed Dryer		Alim Batch Dryer		STR-1	
	Cost per quintal (Tk)	% of total cost	Cost per quintal (Tk)	% of total cost	Cost per quintal (Tk)	% of total cost
Cost of charcoal/ Firing wood	7.83	28.66	9.38	29.18	8.38	28.63
Cost of husk	4.93	18.04	3.75	11.67	3.75	12.82
Cost of diesel	6.00	21.98	8.50	26.47	0	0
Labor cost	7.00	25.64	7.88	24.51	6.50	22.22
Cost of carrying	1.55	5.68	2.63	8.17	1.63	5.56
Cost of electricity	0	0	0	0	9.00	30.77
Total operating cost	27.3	100.00	32.13	100.00	29.26	100.00

Source: Field Survey (Wet season, 2002)

4.2 Measuring Gross Benefits

The formula used for calculating gross benefit was the benefit derived from collected charge (Quantity of dried paddy in quintal x charge collected per quintal for drying Boro paddy) + reduced post-harvest losses + grain saved + increased return for quality improvement. Though this formula was considered but due to lack of data it overlooked the benefit derived from reduced post-harvest loss, grain saved and increased return for quality improvement. Thus the amount of paddy to be dried by the respective dryer multiplied by per unit fixed charge has been considered. The gross benefit of the FBD was found to be Taka 60,000 (Taka 37.50 x 1600 quintals), and Taka 19,200 (Taka 37.50x 512 quintals) and Taka 11,200 (Taka 35.00 x 320 quintals) were found to be the gross benefit for ABD and STR-1 dryer respectively. In addition, 10 percent of the investment cost was considered as salvage value which was added to the 5th years benefit.

4.3 Financial Analysis of the Mechanical Dryers

The financial analysis in this study was computed from the viewpoint of owner of mechanical dryer. Discounted measures of project worth were used for financial analysis. The discounted measures commonly used in agricultural project analysis are (i) Benefit-Cost Ratio (BCR), (ii) Net Present Value (NPV) and (iii) Internal Rate of Return (IRR). The formal mathematical statements of the discounted measures of project worth are suggested by Gittinger (1994). This appraisal, however, is based on the following assumptions:

(a) All the mechanical rice dryer FBD, ABD and STR-1 were purchased in cash.
(b) The life span of the FBD, ABD and STR-1 dryers were considered 5 years.
(c) Production technology was assumed to remain unchanged throughout the project life.
(d) Prices of all inputs and outputs were assumed to remain constant through out the project life.
(e) Discount factor of 15% was assumed for calculating BCR, NPV, as this seemed to be the opportunity cost of capital under the existing condition of Bangladesh economy.

The summary results of financial analysis of the three different types of mechanical dryers are presented in Table 8. It clearly shows that investment on STR-1 dryer was highly profitable while the investments on FBD and ABD were not profitable in the existing condition. The result showed that the BCR for STR-1 dryer was 1.06 that is higher than unity while the BCR of FBD and ABD were respectively 0.87 and 0.43.

The NPV of the STR-1 in existing condition was Taka 2,306 while for the other two types of dryer it was negative indicating the loss of the FBD and ABD respectively. The positive NPV indicates that STR-1 is considered financially viable and IRR of the STR-1 dryer was also greater than the normal bank rate. The average IRR was 40.29 percent while the IRR of other two types of dryer were negative. In view of these circumstances, the financial analysis showed that STR-1 dryer was highly profitable from the viewpoint of individual investments.

Table 8. BCR, NPV at 15 percent discount factor and IRR of different dryers

Dryer type	Existing condition			Remodeling		
	BCR	NPV (Taka)	IRR (%)	BCR	NPV (Taka)	IRR (%)
STR-1	1.06	2,306	40.29	1.01	295	18.03
Flat Bed Dryer	0.87	-30,229	-0.50	1.06	11,137	24.78
Alim Batch dryer	0.43	-93,516	-33.21	0.69	-32,647	-16.21

4.4 Sensitivity Analysis of the Different Types of Dryers

The evaluations of financial analysis as stated in left hand side in Table 8 have been done based on certain assumptions as stated earlier. The local workshop owners and engineers stated that the prices of the FBD and ABD could be reduced to 50 percent (about Taka 70,000) after remodeling the dryers but the flow of income would remain constant during the life cycle. It is possible because the former prices actually did not reflect the purchase price which was taken as research and development cost of the dryers. In case of STR-1 dryer, if the drying period reduced 30 days instead of 40 days due to fine weather. The result of sensitivity analysis shows how the investment decision changes with the changes in the value of any variable in the discounted cash flow analysis. Dillon and Hardeker (1993) also argued that the problem of uncertainty was another knotty problem for which there was no easy solution. In Bangladesh, the price of cost items is increasing day by day. Only the vital factors such as price of the dryers and weather were considered in this study for the sensitivity analysis.

The results of the sensitivity analysis showed that the BCR of the FBD increased to 1.06 and NPV increased to Taka 11,137 and was observed 24.78 percent which were very promising. The BCR, NPV and IRR of the ABD were respectively 0.69, Taka -32,647 and –16.21 per cent, that is, still increasing losses (Table 8). In case of the STR-1, the BCR, NPV and IRR decreased to 1.01, Taka 295 and 18.03 percent, that is, it could still earn a marginal profit. Thus, the study suggested that STR-1 dryer could be used for the household level due to its modest capacity and the FBD dryer could be suggested for the commercial rice husking mills for its larger capacity while there was a possibility of making the ABD profitable when it could be used for drying high valued seed.

5. CONCLUSIONS

Natural or sun drying is solely dependent on weather condition, so the timeliness of work is hard to be achieved. As mentioned in the introduction, drying becomes more problematic for Bangladesh farmers during Boro harvesting season due to

continuous rainfall and preoccupation of farmers for planting the next crop. So artificial drying is very necessary during peak season not only to lessen the burden of farmers but also to prevent the grain deterioration, which will greatly affect the income of farmers. Therefore, FBD, ABD and STR-1 dryer machines were the reasonable alternative methods of sun drying.

Based on the above findings the following conclusions could be drawn:

1) A large quantity of Boro paddy is harvested and sold during the peak period of wet season. Thus, the higher demand for mechanical dryer is observed during that period to ensure fair price to the farmers.

2) The price of Boro paddy varies from place to place depending on variation in weather condition. Higher price (7 to 12 percent) was observed at market than at home and 10-12 per cent higher price was observed at sunny day compared to rainy day. Thus, the farmers could rely on the mechanical dryer for securing fair price of paddy.

3) The price of rice increased by 10 percent in subsequent rainy day while the price of paddy decreased by 8 percent under the same environment so, the dryer could help farmers for earning additional income by taking it as a business venture.

4) Rice husk can also be used, as a cheap fuel for dryer which can eventually reduce the operational cost of a dryer.

5) Finally, the study strongly recommends for rapid extension of appropriate designed dryer through government and non-government initiatives.

References

Akteruzzaman, M. (2003): "Socio-economic aspects of mechanical dryer for Drying Paddy in Wet Season at RDRS sites in Rangpur". Workshop Paper presented at RDRS, Rangpur, Bangladesh.

Dillion, J. L. and Hardaker (1993): Farm Management Research for Small Farmer Development, FAO, Rome.

Gittinger, J.P. (1994): Economic Analysis of Agricultural Projects. John Hopkins University Press, Baltimore.

Parvin, J. (2003): An Economic Study on the Use of Mechanical Dryer for Drying paddy in Wet Season at RDRS Sites in Bangladesh, Unpublished M. S. Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Phan Hieu Hien (1999): A systematic approach to promote dryer as a major measure of quality assurance for rice grain, Workshop Paper, Held at University of Agriculture and Forestry, Vietnam.

RDRS (2001): Community based integrated technology investigation for drying of paddy in wet season, A Project Proposal, RDRS, Rangpur.

Footnoting and writing style of the Bangladesh Journal of Political Economy

1. The Bangladesh Journal of Political Economy will be published in June and December each year.
2. Manuscripts of research articles, research notes and reviews written in English or Bangla should be sent in triplicate to the Editor, The Bangladesh Journal of Political Economy, Bangladesh Economic Association, 4/c Eskaton Garden Road, Dhaka-1000, Bangladesh.
3. An article should have an abstract within 150 words.
4. Manuscript typed in double space on one side of each page (preferably with softcopy) should be submitted to the Editor.
5. All articles should be organized generally into the following sections: a) Introduction: stating the background and problem; b) Objectives and hypotheses; c) Methodological issues involved; d) Findings; e) Policy implications; f) Limitations, if any; and g) Conclusion (s).
6. The author should not mention his/her name and address on the manuscript. A separate page bearing his/her full name, mailing address and telephone number, if any, and mentioning the title of the paper should be sent to the Editor.
7. If the article is accepted for publication elsewhere, it must be communicated immediately. Otherwise, the onus for any problem that may are will lie on the author.
8. The title of the article should be short. Brief subheadings may be used at suitable points throughout the text. The Editorial Board reserves the right to alter the title of the article.
9. Tables, graphs and maps may be used in the article. Title and source(s) of such tables should be mentioned.
10. If the Editorial Board is of the opinion that an article provisionally accepted for publication needs to be shortened or particular expressions deleted or rephrased, such proposed changes will be sent to the author of the article for clearance prior to its publication. The author may be requested to recast any article in response to the review thereof by any reviewer.
11. The numbering of notes should be consecutive and placed at the end of the artile.
12. Reference in the text should be by author's last name and year of publication (e.g. Siddique, 1992, P. 9. In the list of references, the corresponding entry in the case of article should be in the following manner:

Siddique. H.G.A., "Export Potentials of Ready-Made Garments Industry-A Case Study of Bangladesh". The Dhaka University Studies. III, 1982, Pp. 66-67.

In the case of books, the following order should be observed: Author, title, place of publication, publisher, date of publication, page number. As for example: *Hye, Hasnat Abdul, Integrated Approach to Rural Development,* Dhaka: University Press Limited, 1984, Pp.3-4.

13. Reference mentioned in the text should be arranged in alphabetical order and provided at the end of the article.
14. The Bangladesh Economic Association shall not be responsible for the views expressed in the article, notes, etc. The responsiblity of statements, whether of fact or opinion, shall lie entirely with the author. The author shall also be fully responsible for the accuracy of the data used in his/her manuscript.
15. Articles, not accepted for publication, are not returned to the authors.
16. Each author will receive two complimentary copies of The Bangladesh Journal of political Economy and 25 off-prints.

Bangladesh Economic Association
4/C Eskaton Garden Road
Dhaka-1000, Bangladesh
Tel: 9345996; Fax: 880-2-9345996
e-mail: becoa@bdlink.com