This book is provided in digital form with the permission of the rightsholder as part of a Google project to make the world's books discoverable online.

The rightsholder has graciously given you the freedom to download all pages of this book. No additional commercial or other uses have been granted.

Please note that all copyrights remain reserved.

About Google Books

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Books helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at http://books.google.com/

Technical Bulletin No. 33

Vegetable Production in Bangladesh

Commercialization and Rural Livelihoods

Katinka Weinberger
Christian A. Genova II

AVRDC
The World Vegetable Center

Vegetable Production in Bangladesh

Commercialization and Rural Livelihoods

Written by Katinka Weinberger and Christian A. Genova II

AVRDC – The World Vegetable Center

AVRDC
The World Vegetable Center

AVRDC – The World Vegetable Center is an international not-for-profit organization committed to ensuring the world's food security through research, development, and training.

© 2005 AVRDC – The World Vegetable Center

P.O. Box 42, Shanhua, Tainan, Taiwan 741, ROC
tel: +886-6-583-7801
fax: +886-6-583-0009
e-mail: avrdcbox@avrdc.org
www: http://www.avrdc.org

Weinberger, K. and C.A. Genova II. 2005. Vegetable production in Bangladesh: commercialization and rural livelihoods. Technical Bulletin No. 33. AVRDC publication number 05-621. Shanhua, Taiwan: AVRDC–The World Vegetable Center. 51 pp.

ISBN 92-9058-142-5

*For more information contact Dr. Katinka Weinberger, Associate Socio-economist, AVRDC at <weinberg@avrdc.org>

Edited by: Tom Kalb
Cover design: Ming-che Chen
Photos: Thomas Lumpkin

Contents

Chapters

Tables

Figures

Acronyms

ADB	Asian Development Bank
AVRDC	Asian Vegetable Research and Development Center
BADC	Bangladesh Agricultural Development Corporation, later renamed as Bangladesh Agricultural Inputs Supply and Services Corporation
BAPA	Bangladesh Agro-Processor's Association
BARI	Bangladesh Agriculture Research Institute
BBS	Bangladesh Bureau of Statistics
BRAC	Bangladesh Rural Advancement Committee
EU	European Union
EUREPGAP	Euro Retailer Produce Working Group - Good Agricultural Practice
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
HACCP	hazard analysis and critical control point
IPM	integrated pest management
IMPLAN	impact analysis for planning
HYV	high-yielding variety
N	number of respondents
SD	standard deviation
TK	TAKA, Bangladesh's currency
USAID	United States Agency for International Development

Acknowledgements

This study was a collaborative project between the Bangladesh Agriculture Research Institute (BARI) and AVRDC – The World Vegetable Center. We would like to acknowledge a number of individuals for their assistance with this work.

Our respectful appreciation to Dr. Habibul Hoque, Chief Scientific Officer and Head and N. Islam, M. N. Islam and T. M. B. Hossain, scientific officers from the Economics Division of BARI, for providing invaluable support especially in leading a team of ten enumerators to complete the survey work during a two-week period, and for their assistance in the focus group meetings and key informant interviews.

From AVRDC, Kitty Wu, former research assistant, for her supervision of data collection activities in Bangladesh; Ming-Che Chen for the cover page design; and Olivia Liang for the secretarial support.

Finally, we are grateful to the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) and Eiselen Stiftung for the joint financial support provided under contract number GTZ81063039.

1 Introduction

1.1 Background

Bangladesh has an overwhelmingly agricultural economy. Agriculture accounts for 32% of its gross domestic product (GDP), and absorbs 63% of the country's labor force. Sustained government investment in irrigation facilities, rural infrastructure, agricultural research, and extension services has helped Bangladeshi farmers achieve dramatic increases in agricultural production. The process of agricultural production is, however, underpinned by the increasing use of agrochemicals and multiple cropping. And while significant production transformation has been achieved and food production has more than doubled since independence in 1971, these have mostly supported the country's large population base rather than uplifting the living standards of the average citizen. Food security still remains a major development issue. Thus, the government of Bangladesh has called for a departure from "rice-led" growth to a more diversified production base that includes several non-rice crops (Hoque 2000).

Diversification into vegetable crops and increasing commercialization can support the development of the agricultural sector in several ways. Commercialization is characterized by households moving from subsistence systems into semi-commercial and commercial systems (with the main objective of achieving food self-sufficiency), thereby maximizing profits and generating surplus (Pingali and Rosegrant 1995). It implies increased market transactions since farmers participate in the process to capture gains from specialization (von Braun 1995). Similarly, increasing capital intensity in production and processing leads to growth in the agribusiness sector. As a result, the number of agro-processing, distribution and farm-input provision companies increases (Reardon and Barrett 2000). Commercialization can take place on the output side—when the farmer sells their products on the markets—or on the input side with increased use of purchased inputs (von Braun 1995).

If these changes take place, and income and employment opportunities subsequently grow causing an increase in real wages, then increasing commercialization and the development of agribusiness contribute to overall growth and economic development. Yet, little is known on how commercialization-led income growth is actually distributed among different social groups, and whether it actually reduces poverty (von Braun 1995; Barron and Rello 2000; Reardon and Barrett 2000) or how it affects women as compared to men (Spring 2001).

The debate on poverty effects of commercialization thus largely centers on the question whether poor households and farmers benefit from commercialization. The basis for this discussion is that the poor are more vulnerable to risk (Anderson and Roumasset 1996; Marra et al. 2003). Increased risk is an important factor in the production of vegetable crops for several reasons. While vegetables appear to be highly competitive in terms of both financial and economic returns compared with rice (Shahabuddin and

Dorosh 2002), vegetables generally are more costly to produce per hectare than traditional crops (Key and Runsten 1999; Ali and Hau 2001). While staple crops are usually cultivated using a level of input intensity appropriate to the financial resources available within a household, high-value crops such as vegetables often require an intensive input regime, necessitating large labor inputs in planting and harvesting that cannot be met with family labor alone. In developing countries, these high value crops tend to have higher profit variability due to variability in yields and prices. Prices for horticultural crops are more variable because the variability in yields increases the variability in market supply. Also, since markets for these products are usually thin, the price effect of the supply change is often exaggerated (Key and Runsten 1999).

1.2 Objective and Approach

Supported by USAID, AVRDC conducted a project in Bangladesh from 1991–2000 with the aim of overcoming constraints in vegetable production. Interventions included germplasm evaluation and varietal development for many vegetables, including tomato, eggplant, chili pepper, okra, onion, garlic, radish, red amaranth, Indian spinach, kangkong, cabbage, Chinese cabbage, cauliflower, yardlong bean, mungbean, vegetable soybean, peas, cucurbits and asparagus. Off-season production technologies were developed for tomato, cauliflower and okra. Grafting technologies for tomato and watermelon were developed to control soil-borne diseases (AVRDC 2000).

An impact assessment of the USAID project was conducted in 2001. Results revealed that adopting farmers from the four districts in Bangladesh (Jessore, Noakhali, Rangpur and Savar) achieved approximately 30% higher net revenues from vegetable production than their non-adopting peers, among other advantages (Ali and Hau 2001). Despite the substantial improvements observed for both adopting and non-adopting farmers (due to spillover effects) on the farm level, commercialization effects could not be validated at that time. Now, with more than a decade after the project was initiated, evaluation of the project's effects beyond vegetable production is highly plausible.

This study aims to understand the effect increased vegetable production has on the rural population beyond the direct farm level. Specifically, the objectives of this project are to:

- analyze the impact of vegetable commercialization and agribusiness development on off-farm employment opportunities and wages;
- analyze the effect of increased vegetable production on commercialization and agribusiness development (i.e. marketing channels and supporting input industries); and
- undertake the analysis with a focus on differential effects on different groups in society, focusing particularly on the impact on poverty reduction.

2 Research Methodologies and Procedure

The study incorporates quantitative and qualitative methodologies, using structured farmer interviews, focus group discussions, key informant interviews, and available secondary data.

2.1 Survey

Originally, this study intended to utilize the same farm household survey sample gathered by the 1991–2000 USAID-funded Bangladesh project to assess whether adopters and non-adopters of vegetable technologies have had a different probability of finding skilled off-farm employment, and how this has affected their overall well-being in terms of asset accumulation, expenditures for nutrition, and children's education. Unfortunately, the data set was no longer available when our study was in progress.

Under these circumstances, our study followed a purposive sampling design, in which we selected sites close to urban markets since we assume that commercialization can more easily occur where regional markets are available. Within villages, households were randomly selected. We chose two districts from the four districts covered under the initial study (Jessore and Savar) to allow for some comparison with that study, and also attempted to include the same villages, or villages in close proximity to such included in the earlier study. The farm household survey covered 10 villages (Muktodhaho, Mothura pur, Tirer Hat, Haibut pur, Terarhat, Baliadanga, Maruikthuhi, Charamon Khathi, Paltadanga, and Noldanga) in Jessore and 12 villages (Mushurikriola, Jhauchar, South Matika, Tulatali, Char Tulatoli, Chauira, Vakurfa, Kaisharchar, Sadapur, Goper Bari, Chakulia, and Kazi para) in Savar. The research team surveyed 172 farm households in the west side of Jessore district, and 163 in the central area of Savar, which is in the Dhaka district. Between 10 and 15 farmers per village were surveyed, depending on the village size. The survey covered farmer characteristics, marketing and input of crop products, and information on socioeconomic status.

Initially drafted at AVRDC, the survey questionnaire was revised twice in Bangladesh: during the planning meeting and technical discussion with the Bangladesh Agriculture Research Institute (BARI) scientific officers, and after the pretest.

AVRDC trained ten enumerators and prepared the data entry format, while BARI handled the survey logistics and conducted the data entry. The analysis was then performed at AVRDC.

The information on off-farm employment activities with respect to gender and wage gathered by our survey may underestimate the true situation for two principal reasons: (1) farmers interviewed felt embarrassed to disclose that their wives and children work outside for money; and (2) enumerators have a biased perspective on the involvement of wives and children in off-farm work. Also, the average total monthly cash expenditures

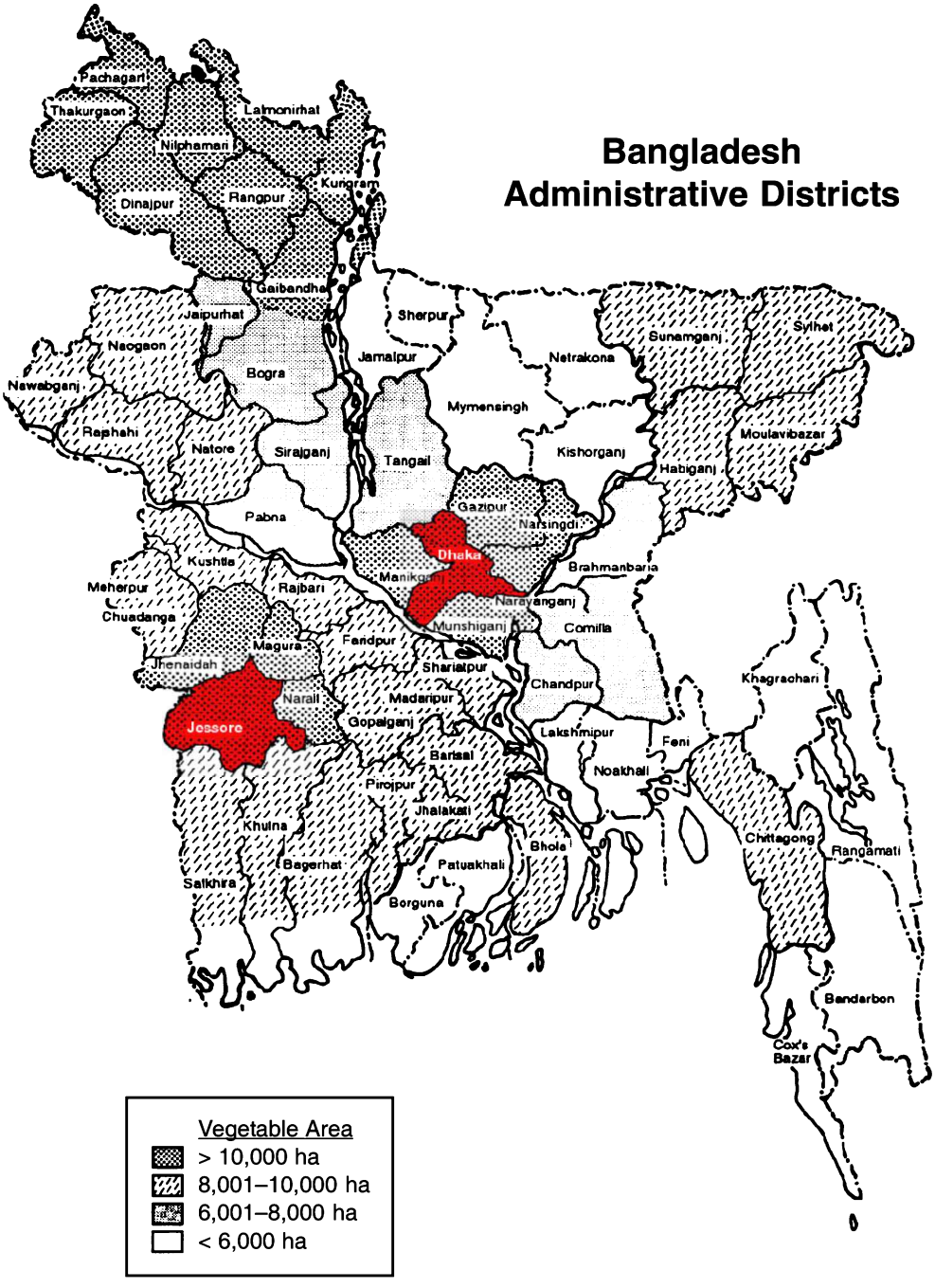
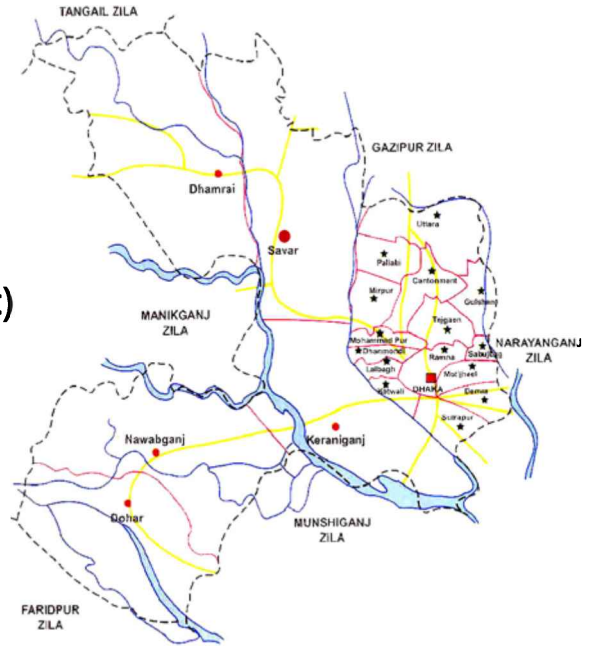
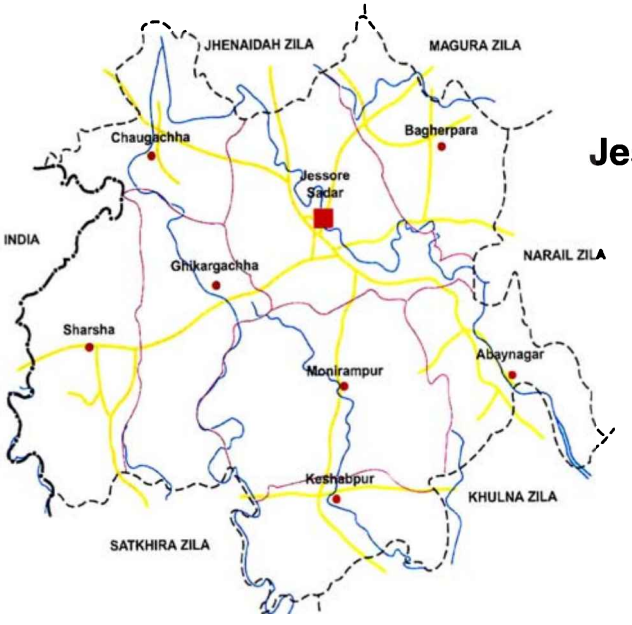


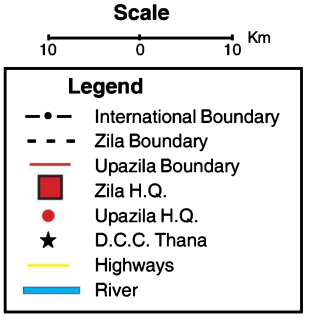
Figure 1. Survey areas

Savar
(Dhaka District)





Jessore



available for all household consumption collected by the survey are lower than the average amount indicated in the 2000 National Household Income & Expenditure Survey. This is because we focused on cash expenditures and excluded in-kind.

2.2 Focus Group Discussions

The survey data was supplemented with qualitative data collected in the focus group discussions held in the rural communities of Jessore and Savar. The discussions were done primarily to learn from the villagers the range of new agribusiness that have developed relative to increasing vegetable production, new job opportunities that have emerged, and the beneficiaries from the increase in agro-industrialization. Ten interviews were conducted each at the nine villages in Jessore (Muktodhaho, Mothura pur, Tirer Hat, Haibut pur, Kadir para, Shahabaj pur, Charamon Khathi, Paltadanga, and Noldanga) and nine villages in Savar (Mushurikriola, Kanda para, Mushuri Kriola, Chauira, Bakurta Hinda para, Kisherchar, Sadapur, Kazi para, and Chakulia). The focus group discussions were conducted with men and women separately.

Results show that the male focus groups are more knowledgeable on the technical aspects of farming, and are reluctant to provide employment information with respect to gender and children. Female focus groups, on the other hand, are the reverse. Nevertheless, both groups find it difficult to identify benefits to the community from increased vegetable production and increased employment opportunities in vegetable production. Social classes are still evident in Bangladesh, which explains the lack of participation of landless farmers (considered to be of lower status) compared with land-owning farmers during the discussions.

2.3 Key Informant Interviews

On the meta level, ten interviews were conducted with key informants such as community leaders, entrepreneurs, and market middlemen in Jessore, Savar, and Dhaka areas. Of these, four interviews were conducted with vegetable wholesalers, vegetable retailers, and seed retailers; while the other six interviews were with the representatives from the Department of Agriculture Marketing in Bangladesh, Bangladesh Seed Merchant Association, seed producers, food processing companies, and Bangladesh Women Entrepreneurs Association. These semi-structured interviews provided information on the impact of increased vegetable production on commercialization and agro-industrialization. The interviews, although completed in a satisfactory manner, failed to capture a detailed picture of the business practices in Bangladesh since both food processing companies and seed producers did not divulge detailed wage information and marketing schemes used by their companies to promote agri-products.

3 Vegetables in Bangladesh

3.1 Overview on Vegetables and Growing Patterns

More than 60 types of vegetables of indigenous and exotic origin are grown in Bangladesh. Based on the growing season, vegetables are categorized as summer/rainy season vegetables, winter season vegetables, and all-season vegetables. Of the summer vegetables, various cucurbits, vegetable cowpea, hyacinth bean, stem amaranth, several aroids and Indian spinach are predominant. Winter vegetables include tomato, cabbage, Chinese cabbage, cauliflower, eggplant, carrot, spinach, bottle gourd, bush bean and radish. Crops like okra, heat-tolerant tomato, eggplant, carrot, spinach, many leafy vegetables and small onion are grown all year round. Summer vegetables are cultivated during the monsoon season from May to October. On the other hand, winter vegetables are grown from November to April. The production of vegetables is higher during winter (60 to 70%) and most districts produce marketable surplus during that season.

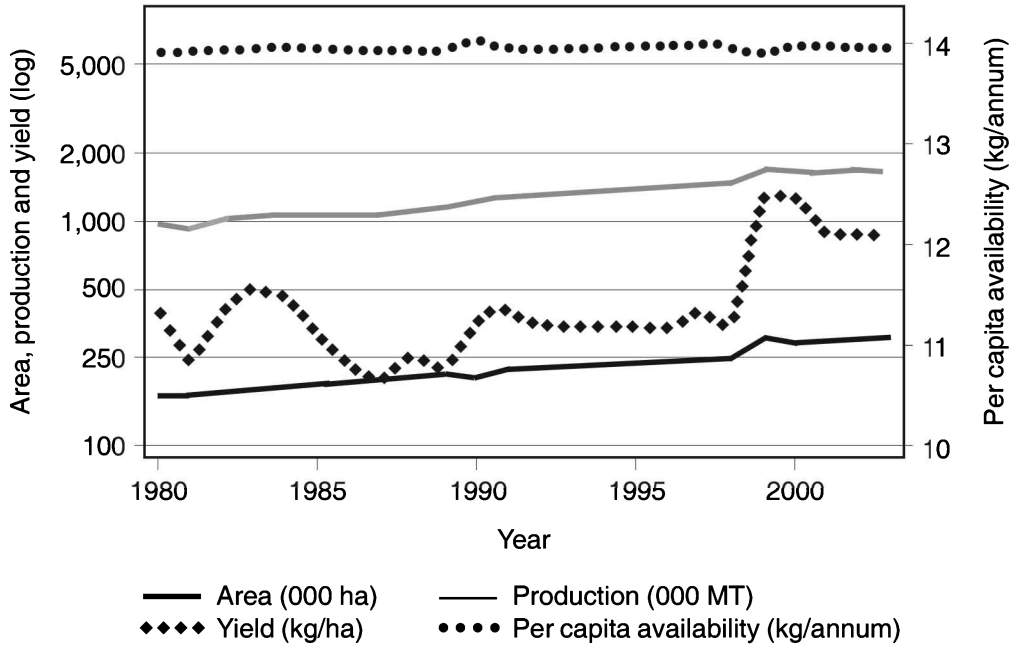
<table>
<tr><th></th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="2">Lowlands</td><td colspan="4" rowspan="2">Rabi crops (cont.): Maize, watermelon, onion, chili, pulses, oilseeds</td><td colspan="4">Rice/fish integration</td><td colspan="4">Rabi crops (beginning)</td></tr>
<tr><td colspan="4">Sesame, groundnut, jute</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Medium elevation lands</td><td colspan="3">Rabi crops (cont.): Maize, watermelon, onion, chili, pulses, oilseeds</td><td colspan="3">Summer vegetables</td><td colspan="3">HYV aman specialty rice</td><td colspan="3">Rabi crops (beginning)</td></tr>
<tr><td colspan="4">Rabi crops (cont.): Maize, watermelon, winter vegetables, onion, chili, pulses</td><td colspan="4">HYV aman specialty rice</td><td colspan="4">Rabi crops (beginning)</td></tr>
<tr><td rowspan="2">Highlands</td><td colspan="4">Cotton (cont.)</td><td colspan="4">Summer vegetables, jute</td><td colspan="4">Cotton (beginning)</td></tr>
<tr><td colspan="12">Perennials (banana, papaya, sugarcane) intercropped in the first rabi season with pulses, oilseeds or vegetables</td></tr>
</table>

Source: Adapted from Faruqee (1998)

Figure 2. Vegetable-based cropping patterns in Bangladesh

3.2 Trends in Vegetable Production

Vegetable production in Bangladesh has increased between 1980 and 2003, with an average annual growth rate of 2.8%. Most of this growth can be attributed to area expansion (2.6%) and only a small share to yield increases (0.2%). Current yields are 5.8 t/ha, as compared to 5.7 t/ha in 1980. However, it is misleading to discuss yields for aggregates of vegetables, as the mix of crop within the aggregate group may have changed significantly over time. Total production in 2003 was 1.74 million t. The share of area under vegetable cultivation in total arable land has nearly doubled from 1980 to 2002, from 1.9% up to 3.6%. A relatively stark expansion in area can be observed between 1998 and 1999[1]. This increase has also translated into greater per capita availability, which increased from approximately 11 to 12 kg (drawn on the right axis of Figure 3). Altogether, however, domestic vegetable availability is still far from fulfilling domestic demand, which explains the large trade deficit for horticultural products discussed below.



Source: FAOSTAT data, 2004.

Figure 3. Trends in vegetable production, 1980–2003

[1] Increases in area and production may be due to improvements in estimation methods after 1995/96, which in some cases has led to upward adjustments of rice and vegetable production (ADB 2001).

Overall, the growth of the vegetable production sector compares favorably with the productivity growth of cereal crops (Table 1). The growth of non-cereal crops during the post-1996 period was led by vegetables and herbs, rather than the major traditional crops e.g. jute, sugarcane, pulses and tobacco (ADB 2001). Most of the vegetable crops experienced high growth during the period. For most crops that experienced high growth, net financial returns were relatively high[2] indicating favorable price responses by the farmers (Shahabuddin and Dorosh 2001). This appears to indicate the beginning of a qualitative shift in agricultural production and farmers' willingness to exploit opportunities under favorable conditions.

Table 1. Agricultural growth during the 1990s

Item	1990–1996	1996–2000
Agriculture	1.81	5.32
All crops	–0.09	4.64
Cereals	–0.61	5.23
Rice	–0.88	5.12
- *Aus*	–6.90	–0.23
- *Aman*	–1.23	3.00
- *Boro*	2.69	10.12
Wheat	7.44	7.82
Non-cereals	1.01	3.21
- Vegetables	3.51	5.43
- Herbs	–0.18	18.81
- Oilseeds	1.51	4.93
Livestock	2.40	2.67
Fishing	7.78	8.85

Source: ADB (2001).

Several policy measures contributed to this period of high agricultural growth, among them: (1) expansion of irrigation favoring greater land utilization during the dry season (total irrigated area increased from 3.73 million ha in 1995/96 to 4.51 million ha in 1999/00); (2) increased availability of improved variety seeds and fertilizer (total fertilizer use expanded from 3.02 million metric tons to 3.20 million metric tons during 1996-2000); (3) increased availability of credit (distribution of agricultural credit increased from TK16.36 billion in 1995/96 to TK28.51 billion in 1999/00); (4) greater dissemination of extension messages regarding marketing prospects and profitability of new and potential crops; and (5) development of transport/communication network providing incentives to farmers to adopt more intensive use of land and other resources (summarized from ADB 2001). Thus, the USAID-funded AVRDC project aiming at introducing new vegetable varieties and technologies fell into a phase of supportive policies, which would have contributed to the success of the project.

[2] A number of crops, namely vegetables, potato, cotton and onion, have net financial and economic returns either as high as or higher than that of high yielding varieties (HYV) of rice (Shahabuddin and Dorosh 2001).

3.3 Vegetable Exports

Export volumes for fruit and vegetable products, though modest in relative terms (about $US16.5 million in 2002), have been rising rapidly in the recent past (export volumes in 2000 were five times those of 1990). Fresh fruits and vegetables are mostly exported through members of the Bangladesh Fruits, Vegetables and Allied Products Exporters' Association. The Association had a total of 252 members in 2001, approximately 25 of whom are reportedly active in exporting activities (Hossain 2004).

Although vegetable production has increased over the years, its contribution to export earnings in Bangladesh continues to be marginal (Figure 4). Main crops exported are yardlong bean, taro, and several gourds (teasle gourd, bitter gourd, bottle gourd, ridged gourd, and white gourd). Most exports are destined to the United Kingdom and the Middle East (United Arab Emirates, Saudi Arabia, Qatar, Kuwait and Oman), all countries with a large population of Bangladeshi migrant workers (Quasem 2003).

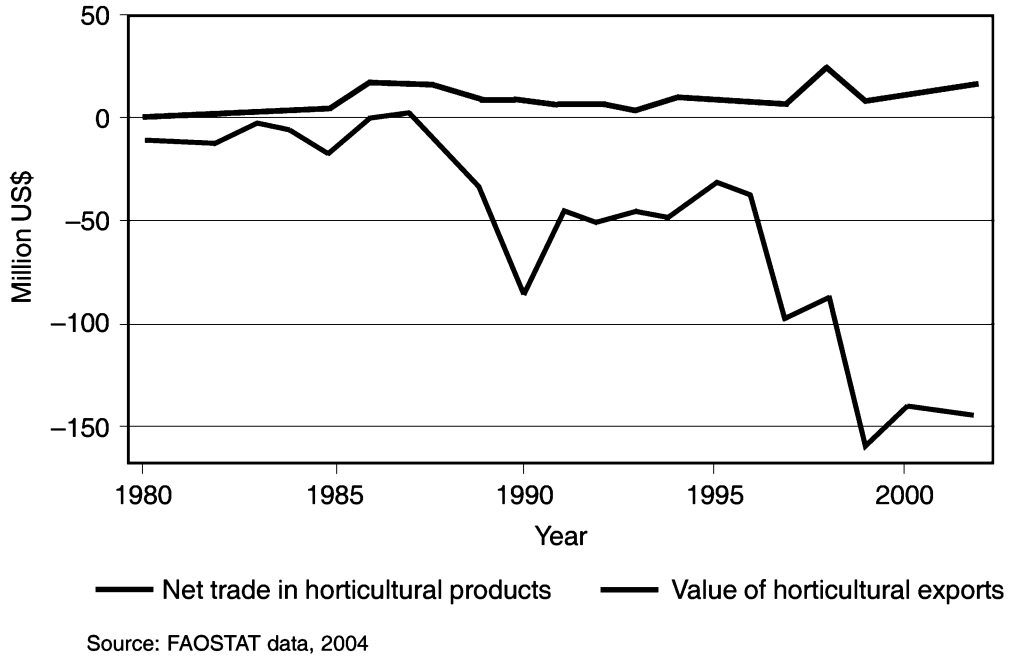


Figure 4. Value of horticultural trade in Bangladesh

Figure 4 shows that Bangladesh is a net importer of horticultural products. Although the share of fruit and vegetables in total agricultural exports has increased strongly over the past 20 years, from 0.4% in 1980 to 16.5% in 2002 (FAO 2003), this increase in share is largely due to a reduction in the value of overall agricultural exports.

This study chooses to concentrate in the discussion of vegetable production in the domestic arena, rather than the export markets. This sets this study apart from the large and growing literature dealing with poverty and employment effects of export horticulture, particularly in sub-Saharan Africa (Dolan et al. 1999; Dolan 2002; McCulloch and Ota 2002; Barrientos et al. 2003; Humphrey et al. 2004; Minot and Ngigi 2004).

4 Farmer Characteristics

4.1 Socio-economic Variables

Of the original 335 household respondents, only 300 were considered in the statistical analysis because part of the data was incomplete for the remaining households. Apart from socio-economic information at the farm level, information on use of hired employment, input use, and marketing of crops was also collected for 1,216 plots, of which 925 were plots under vegetable cultivation.

The vast majority (89%) of the survey respondents were household heads. The rest were: daughter/son (10.3%), sister/brother and mother/father (0.3% each). Of these, 43% had been to school for an average of three years, and only 8% are members of an organization (Table 2). The very low mean school years imply that the majority had not completed elementary education.

Between the two districts, higher literacy (in terms of people's ability to read and write) was observed in Jessore with about 53% of its respondents having the ability, while in Savar, only 33% of respondents were literate. The mean attendance ratio for the 5–14 age group population is high at 0.9 (Table 2) for both districts. The government's mandate in making primary education compulsory since 1990 could be one of the factors contributing to this (Government of the Republic of Bangladesh 2003).

Table 2. Organization and education variables

	Jessore		Savar		Total sample	
	N	Share (%)	N	Share (%)	N	Share (%)
Member of organization	9	6.0	19	10.7	25	8.3
Illiterate	34	22.7	51	34.0	85	28.3
Can sign	37	24.7	49	32.7	86	28.7
Can read and write	79	52.6	50	33.3	129	43.0
	Mean	SD	Mean	SD	Mean	SD
School years	4.2	4.3	2.0	3.2	3.1	4.0
Attendance ratio[a]	0.9	0.3	0.8	0.3	0.9	0.3

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.
[a] Attendance ratio is the ratio from number of children aged 5–14 living in the house and attending some form of school to all children aged 5–14 belonging to the household.

The average household size in Jessore and Savar is 5.9. This is marginally higher than the national average of 4.9 (BBS 2003). There are, on average, 3.9 adults per household, resulting in a ratio of 0.2 ha of cultivated land per adult per household (Table 3).

Table 3. Household characteristics

Characteristic	Jessore		Savar		Total sample	
	Mean	SD	Mean	SD	Mean	SD
Household size	5.2	1.7	6.5	2.7	5.9	2.3
Number of adults	3.7	1.6	4.2	2.0	3.9	1.8
Cultivated ha per adult	0.20	0.12	0.20	0.16	0.20	0.16

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

The average owned land in both districts amounts to 0.61 ha per household. Jessore has a higher area of 0.69 ha per household compared with Savar's 0.53 ha. The above observation reverses for the average area of land rented in, average cultivated area, and average vegetable production area (Table 4). These could be due to Savar's higher population density distributed to relatively smaller farm landholdings (as can be seen in Table 5), and its relative proximity to Dhaka. Savar's household size ranged from as low as 3 members to as high as 23, in contrast to Jessore's maximum household size of 13.

Table 4. Land details

Area (ha)	Jessore		Savar		Total sample	
	Mean	SD	Mean	SD	Mean	SD
Land owned	0.69	0.69	0.53	0.61	0.61	0.65
Land rented in	0.16	0.28	0.36	0.45	0.28	0.40
Land rented out	0.08	0.24	0.04	0.16	0.04	0.20
Land cultivated	0.65	0.49	0.77	0.57	0.73	0.53
Vegetable cultivation area	0.32	0.24	0.57	0.49	0.45	0.40

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Table 5. Distribution of land owned

Area (ha)	Jessore		Savar		Total sample	
	N	Share (%)	N	Share (%)	N	Share (%)
< 0.2	37	24.7	39	26.0	76	25.3
0.2 < 0.4	24	16.0	40	26.7	64	21.3
0.4 < 0.6	33	22.0	28	18.7	61	20.3
0.6 < 0.8	16	10.7	13	8.7	29	9.7
0.8 < 1.2	12	8.0	14	9.3	26	8.7
1.2 < 2.0	22	14.7	8	5.3	30	10.0
> 2.0	6	4.0	8	5.3	14	4.7
Total	150	100	150	100	300	100

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

On the average, most farmers in both districts are small-scale farmers possessing less than 0.6 ha of land (Table 5). Of this, the average cultivated area in both districts falls around 0.2 ha to 0.6 ha (Table 6). Smaller plots of land are however predominant in Savar with almost 71% of the sample farmers owning lands below 0.6 ha (Table 5).

Table 6. Distribution of land cultivated

	Jessore		Savar		Total sample	
Area (ha)	N	Share (%)	N	Share (%)	N	Share (%)
< 0.2	13	8.7	7	4.7	20	6.7
0.2 < 0.4	51	34.0	26	17.3	77	25.7
0.4 < 0.6	32	21.3	35	23.3	67	22.3
0.6 < 0.8	24	16.0	32	21.3	56	18.7
0.8 < 1.2	12	8.0	30	20.0	42	14.0
1.2 < 2.0	16	10.7	12	8.0	28	9.3
> 2.0	2	1.3	8	5.3	10	3.3
Total	150	100	150	100	300	100

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

4.2 Farmer Classification by Type

Land ownership is widely regarded as an indicator for household wealth in Bangladesh. However, small-scale farmers may not be at disadvantage in the cultivation of vegetables, due to the relative absence of economies of scale in vegetable production (compared to grain production and livestock). Finally, cultivation is not restricted to owned land. Tenancy is a common practice. About one-fifth of the total operated area is under some kind of tenancy arrangements with sharecropping covering about one-half of such land (Ahsan and Ahmed 2003). The tenancy data derived by this study is slightly higher, which set the average share of land under tenant-owners in Bangladesh at 40%. On average, 57% of the sample (51% in Jessore and 63% in Savar) rent land from other farmers.

In order to account for the fact that there are marked differences between area under cultivation and area owned for individual farmers, and because both variables may influence farm production patterns, we identified farmer types by a combination of both variables. We constructed a variable that clustered farms into six groups according to ownership and cultivation of land. Based on a SPSS cluster analysis we identified the most likely clusters based on quintiles for both variables, where the first quintile identifies the smallest 20% of landowners and cultivators, respectively, and the fifth quintile identifies the 20% largest landowners and cultivators, respectively (Figure 5).

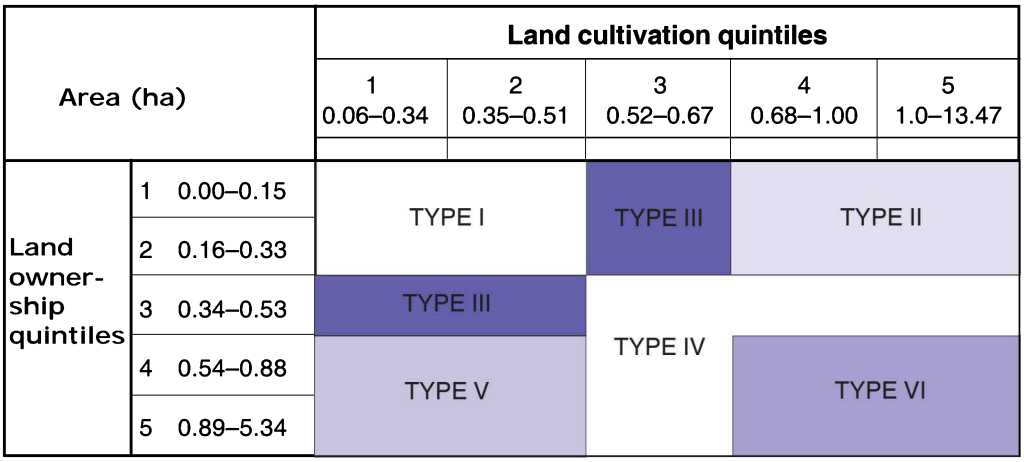


Figure 5. Farmer characterization

Table 7 shows distribution of these farmer types by district. More than one-quarter (28%) of farmers in Jessore district are resource-poor farmers without access to additional land (TYPE I). In contrast, approximately half of land-poor farmers in Savar rent land and cultivate on an average of 0.93 ha, 5.8 times larger than their own areas (TYPE II). More large-scale landowners rent out land to other farmers in Jessore than in Savar (TYPE V). The share of relatively resource-rich farmers cultivating on relatively large areas (TYPE VI) is similar in both districts.

Table 7. Farmer type by district

	Jessore		Savar		Total sample	
Farmer type	N	Share (%)	N	Share (%)	N	Share (%)
TYPE I	42	28.0	27	18.0	69	23.0
TYPE II	1	0.7	24	16.0	25	8.3
TYPE III	24	16.0	36	24.0	60	20.0
TYPE IV	28	18.7	27	18.0	55	18.3
TYPE V	18	12.0	1	0.7	19	6.3
TYPE VI	37	24.7	35	23.3	72	24.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Table 8 shows selected farm characteristics by farmer types. On average, the land-rich farmers (TYPES V and VI) have attended between 1.5 and 2 years more school years than the sample mean. The attendance ratio of children currently attending school is very similar among all farmer types. Farmers operating on larger areas (TYPES II, IV and VI) all have larger household sizes and more adults living in the household com-

pared to farms cultivating smaller areas (TYPES I, III and V). This reflects higher labor needs associated with larger farm cultivation areas. Finally, in terms of household expenditure, there are small, but non-significant differences. Households of TYPES II and IV have highest per capita expenditure, while those belonging in TYPE V have the lowest. There is a marked difference in ownership of livestock, which is highest for households of TYPE VI.

Table 8. Selected farm characteristics by farmer type

Item	I	II	III	IV	V	VI
Total land owned (ha)***	0.16	0.16	0.32	0.61	0.81	1.46
Total land cultivated (ha)***	0.28	0.93	0.49	0.77	0.36	1.29
School years completed***	2.8	2.0	1.4	3.1	4.9	4.7
Attendance ratio (%)	89.4	89.8	85.7	78.4	88.9	91.7
No. of household members***	4.9	6.1	5.6	6.1	5.4	7.0
No. of adults***	3.2	4.4	3.7	3.7	3.9	4.9
Per capita monthly cash expenditure	439	443	426	451	378	427
Households with livestock (%)***	66.7	60.0	73.3	69.1	78.9	90.3

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.
*,**, *** Signficant at $P \leq 0.05$, 0.01 or 0.001, respectively.

In sum, households of TYPE VI appear to be those with the highest endowment, in terms of land ownership, access to cultivated land, human capital (years of education) and labor force. The share of households owning livestock is the greatest for farmers of this type. However, they do not have the highest per capita expenditures.

On the other end of the spectrum, households of TYPES I and II are endowed with only small plots of land, although some farmers (mainly in Savar) manage to rent large additional land areas for cultivation. The main difference between farmer TYPES I and II is access to labor force. These households have only little formal education and are less likely to own livestock than the other farm types.

TYPE V farmers stand out because their endowment with land is relatively high, 0.4 ha on average, and less than half is used for cultivation. These households have highest years of completed school education, but their monthly per capita expenditure is TK50 lower than that of the next group. Farmers of this type are concentrated in Jessore.

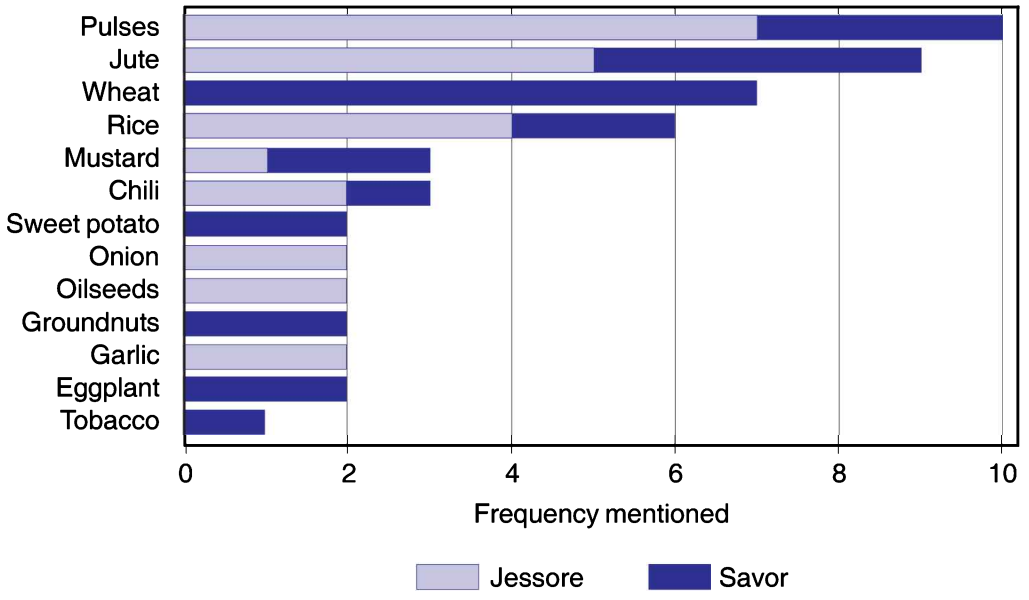
In the following chapters we will return to this classification scheme to identify which farmers are benefiting the most from increasing commercialization.

5 Adoption and Access to Vegetable Technologies

5.1 Vegetable Production in Jessore and Savar

Vegetable production is an important activity among farmers of Jessore and Savar. In fact, over 98% (295 of 300) of farmers were engaged in a vegetable cultivation activity from our random sample. Since Ali and Hau (2001) purposely included non-vegetable farmers into their earlier sample from the same districts, the data does not allow for comparison regarding increased significance of vegetable cultivation. However, since the authors do not mention any problems in identifying non-vegetable farmers, it may well be concluded that vegetable production has become more important over recent years. Statements made within focus group meetings support this assumption. Vegetables have gained in relative importance over the past 10 to 20 years and have particularly replaced wheat, rice, pulses and jute in the process (Figure 6). Focus groups pointed out several reasons for this development.

Vegetable crops are attractive because: (1) they are cash crops; (2) they are considered more profitable than staple crops and less risky as compared to the production of pulses and mustard; (3) they have relatively short production cycles as compared to many field crops; (4) they are suitable in some highland areas, particularly after irriga-



Source: Twenty group meetings held in collaboration between AVRDC and BARI. Multiple answers.

Figure 6. Frequency rank of crops replaced by vegetables

tion has become available; and (5) they serve social purposes, occasionally given away as gifts to visiting neighbors (also mentioned in Hallman et al. (2003)). But above all, the demand for vegetables has been increasing, while demand for other crops, such as jute has declined. From 1995 to 2000, the production of pulses and jute (and wheat in Jessore) declined while vegetable had been steadily increasing, especially in Jessore where vegetable area has tripled and production increased by 31%[3] (BBS 2002a).

It should be kept in mind that Jessore and Savar were selected because of their vegetable production contribution in the country. This significance of vegetable production compared to other crops is reflected in Table 9. Compared with staples, potato and pulses, vegetables are the most important crop group. In Savar, three-quarters of all production area is under vegetable production; while in Jessore, the share is 50%. Jessore is also an important production center for potatoes. The production of pulses is negligible in both districts.

Table 9. Production areas of various food crops

	Jessore		Savar		Total sample	
Crop	N plots	Area (%)	N plots	Area (%)	N plots	Area (%)
Vegetables	378	50.0	547	76.1	925	64.8
Staples	126	36.3	115	23.6	241	29.1
Potato	36	12.6	4	0.2	40	5.6
Pulses	9	1.1	1	0.1	10	0.5
Total	549	100.0	667	100.0	1,216	100.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 1,216 plots.

In total, we found approximately 35 different vegetables including several gourds, leafy and fruit vegetables. The vegetables often mentioned in the 'top three' in the focus groups were cabbage, pointed gourd, eggplant, green bean, radish, red amaranth and Indian spinach. These correspond with most of the results in the household surveys. The main vegetable crops in Jessore are green bean, radish, eggplant, pointed gourd and cabbage. In Savar, they are coriander, red amaranth, kohlrabi, cabbage and carrot (Table 10).

In terms of the two districts' apportionment of vegetable area, about 50% of households from Savar and Jessore allot 0.4 ha or less and 0.3 ha or less to vegetables, respectively. Nonetheless, the mean share of vegetable production area to the total cultivated area is quite high (Table 11). Similar with other commercialization studies (von

[3] In the Dhaka district, the increase in cropped area had been highest for vegetables, exhibiting growth of 44% compared with rice, wheat, pulses, jute and potato, from 16,471 ha to 29,502 ha. Similarly, Jessore registered a 65% increase from 15,701 ha to 44,718 ha. The same is true for vegetable production in both districts, steadily increasing during the same period. The cropped areas and production of pulses and jute (and wheat in Jessore) had decreased on the other hand between 22% to as much as 92% (pulses in Jessore) (BBS 2002a).

Table 10. Important vegetable crops

Crop	Jessore		Savar		Total sample	
	Plots	Share (%)	Plots	Share (%)	Plots	Share (%)
Amaranth, red	14	2.9	61	9.5	75	7.3
Bean, green	75	22.3	7	0.6	82	7.9
Cabbage	34	13.6	53	9.8	87	11.1
Carrot	0	0	52	15.2	52	10.1
Coriander	0	0	67	9.9	67	6.6
Eggplant	54	14.5	1	0.1	55	4.9
Gourd, pointed	39	10.2	0	0	39	3.4
Kohlrabi	4	1.5	56	13.6	60	9.6
Radish	58	15.0	22	3.8	80	7.6
Others	100	20.0	228	37.5	328	31.5
Total	378	100.0	547	100.0	925	100.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 925 plots.
Note: Plots refer to number of plots; Share refers to area share in all vegetable area.

Table 11. Percent share of total crop area grown in vegetable crops

Area (ha)	Jessore (%)	Savar (%)	Total sample (%)
< 0.2	69.7	78.7	74.3
0.2 < 0.4	57.5	72.0	66.6
0.4 < 0.6	56.7	70.8	63.2
0.6 < 0.8	61.5	69.4	65.1
0.8 < 1.2	55.0	65.1	60.5
1.2 < 2.0	40.1	60.9	45.6
> 2.0	36.3	70.3	55.8
Average	57.2	72.0	64.6

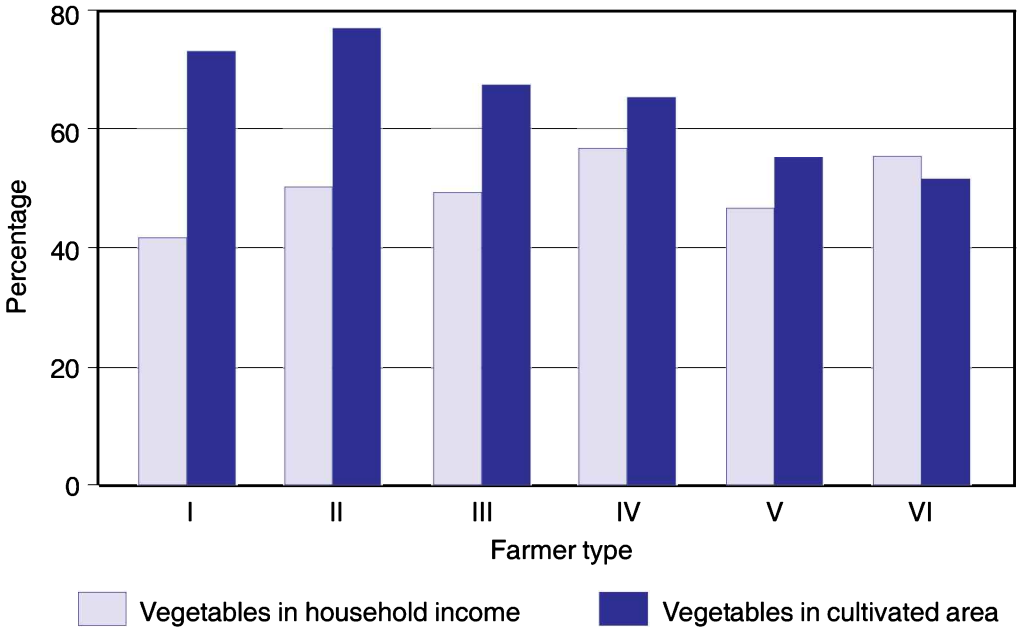
Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Braun 1995), cultivators of smaller land areas tend to allocate a larger share to the cultivation of cash crops. Almost all land groupings, except for land areas in Jessore greater than 0.8 ha, have a mean share higher than 50%.

Savar is inherently dependent on vegetable production compared with Jessore, as far as overall diversity of vegetable crops and number of vegetable plots are concerned (Table 10). The former is reflected in the large number of crops subsumed under "others". Other popular crops in Savar are water gourd, spinach and cauliflower. Correspondingly, almost 60% of the 925 plots from the equally distributed sample population (N = 300) come from Savar.

Farmers, on average, earn three-quarters of their income through farm-related activities, and approximately 60% of all farm cash income is vegetable-related. This is a strong increase from the earlier survey where between 27 and 40% of all farm cash income was reported to be related to vegetable production (Ali and Hau 2001). The

comparison of the significance of vegetables for livelihoods by different farmer types shows that small landowners, whether cultivating large or small areas, allocate a large share of their land to vegetable production (Figure 7). The share is close to 80%. In contrast, resource-rich farmers allocate only about 55% of their area to vegetable cultivation. On the other hand, in terms of income, small-scale farmers (TYPE I) rely less on vegetable production (40%) as compared to other income sources. Larger-scale farmers (TYPES IV and VI) derive around 55% of their total household income from vegetable cultivation.



Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Figure 7. Significance of vegetables for livelihoods by farmer type

5.2 New Vegetable Technologies

New agricultural technologies and innovations in farm practices are prerequisites for sustained improvements in output and productivity levels. In Bangladesh, the use of improved vegetable technologies is common. An average of 91% of farmers recorded the use of some new vegetable technology over the past five years with negligible differences across farm types.

Tables 12 and 13 show various adopted vegetable technologies by different crops in absolute numbers, and by the average number of adoption years. AVRDC technologies introduced under the USAID-funded project included varietal development for tomato,

Table 12. Adaptation of improved vegetable technologies and varieties

Crop	Total	Improved variety	Hybrid seed	Line sowing	Ferti-lizing	Grafted seedling	Raised bed	Other	Total
Amaranth, green	5	5	0	0	2	0	0	0	7
Amaranth, red	18	17	0	0	4	0	0	0	21
Arum	1	0	0	1	1	0	0	0	2
Bean, green	57	44	0	10	8	0	1	40	103
Bean, yardlong	4	3	0	1	0	0	0	0	4
Beet	6	1	5	0	1	0	0	0	7
Cabbage	63	25	38	7	2	0	2	2	76
Carrot	38	14	24	3	4	0	0	0	45
Cauliflower	38	10	29	7	1	0	1	1	49
Coriander	63	5	58	0	1	0	0	0	64
Eggplant	36	33	3	10	6	0	2	7	61
Gourd, bitter	3	2	0	0	0	0	0	1	3
Gourd, pointed	28	17	0	3	0	8	0	16	44
Gourd, snake	1	1	0	0	0	0	0	0	1
Gourd, sweet	5	4	1	1	1	0	0	0	7
Gourd, teasle	1	1	0	1	1	0	0	0	3
Gourd, water	8	8	0	3	0	0	0	1	12
Jute	2	2	0	0	0	0	0	0	2
Kangkong	1	1	0	0	0	0	0	0	1
Kohlrabi	54	10	44	7	4	0	0	0	65
Mustard	8	8	0	0	1	0	0	0	9
Okra	1	1	0	0	0	0	0	0	1
Pepper, chili	6	4	0	4	2	0	0	0	10
Radish	61	55	6	7	2	0	1	0	71
Spinach	13	11	1	1	2	0	0	0	15
Spinach, Indian	2	2	0	0	1	0	0	0	3
Tomato	14	12	2	5	0	0	0	0	19
Turnip	2	1	1	0	0	0	0	0	2
Total	539	297	212	71	44	8	7	68	707
Share (%)		42.0	30.0	10.0	6.2	1.1	1.0	9.6	100

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 707 technologies.

eggplant, chillies, okra, radish, red amaranth, Indian spinach, kangkong, cabbage, cauliflower, yardlong bean and bitter gourd; and grafting of tomato for control of soil-borne diseases (AVRDC 2000). More than two-thirds (72%) of all new technologies adopted were either improved open-pollinated or hybrid seed varieties; in contrast, no farmers adopted tomato grafting. This highlights the continued need to invest into varietal improvement research, since it requires less behavioral changes as compared to crop management practices (Kuehn et al. forthcoming). Among crop management practices, line sowing stands out as the most widely adopted technology.

Table 13. Average number of years since technology introduction

Crop	Improved variety	Hybrid seed	Line sowing	Ferti-lizing	Grafted seedling	Raised bed	Other	Average
Amaranth, green	2.5	3.0	1.0	12.0	-	-	-	2.9
Amaranth, red	4.9	2.0	0	8.5	-	-	-	4.6
Arum	4.9	2.0	0	8.5	-	-	-	4.6
Bean, green	4.9	5.0	5.8	6.0	-	4.0	4.3	4.9
Bean, yardlong	5.2	-	6.1	6.6	-	4.0	3.6	4.5
Beet	4.8	3.6	3.6	7.0	-	4.0	5.3	4.1
Cabbage	4.8	3.6	3.6	7.0	-	4.0	5.3	4.1
Carrot	2.5	-	-	2.0	-	-	-	2.3
Cauliflower	2.7	4.2	4.9	6.2	-	-	-	4.0
Coriander	4.6	4.2	4.5	4.8	-	-	-	4.3
Eggplant	3.9	-	4.7	-	4.3	-	5.1	4.5
Gourd, bitter	2.5	-	-	2.0	-	-	-	2.3
Gourd, pointed	4.6	4.0	6.0	9.0	-	4.0	-	4.6
Gourd, snake	4.4	3.5	4.8	6.2	-	5.0	7.0	4.1
Gourd, sweet	4.9	5.0	5.8	6.0	-	4.0	4.3	4.9
Gourd, teasle	4.5	3.6	5.1	6.7	4.3	4.1	4.2	4.2
Gourd, water	4.5	3.6	5.1	6.7	4.3	4.1	4.2	4.2
Jute	3.9	-	4.7		4.3	-	5.1	4.5
Kangkong	5.4	4.0	15.0	9.3	-	-	-	5.2
Kohlrabi	5.2	-	6.1	6.6	-	4.0	3.6	4.5
Mustard	4.4	3.5	4.8	6.2	-	5.0	7.0	4.1
Okra	3.5	-	5.0		-	-	4.0	3.5
Pepper, chili	4.6	4.2	4.5	4.8	-	-	-	4.3
Radish	2.5	3.0	1.0	12.0	-	-	-	2.9
Spinach	3.5	-	5.0		-	-	4.0	3.5
Spinach, Indian	2.7	4.2	4.9	6.2	-	-	-	4.0
Tomato	5.4	4.0	15.0	9.3	-	-	-	5.2
Turnip	4.6	4.0	6.0	9.0	-	4.0	-	4.6
Average	4.8	3.6	3.6	7.0	-	4.0	5.3	4.1

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 707 technologies.

In Jessore, 54% of farmers reported to have adopted at least one of the improved varieties or technologies provided through the USAID-funded AVRDC project. In Savar, the rate was lower but still high at 33%. Among all improved technologies adopted by farmers during the past five years, the rate of AVRDC technologies was 45% in Jessore and 19% in Savar. Thus, diffusion of technologies has been widespread and sustainable.

5.3 Comparison of Access by Farmer Type

On average, adoption levels for new and improved technologies related to vegetable cultivation have been high and widespread in these two districts. They are also equally distributed across all farmer types. The share of farmers adopting at least one AVRDC technology is slightly lower for smaller-scale farmers, and particularly low for farmers of TYPE II (Table 14). It is particularly high for farmers of TYPE V. The reason may be site specific, since farmers of TYPE II are concentrated in Savar, and farmers of TYPE V are concentrated in Jessore. The share of AVRDC technologies in all technologies adopted is somewhat lower, at an average of 31%, and very similar for farmer types, again with the notable exception of farmers of TYPE II (very low) and farmers of TYPE V (very high).

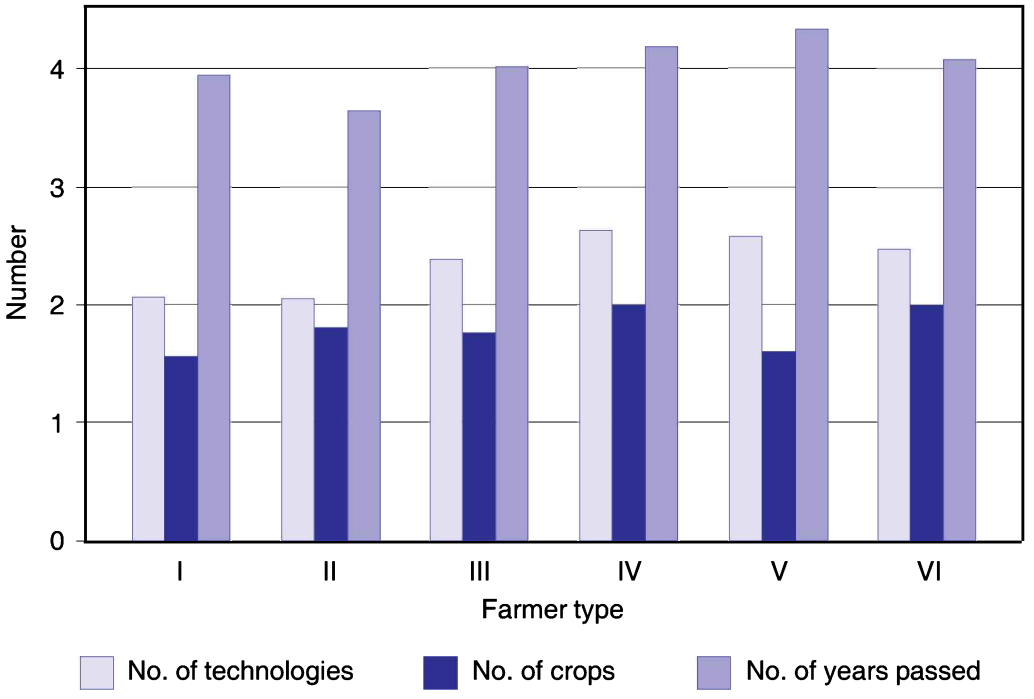
Table 14. Adoption rates by farmer type

Item	I	II	III	IV	V	VI
Farmers adopting new vegetable technology	89.9	92.0	90.0	92.7	89.5	90.3
Farmers adopting AVRDC technology*	39.1	12.0	41.7	47.3	52.6	51.4
Share of AVRDC technologies*	29.9	11.1	29.2	33.9	46.7	32.4

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.
*Significant at $P \leq 0.05$ level (ANOVA test of means)

On average, farmers have adopted 2.4 new vegetable technologies on an average of 1.8 crops. Resource-poor farmers adopted a smaller number of technologies. The average number of crops for which the technology was adopted was smallest for farmers of TYPES I and V (Figure 8). The average number of years passed since technology adoption varies from 3.6 years (small owned farmland with additional large rented area, TYPE II) to 4.3 years in large farms with small cultivated areas. Obviously, small-scale farmers that rent large additional areas are more risk adverse than other farmers and are slower adopters. However, an analyses of variance (ANOVA) test of means showed none of these differences are significant.

These results indicate that small-scale farmers with small endowments of land adopt, on average, a smaller number of technologies for a smaller number of crops, and later than farmers who own more land. The reason is probably that these farmers are more risk adverse. However, they are not at a disadvantage concerning access to new technologies per se, since the average share of farmers applying at least one new technology in vegetable production over the past years was similar and high across all farmer types.



Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Figure 8. Number of technologies adopted and average years since adoption by farmer type

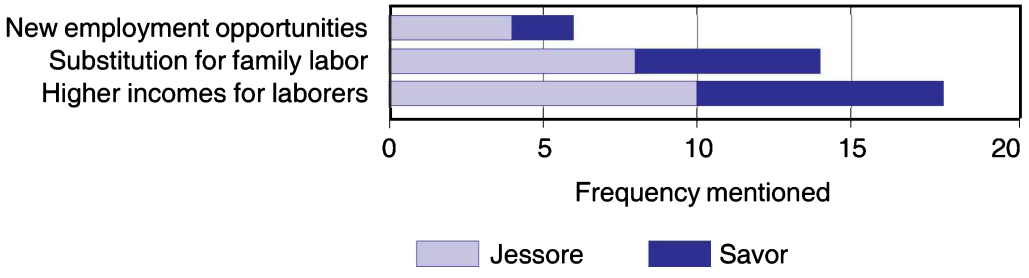
6 Employment and Wage Rate

Simon Kuznet argues that agriculture stimulates the economy in three ways, namely: product, market and factor contributions (Liu 1994). It creates a multiplier effect starting from product contribution down to factor contribution. The process starts with agricultural expansion (product contribution), followed by agricultural trade (market contribution) and the transfer of productive resources to other sectors in the economy (factor contribution). In terms of effects, first as direct effects, the vegetable industry generates output and added value, providing employment and wages. Second, as indirect effects, it facilitates the purchase of goods and services as inputs from other industries. And third, as induced effects, there is higher personal consumption expenditures boosting the local economy (Hodges et al. 2001; Hall and Skaggs 2003). This chapter will focus on the first effect brought about by increases in vegetable cultivation and the value added from labor.

6.1 Employment

Commercialization and diversification of agriculture can affect the structure and the level of employment. Family labor may be substituted by hired labor, and changes may also take place in the level of labor input as well as the distribution of labor by gender (von Braun 1995).

While this study incorporated the analysis of employment and wage effects vis-à-vis increased vegetable production in the focus groups, it did not estimate the magnitude of substitution of family labor for hired labor or the degree of additional hired labor created over time due to data restriction concerning quantitative comparison over time. Three employment and wage effects were mentioned, namely: (1) increased incomes for laborers (wages have risen over time); (2) substitution of family labor with hired labor (farmers could devote their time to other activities, such as part-time jobs, trading activities, or other farm activities like livestock raising; and (3) new employment opportunities particularly for the landless and beggars (Figure 9).



Source: Twenty group meetings held in collaboration between AVRDC and BARI. Multiple answers.

Figure 9. Employment related benefits of enhanced vegetable production

One problem in the data set is the farmers' propensity to hire contractors in performing certain tasks, particularly in the land preparation and irrigation activities. Contractors hire and supervise a group of laborers, of which the scale of labor inputs is unknown to the farmers. Hence, all the information provided in the following sub-chapters pertains to individually hired labor only, if not stated otherwise.

6.1.1 Level of Hired Labor Input

Hiring labor for vegetable-related production activities is a common practice. In the survey samples, hiring of labor was observed for 914 of the 925 (98.8%) plots. Ten production steps were identified in this study starting from land preparation up to harvesting. On the average, 3.8 of these steps are being performed by hired labor. The top three activities with a large share of hired labor are land preparation, weeding and irrigation.

Table 15. Percent share of activities, wholly or partially, performed by hired labor

Farm activity	Jessore (%)	Savar (%)	Total sample (%)
Preparing land	83.6	94.5	90.0
Making raised beds	14.7	2.8	7.7
Sowing/transplanting	48.3	28.5	36.5
Irrigating	70.8	71.0	70.9
Mulching	29.5	3.3	14.0
Weeding	87.4	92.6	90.5
Abstracting	9.7	0.6	4.3
Emasculating	5.6	0.0	2.3
Spraying pesticides	5.1	33.3	21.8
Harvesting	63.3	34.8	46.4

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 914 plots.

Table 16. Average number of hours/hectare for hired employment by farm activity

	Jessore		Savar		Total sample	
Farm activity	Mean	SD	Mean	SD	Mean	SD
Preparing land	35	148	91	343	54	230
Making raised beds	25	77	5	40	12	59
Sowing/transplanting	77	111	62	128	69	124
Irrigating	5	37	0	0	2	25
Mulching	86	69	15	79	42	128
Weeding	801	848	781	497	788	662
Abstracting	151	635	2	47	64	412
Emasculating	106	628	0	0	44	403
Spraying pesticides	17	143	7	37	12	101
Harvesting	526	988	232	420	351	722

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 913 plots.

Total hired hours for individually hired laborers per hectare for all crops average 1,374 (Table 17). These are approximately 170 labor days per ha. The study of Ali and Hau (2001) indicated that the average labor use per ha of vegetable production in Bangladesh is 338 days. This shows that, approximately, half of all labor requirements are hired through individual labor contracting arrangements. Among the vegetable crop groups, the top three crops produced with high inputs of individually hired laborers are pointed gourd, green bean and eggplant, with 3,358 h/ha, 2,691 h/ha and 2,152 h/ha, respectively (Table 17). Jessore's larger production area as well as its concentration in the cultivation of these crops, have notably inflated the overall mean hours per hectare.

Table 17. Total number of hired hours/hectare by crop[1]

	Jessore		Savar		Total sample	
Crops	Mean	SD	Mean	SD	Mean	SD
Amaranth, red	605	269	828	566	786	529
Bean, green	2,780	2,068	1,730	502	2,691	2,004
Cabbage	1,011	608	996	529	1,001	558
Carrot	-	-	1,438	546	1,438	546
Coriander	-	-	1,053	741	1,053	741
Eggplant	2,165	1,633	1,520	-	2,152	1,618
Gourd, pointed	3,358	2,622	-	-	3,358	2,622
Kohlrabi	899	237	1,169	571	1,151	556
Radish	806	751	1,193	689	912	751
Other	1,174	1,955	1,085	746	1,112	1,228
Average	1,772	1,962	1,100	684	1,374	1,399

Source: Survey conducted in collaboration between AVRDC and BARI. N = 914 plots.
[1]Excludes contract labor.

6.1.2 Gender Effects in Employment

In Bangladesh, women's participation in the labor force is increasing faster than that of men's and it is estimated that approximately 8 million women are seeking employment (White 1999).

Some studies have documented the increasing feminization of agriculture. Men move out of the sector more quickly than women, and women are becoming the preferred labor type by many employers (Gill 2001; Singh 2003). In a study conducted by Gill (2001) in Punjab, India during the mid-1990s, around three-quarters of all workers in the vegetable production sector were hired labor, and female hired labor accounted for 49%. Paddy rice has 25% female hired labor. Further, female labor accounts for 58% of total labor hours, compared with 34% in paddy rice. In tomato production alone, female labor accounted for almost 60% of the total labor hours.

In contrast, hired vegetable-based labor in Jessore and Savar continues to be male-dominated, perhaps due to cultural restrictions that women face in working outside the

homestead (purdah). Individual hiring of laborers for production activities is usually male-dominated, except for harvesting activities in Jessore. In Jessore, women are also involved in abstracting and emasculating (Table 18). However, focus group discussions highlighted that post-harvest activities, which were not recorded in the farm production survey, are female-dominated. Women are usually involved in cleaning, washing and grading of harvested goods. Similarly, women are usually responsible for seed production of vegetables.

Table 18. Percent share of farmers hiring different labor groups by activity

Town/ Farm activity	Male	Female	Child	Mixed	Contracted
Jessore					
Preparing land	2.4	0.3	0.3	0.0	81.0
Making raised beds	12.9	0.5	0.0	0.0	1.1
Sowing/transplanting	43.7	2.4	0.3	0.0	1.6
Irrigating	0.8	0.0	0.0	0.0	70.2
Mulching	27.9	0.5	0.0	0.0	0.8
Weeding	83.6	2.1	0.3	0.0	0.8
Abstracting flowers	2.1	6.4	0.5	0.8	0.3
Emasculating	2.1	1.3	2.1	0.8	0.0
Spraying pesticides	1.3	0.0	0.0	0.0	2.7
Harvesting	50.7	11.5	1.3	1.6	1.9
Savar					
Land preparation	0.6	0.0	0.0	0.0	94.1
Making raised beds	2.8	0.0	0.0	0.0	0.0
Sowing/transplanting	26.1	0.0	1.5	0.4	0.0
Irrigating	0.0	0.0	0.0	0.0	70.4
Mulching	3.1	0.2	0.0	0.0	0.0
Weeding	91.1	0.0	0.0	0.2	0.9
Abstracting flowers	0.2	0.4	0.0	0.0	0.0
Emasculating	0.0	0.0	0.0	0.0	0.0
Spraying pesticides	10.4	0.0	0.0	0.0	22.0
Harvesting	31.1	2.6	0.0	0.0	0.6

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.
Note: Does not add up to 100% because farmers may not perform activity at all, or through family labor.

Rahman (2000) reports that while the overall share of women in vegetable production in terms of labor hours performed is high (47.7% of all labor activities, compared to 11 to 18% in food grains), only a minor share of this is performed by hired labor (1.2%). The data for that study dates back to 1989, and it may well be expected that restrictions on female labor have become less tight over the years. In fact, there is a marked difference between Jessore and Savar in terms of the share of female hired labor to total hired labor hours, at 17.2% and 1.5%, respectively (Table 19). In addition, nine out of the ten focus groups in Jessore and four in Savar identified female laborers among the benefi-

ciaries of increasing labor requirements. Compared with Jessore, several villages in Savar do not hire women and children as a rule, regardless of whether they are locals or from neighboring communities. The reason may be that Jessore is less conservative (Hallman et al. 2003). Thus, there appears to be an employment-generating effect of modern vegetable technologies that favors female labor employment to some extent, social and cultural circumstances permitting.

Table 19. Hired labor hours by gender or maturity

Gender or maturity	Jessore	Savar	Total sample
Male	75.6	97.8	86.7
Female	17.2	1.5	9.3
Child	3.4	0.4	1.9
Mixed	3.8	0.3	2.0
Total	100.0	100.0	100.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

6.2 Wage Effects

The average daily wage in both districts amounts to TK88 (Table 20). An analysis of the relationship between wage rate and vegetable production by district could not be undertaken due to the absence of wage data information. Thus, this study can only speculate that the increase in wage rates, especially in Savar, is due to the scarcity of labor during the busiest part of the growing season as agriculture competes with the ever growing service and commercial sectors.

Table 20. Average daily wage rate (TK)

	Jessore			Savar			Total
Farm activity	Male	Female	Child	Male	Female	Child	sample
Preparing land	75.2	-	-	100.0	-	-	84.0
Making raised beds	81.6	-	-	97.6	-	-	84.8
Sowing/transplanting	77.6	80.0	80.0	103.2	-	77.6	88.0
Irrigation	80.0	-	-	-	-	-	80.0
Mulching	79.2	80.0	-	111.2	88.8	-	84.0
Weeding	76.8	80.0	80.0	100.8	-	-	92.0
Abstracting flowers	75.2	76.8	46.4	80.0	70.4	-	75.2
Emasculating	72.0	80.0	32.0	-	-	-	52.8
Spraying pesticides	80.0	-	-	98.4	-	-	96.8
Harvesting	76.8	64.8	58.4	100.8	76.0	-	85.6
Average	77.6	72.0	48.0	101.6	76.0	77.6	88.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Wage differentials are evident between the two districts, particularly for men (Table 20). Proximity to the urban area (Dhaka) and the presence of other employment opportunities might have caused these wage differentials. Savar males receive wage rates 25% higher than Jessore males. In both districts, wages do not differ for different crops (i.e., staple crops and vegetable crops).

The wage differential derived from the survey between male and female laborers is smaller compared with the average agricultural wage rate in Bangladesh. Using 1999 data, BBS (2002b) reported that men receive TK60 and women TK33. However, comparison gender wage differences by district, the difference is larger in Savar, where women on average earn approximately 25% less than men. In fact, several focus groups in Jessore pointed out that women and children receive the same wages as men in several activities.

Table 21 shows that the average value added in wages (including wage cost for contract labor) per hectare in the cultivation of any vegetable crop equals TK9,211, approximately US$400 per ha. The average hired labor cost for Aus rice is TK3,134 per ha, or US$53[4] per ha (Quayum and Mustafi 2001). Thus, value added through hired labor in vegetables is approximately 7.5 times higher than through hired labor in rice production.

Similar with the results from Table 17, pointed gourd, green bean and eggplant are the vegetables with the highest wage cost per hectare. These three main crops have considerably affected the mean wage per hectare in Jessore, amounting to TK23,741 compared to the TK22,088 in Savar.

Table 21. Average wage cost (TK) per hectare

	Jessore		Savar		Total sample	
Crop	Mean	SD	Mean	SD	Mean	SD
Amaranth, red	11,114	4,085	17,917	7,848	16,612	7,739
Bean, green	32,827	18,727	25,510	3,207	32,202	18,038
Cabbage	16,728	9,815	22,375	7,556	20,128	8,915
Carrot	-	-	27,900	7,751	27,900	7,751
Coriander	-	-	20,761	10,502	20,761	10,502
Eggplant	31,067	19,632	32,313	-	31,090	19,451
Gourd, pointed	39,026	27,228	-	-	39,026	27,228
Kohlrabi	12,691	2,276	25,547	9,587	24,660	9,825
Radish	13,509	8,231	20,954	9,842	15,582	9274
Other	16,882	18,322	21,285	10,835	20,010	13,553
Average	23,741	19,849	22,088	10,015	22,760	14,846

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 913 plots.

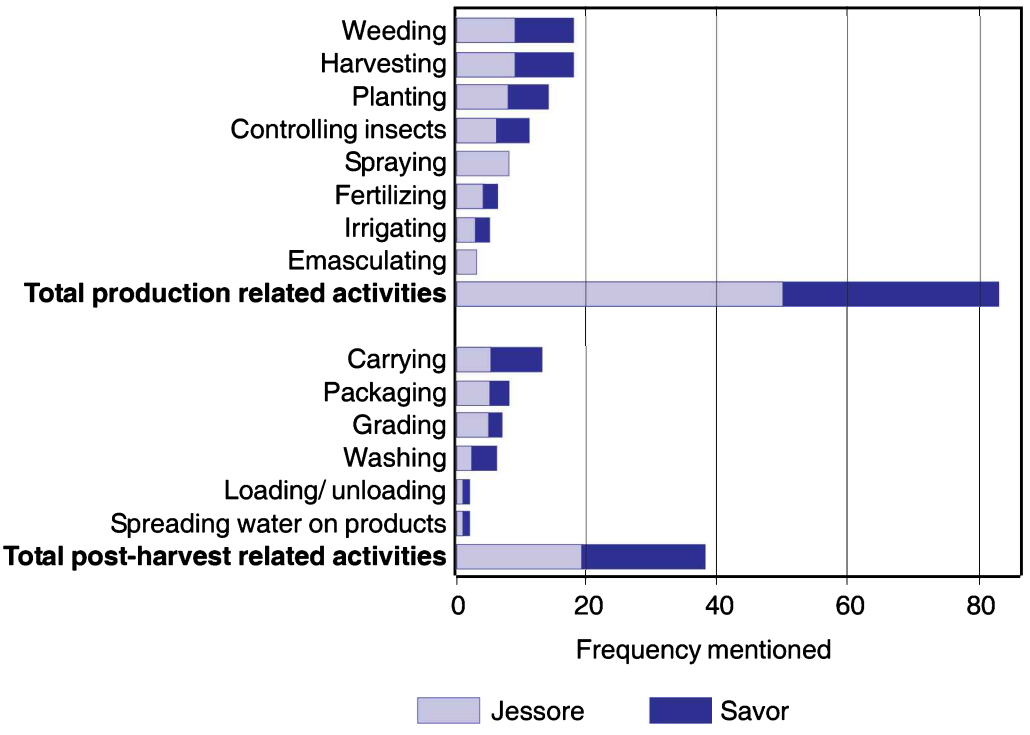
[4] Based on the October 2004 exchange rate of 1 US$ = 58.565 TK. *Aus* rice is used in place of *Boro* rice as representative of the competing crop to most vegetables due to the availability of recent data.

6.3 Off-farm Employment

Although the agriculture sector in Bangladesh still dominates rural employment, its share has been declining over the past years and rural employment in the non-agriculture sector grew over three times faster than in agriculture (World Bank 1997).

In the past, off-farm employment, including employment in industries, manufacturing and services, was viewed as a transitory situation, and only considered necessary as an income source to augment low earnings (Bharadwaj and Findeis 2003). This view has changed over the years and off-farm employment's macroeconomic contribution in terms of direct, indirect and induced effects is considered substantial. In particular, the economic impacts of the fruit and vegetable processing industries have been shown to be substantial in developed countries, for example, the USA (Hodges et al. 2001; Hall and Skaggs 2003)[5].

Figure 10 shows approximately 120 responses by the 20 focus groups regarding various activities, two-thirds of which are production related (mainly weeding, harvesting and planting); and the rest, post-harvest related (grading, washing, packaging, carrying



Source: Twenty group meetings held in collaboration between AVRDC and BARI. Multiple answers.

Figure 10. Employment activities at village level generated through vegetable production

and loading/ unloading). The results further show that vegetable-based processing and the food manufacturing industry in all the villages surveyed have not yet developed. This is reflected by the very low 1.3% share of Bangladeshis in the food manufacturing sector (Table 22) compared to India's 2.4%[6] (International Labour Organization). In terms of gender distribution, women account for 3.8% of the total labor force in the food manufacturing industry, about five times the total male labor population. The share is even higher for rural women at 4.5%.

Table 22. Labor force and wage rate in food manufacturing (1999/2000)

Category		Total employment (000)	Food manufacturing employment (000)	Food manufacturing employment (% share)
All	Total	38,979	520	1.3
	Men	31,087	217	0.7
	Female	7,891	303	3.8
Urban	Total	8,695	132	1.5
	Men	6,795	95	1.4
	Female	1,967	37	1.9
Rural	Total	30,284	388	1.3
	Men	24,359	122	0.5
	Female	5,924	265	4.5

Source: BBS (2002b).

6.4 Employment Effects by Farmer Type

Among other forms of employment, farmer households also work in other farms, while they hire laborers in their farms. The increasing demand for hired labor especially in vegetable production drives other farmers, especially from the small resource-poor families, to grab a share in the overall farm labor requirement. Table 23 shows the level and gender distribution of off-farm employment. Men and women belonging to the small resource-poor households (TYPE I) have the highest percentage in terms of employment in other farms at 53.6% and 16.0%, respectively. The majority of these activities are vegetables related. For instance, one-third of the resource-poor households (TYPE I) are employed in vegetable production-related activities. Only one household from the total sample reported to have employment in processing of vegetables.

[5]These studies are based on software (Impact Analysis for Planning (IMPLAN) PRO™ software) that enables the construction of regional input-output model for any country and uses three categories of effects (direct, indirect and induced effects) to describe the economic impacts of a selected industry. In Florida, for instance, total economic impacts of the fruit and vegetable processing industries included 135,000 directly employed persons, $11.5 billion in output, and $6.0 billion in value added.

[6]Computed based on data from International Labour Organization. Next to agriculture, the small-scale industry (SSI) sector in India provides the largest employment opportunities for the Indian populace. Among the subsectors, the food products industry ranked first in generating employment for 482,000 persons (13.1%) based on the survey conducted by the Ministry and National Informatics Centre (Anonymous 2004).

The average amount of household income generated through off-farm employment is also highest for households of TYPE I. Thus, it is safe to conclude that some redistribution through value added in employment is taking place, of which small and resource-poor households benefit the most.

Table 23. Off-farm employment by farmer type

Item	I	II	III	IV	V	VI
Male off-farm employment (%)	53.6	24.0	36.7	25.5	31.6	18.1
Female off-farm employment (%)	15.9	0.0	3.3	0.0	0.0	0.0
Child off-farm employment (%)	5.8	0.0	1.7	0.0	0.0	0.0
Vegetable-related employment (%)	36.2	16.0	26.7	18.2	21.1	9.7
Household off-farm employment income (TK/month)	397.2	159.2	284.3	149.9	216.3	142.5

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

7 Input and Output Markets

In the previous chapter, discussion focused on the direct effects of agricultural development in terms of employment and wages to the local economy. This chapter will put emphasis on the effect(s) of expansion in vegetable production to the growth of local support industries.

7.1 Input Supply to Vegetable Production

Input sectors evolve through several stages of development characterized by changes in the types of inputs used, the manner in which they are acquired by farmers, and the relative roles of the government and the commercial sector in supplying both inputs and credit (Pingali and Rosegrant 1995; Crawford et al. 2003). In general, subsistence farming systems are characterized by farmers using household generated (non-traded) inputs. Semi-subsistence and commercial systems, on the other hand, have shifted dependence on traded inputs, the share of which has been gradually increasing.

Vegetable production is heavily dependent on the supply of external input factors compared to cereal production, as shown in Table 24. This is particularly true for inputs such as seeds and seedlings, inorganic fertilizers, farm manure, pesticides, and "other" inputs such as plastic mulch, mesh netting and bamboo sticks. Apparently, the degree of commercialization is increasing for such "other" products in the case of vegetable production. These inputs are often purchased locally, although a large share of inputs in Savar can also be acquired in the town markets. In general, the external input markets (or place of acquisition) for both agricultural activities do not differ significantly (Table 25).

Table 24 shows there is a difference in the degree of commercial inputs for vegetable and cereal production. For vegetables, in general, small-scale farmers purchase the same degree of inputs as large-scale farmers. In some instances, the degree of market purchases is even higher, for example, with farm manure. For cereals, however, the share of small-scale farmers purchasing inorganic fertilizers and pesticides is significantly lower

Table 24. Percent share of farmers purchasing inputs for production of vegetables (V) and cereals (C)

	Jessore		Savar		Total sample	
Inputs	V	C	V	C	V	C
Inorganic fertilizer	98.7	95.1	100.0	85.3	99.3	90.1
Farm manure	16.2	6.9	20.0	1.3	18.1	4.1
Seed and seedlings	94.6	79.2	99.3	74.7	97.0	76.9
Pesticides	98.6	91.7	99.3	82.7	99.0	87.1
Other	62.8	0.0	18.7	0.0	40.6	0.0

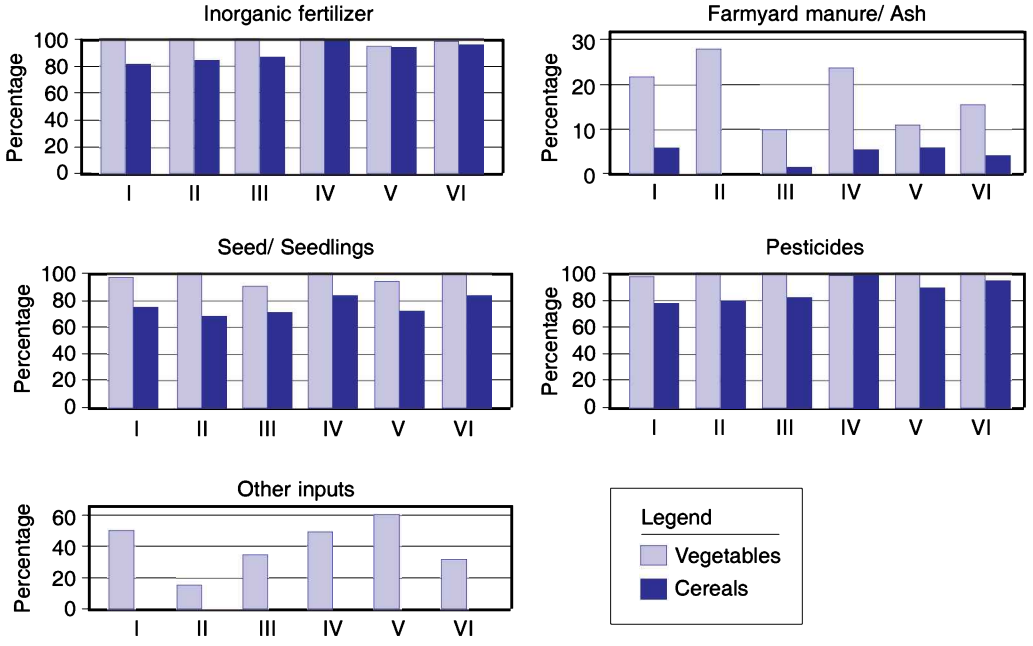
Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Table 25. Source of purchased inputs for production of vegetables (V) and cereals (C)

District	Crop	Item	Town market	Local market	Neighbor	Other	Total
Jessore	V	N	47	447	83	3	580
		%	8.1	77.1	14.3	0.5	100.0
	C	N	36	344	13	0	393
		%	9.2	87.5	3.3	0.0	100.0
Savar	V	N	175	289	44	7	515
		%	34.0	56.1	8.5	1.4	100.0
	C	N	110	250	11	0	371
		%	29.6	67.4	3.0	0.0	100.0
Total sample	V	N	222	736	127	10	1095
		%	20.3	67.2	11.6	0.9	100.0
	C	N	146	594	24	0	764
		%	19.1	77.7	3.1	0.0	100.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 1,859 purchased inputs.

than the share of large farmers, and a lower share of small farmers cultivating large areas (TYPE II) purchase seeds for cereal production as compared to larger-scale farmers (Figure 11).



Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Figure 11. Purchase of external inputs for vegetable and cereal production (percent of farmers) by farmer type

7.2 Seed Supply System

The availability of quality seed is an important input in all crop-based farming systems and a key factor in determining the upper limit of yields. Focus group discussions revealed that access to quality vegetable seed remains a major bottleneck to production of vegetables.

Interview partners from seed companies and seed dealers expressed that the demand for vegetable seed has constantly risen over the past years (Table 26). Domestic seed production, however, cannot cope with the increasing demand due to climatic factors, since seed production for vegetables is limited in North Bangladesh, which has longer winters and lower temperatures as compared to other regions of the country. And while domestic supply has steadily increased during the last three years, the demand-supply gap still persists as total demand continues to rise significantly, leading to a surge in seed imports from China, Japan and South Korea.

Table 26. Domestic vegetable seed production and demand (MT)

Item	2000/01	2001/02	2002/03
BADC[1]	19.4	22.8	15.4
Seed companies	243.3	328.5	481.0
NGOs	95.2	75.7	38.1
Total production	357.9	427.0	534.4
Total demand	1,116.0	1,078.0	2,424.4
Imports	758.1	651.0	1,890.0

Source: Bangladesh Seed Merchant Association, 2004.
[1]Bangladesh Agricultural Development Corporation.

In Bangladesh, domestic seed production takes place under a contract scheme, established in 1995/96 by the Food and Agriculture Organization of the United Nations (FAO), Bangladesh Rural Advancement Committee (BRAC) and others. This contract scheme includes one to two days of training of seed growers provided by BRAC covering all aspects in handling seed from sowing to storage. The seed growers enter into direct contracts with private seed companies, for example, East-West Seed Company and Nadim Seed Company. The East-West Seed Company provides contracts to between 2,000 and 3,000 growers at a fixed purchase price. Nadim Seed Company similarly fixes the price of seed ahead; however, this company provides 30% of advance to growers, another 20% during harvesting and the remaining 50% at seed delivery.

Small-scale seed dealers also rely on contract growers, in addition to the seed they sell from large and established companies such as East-West and Molikor, and imported seed. A thriving local seed business also provides employment, as the following box shows.

A local seed retailer from Savar

Nazrul Hoque owns a well-going business at Savar Bajar Market, selling different varieties of vegetable seeds. In winter, the most popular seeds are cabbage, kohlrabi and carrot, while radish, Indian spinach and red amaranth are most popular during the summer.

Nazrul receives his local seeds from seed wholesalers in Dhaka and imported seeds from Japan. In addition, he augments his seed supply from twelve contract growers from two villages. In the contract arrangement, he purchases seeds from BRAC and transfers it to the farmers as base seeds. He then fixes the seed price and a target with the farmers before planting. These local farmers produce seeds of indigenous vegetables for him, mainly gourds (bottle gourd and snake gourd), leafy vegetables (red amaranth and Indian spinach) and yardlong bean. Established ten years ago with a partner, he now manages the business by himself and considers the business to be profitable. This dealer hires labor for a variety of activities:

- Delivery of seeds to growers (local male temporary laborers for TK100 per day)
- Moisture control and grading (local female temporary laborers for TK80 per day)
- Packaging (local male and female permanent laborers at TK100 and TK80, respectively, per day)
- Carrying of bags (local male temporary laborers at TK20 per bag)
- Store help (local male permanent laborer at TK2200–2500 per month, including food)

7.3 Marketing of Products

7.3.1 Degree of Market Integration for Output

Commercialization is characterized by increasing market transactions, whether on the input or on the output side. As Table 27 shows, the share of produce sold to the market is much higher for vegetables, pulses and potatoes than for staple crops (rice, wheat and maize). While only about 5% of all vegetable produce is retained for home consumption and gifts, farmers in Jessore and Savar keep approximately 75%–90% of their staple crops for home consumption. This practice is also true in other parts of the world (Weinberger and Msuya 2004). Clearly, market integration of vegetable production in both districts is more developed as compared with other crops.

Table 27. Percent share of produce sold by district and crop group

Crop	Jessore		Savar		Total sample	
	Mean (%)	SD	Mean (%)	SD	Mean (%)	SD
Vegetables	94.4	12.5	96.4	8.0	95.6	10.1
Staples	27.3	34.3	10.4	27.0	19.2	32.1
Potato	90.1	16.8	70.9	30.2	88.1	18.9
Pulses	100.0	-	73.2	35.0	75.9	34.0
Average	78.4	34.6	81.2	35.4	79.9	35.1

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 1,217 plots.

Table 28 further shows that the degree of market integration in vegetable production is the same for all farmer classifications. Small-scale farmers sell the majority of their produce to markets, just as large-scale farmers do. This is clearly not the case for staple crops. Small-scale farmers, whether cultivating small (TYPE I) or relatively larger areas (TYPE II), sell only a minor share of their staple crop products in the markets (less than 10%) in contrast to large-scale farmers who may sell up to two-thirds of their staple crop production.

Table 28. Percent share of produce sold by farmer type and crop group

Crop	I	II	III	IV	V	VI
Vegetables	95.5	96.3	96.5	95.7	95.7	94.7
Staples	5.9	9.4	8.5	19.0	28.3	33.0
Potato	92.1	0.0	69.3	90.2	95.0	89.0
Pulses	98.0	0.0	96.0	100.0	55.0	10.0
Average	80.7	82.0	77.4	80.0	75.8	81.1

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers and 1217 plots.

7.3.2 Marketing Channels

Wholesaling is a very important step in the process of distributing agricultural products. Since food processing is not yet a fully developed industry in Bangladesh, all the vegetable crops either for domestic consumption or for export remain mostly in fresh form or in primitive processing form. And since many vegetables decay within days if not refrigerated, they have to be sold as soon as possible. This explains why good transportation systems are the first of the essential components in the marketing channels of vegetable trade. According to vegetable traders, trade in vegetables has become less risky due to continuous improvement in the transportation systems, particularly roads and bridges, in the country.

The development of supermarkets is a recent addition in the domestic retail section of Bangladesh. Supermarkets started appearing less than five years ago. New outlets

are coming up in quick succession. To date, there are about 30 supermarket stores operating in the country as a whole, of which 22 are located in Dhaka. Although the coverage of supermarket chains is still very low, not even 1% of the retail sector, Hossain (2004) reports that they are creating an impact on quality production of horticultural crops and that consequently farmers are getting increasingly exposed to requirements related to IPM farming and organic cultivation.

Since supermarkets continue to play a minor role in Bangladesh, most vegetable produce are sold either in the local markets, or to wholesalers who then transports the produce to the city markets, i.e. Dhaka. Consequently, production is little organized, and none of the farmers in our sample admitted participating in contract growing arrangements. Wholesalers and small traders are the major players in vegetable trade, capturing 96% of the market. Most Savar farmers transact and sell volumes of their vegetable crops in the field and town market rather than the local market or elsewhere (Figure 12); contractors will organize harvests by contracting groups of harvesters and supply wholesalers with the product. This highlights that vertical coordination of the vegetable market is more advanced in Savar, again due to its proximity to Dhaka. In Jessore, on the other hand, most produce is sold in the local market.

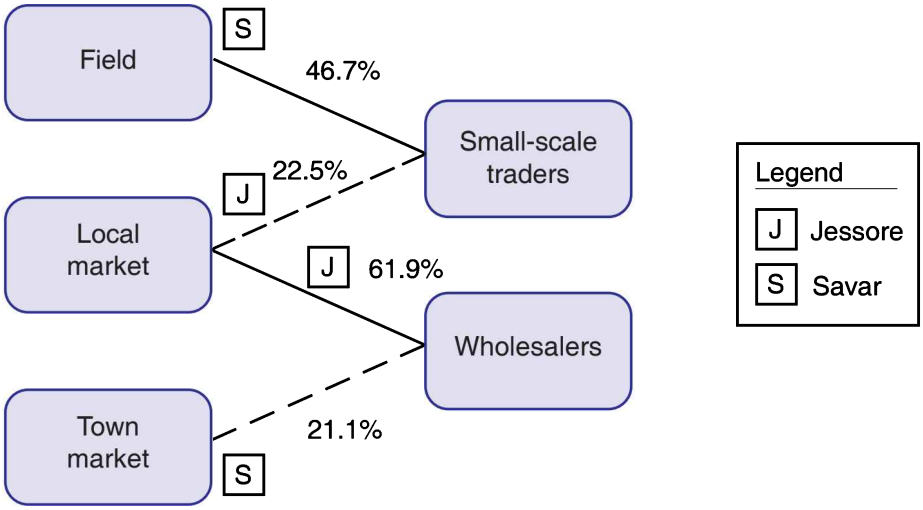


Figure 12. Marketing channels of vegetable production

In connection with Table 27, almost all vegetables harvested are sold in the market, except for radish, spinach, and mustard (classified as others) where several households consume all the produce at home (Table 29). By no means is vegetable production in Jessore and Savar an activity restricted to homesteads and for subsistence purposes only.

Table 29. Percent share of produce sold by individual vegetables

Crop	Jessore			Savar			Total sample		
	Share	Min	Max	Share	Min	Max	Share	Min	Max
Red amaranth	97.9	94	100	94.9	50	100	95.5	50	100
Bean, green	96.2	80	99	97.4	96	99	96.3	80	99
Cabbage	96.8	90	100	97.9	90	100	97.5	90	100
Carrot	-	-	-	97.0	85	100	97.0	85	100
Coriander	-	-	-	98.2	90	100	98.2	90	100
Eggplant	96.1	90	99	96.0	96	96	96.1	90	99
Gourd, pointed	96.1	85	100	-	-	-	96.1	85	100
Kohlrabi	99.2	99	100	97.2	50	100	97.3	50	100
Radish	95.8	0	100	96.1	70	100	95.9	0	100
Others	89.2	0	100	95.2	25	100	92.8	0	100
Average	94.4	0	100	96.4	0	100	95.6	0	100

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

7.4 Processing of Fruits and Vegetables in Bangladesh

Fruit and vegetable processing involves activities starting from pre-cooling, washing, grading, treating, storing, dehydrating, pickling, peeling, slicing, crushing, extracting, steaming, blanching, sterilizing, filling, scaling and sealing containers, up to labeling. Processed products of fruit include jam, jelly, and juice drinks. And other than tomato sauce, paste and ketchup, chili sauce, chili powder, pickles, and packing of peas (motor shuuti) in preservatives, the contribution of vegetable processing industry to the total economy is not significant. However, the number of fruit and vegetable industries have grown from 12 in 1986 to 62 registered with Bangladesh Agro-Processors Association (BAPA) in 2000 (SDNP 2003). In addition, it provides employment opportunities, especially to women. SDNP (2003) reports that around 75% of the permanent and casual workers in the processing units are women. In one of the processing units the team visited, women comprised 98% of all labor.

The small number of vegetable processing industries may be explained by small farm sizes and limited organization of farmers, coupled with high production during only a certain period of the year. This results in underutilization of capacities, hardly justifying high capital cost of industries. Also, there continues to be a limited domestic market for processed vegetables.

The limited number of agro-processing industries may have led to the absence of vegetable contract growers. Further growth of the sector may stimulate the development of such arrangements of vertical integration. Contract farming could be beneficial to small-scale farmers, since it offers access to new markets, technical assistance, specialized inputs, and financial resources. Contracts can also reduce crop price variation, helping farmers bear the risk of nontraditional crop production (Key and Runsten 1999).

However, for further development of the industry, investments in new equipment, knowledge and changes in practices are required. Often, small enterprises do not have access to sufficient assets or information to meet international requirements, leading to concentration of markets (Dirven 1999; Reardon and Barrett 2000). Unnevehr and Jensen (1999) present illustrations of difficulties of small firms from Bangladesh implementing HACCP and affording equipment changes and re-training, as well as certification.

8 Welfare Effects

The objective of this study was to assess the impact of increasing vegetable production on farmers through commercialization and employment effects. As pointed out before, horticultural exports from Bangladesh remain negligible. Similarly, agro-processing industries remain limited in numbers, and supply of horticultural products can only address the country's domestic requirements. Nevertheless, farmers are faced with good market opportunities. The preceding chapters have looked at the contribution of enhanced vegetable production to increasing commercialization of the rural economy, in different aspects. Now, we turn our attention to the question of how this has influenced the welfare of farmers.

The average total household income for the complete sample is TK2,436 (Table 30). This is similar to the average farm income achieved by adopters of improved AVRDC technologies and reported in Ali and Hau (2001) of TK2,413 but higher than their sample average of TK2,167. It appears that 'late adopters' have also been able to capitalize on improved vegetable technologies, and in the process have leveled down initial income differences between households. As we would expect from the proximity to urban centers and as also reflected in wage differentials reported earlier, household incomes are approximately TK600 higher in Savar as compared to Jessore. Vegetable production contributes to approximately half of all household income, with a higher share in Jessore (54%) as compared to Savar (45%). This share has risen considerably as compared to the earlier study, which reported a share of 40% in total incomes. Since off-farm incomes are approximately the same in both studies, and total household incomes have not changed dramatically either, the major changes appear to have occurred in the composition of farm income—toward vegetable-based income and away from other farm sources.

Table 30. Household cash income by income sources (TK) and district

	Jessore		Savar		Total sample	
Income source	Mean	%	Mean	%	Mean	%
Vegetable cash income	1,151	54.0	1,242	45.4	1,197	49.1
Other farm cash income	736	34.5	570	20.8	653	26.8
Agriculture labor income	240	11.2	234	8.6	237	9.7
Off-farm income	151	7.1	411	15.0	281	11.5
Other (transfers)	22	1.0	115	4.2	69	2.8
Total household income	2,132	100.0	2,739	100.0	2,436	100.0

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

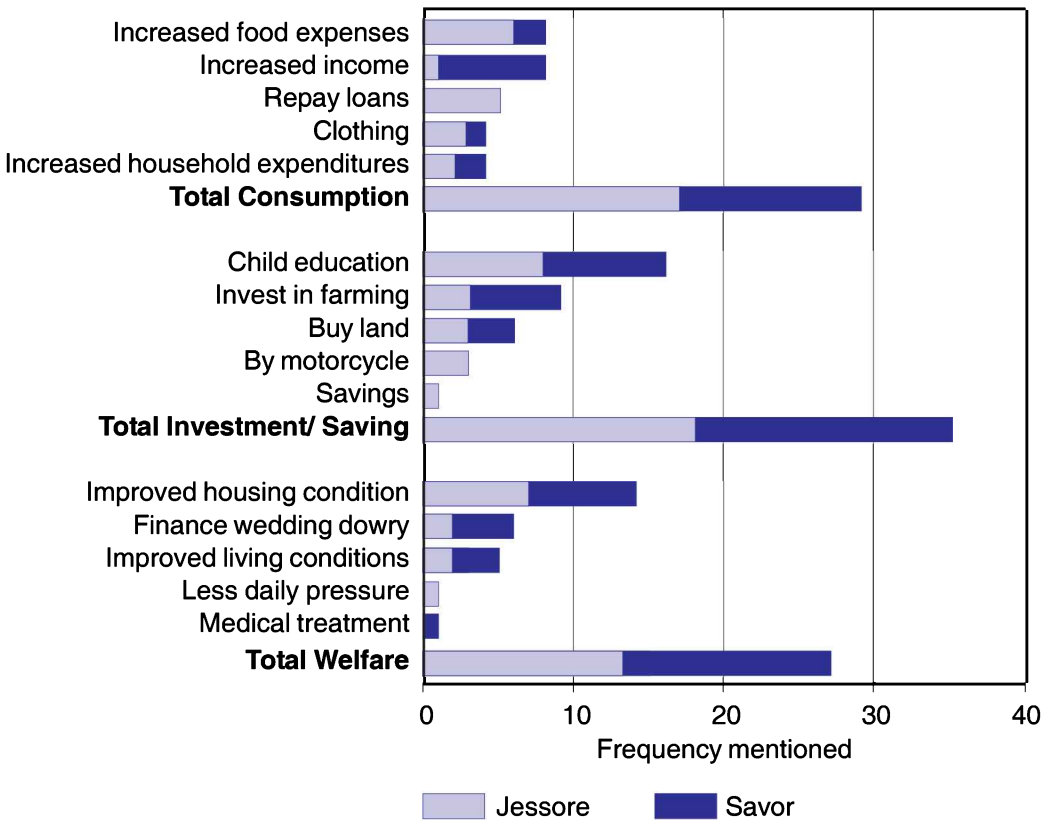
Figure 13 shows how household incomes are distributed across different farmer types. They are lowest for resource-poor farmers cultivating small areas (TYPE I) and resource-rich farmers cultivating small areas (TYPE V). For both types, the absolute value

of income from vegetables is also lowest. Farmers of TYPE I rely more on off-farm activities than other farms. TYPE I households on average hold 1.3 off-farm jobs as compared to the average of 0.8 for other farms. Such households benefit from additional income opportunities that have evolved through increasing vegetable cultivation. Incomes are highest for land-rich farmers who cultivate large areas.

Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Figure 13. Total farm income by sources and farmer type

Income data represents only a partial picture of total household well being. In focus group meetings, we were able to determine various improvements that households had experienced over the past years, including improvements that households related to their communities having greater involvement in vegetable production (Figure 14). Households' responses can be categorized into three different groups, namely: (1) increased consumption, (2) higher investments or savings, and (3) welfare improvements, such as a "lower pressure to make ends meet", or the ability to finance wedding dowries. Two groups (one in Jessore, one in Savar) felt that no improvement had taken place. The number of responses for each category (consumption/ investment/ welfare) is relatively equal, with a slightly higher share of responses for the investment category. The single most important improvement mentioned was the ability to invest in child education. This is not only restricted to primary and secondary education, but also includes tertiary



Source: Twenty group meetings held in collaboration between AVRDC and BARI. Multiple answers.
Note: Two groups (one each in Jessore and Savar) responded they did not see any benefits in increased vegetable production.

Figure 14. Life improvement indicators

education. Individual focus group meetings mentioned that children were being sent out of the country for university education. Remember also that the average school attendance ratio in this sample is much higher as compared to the average of Bangladesh.

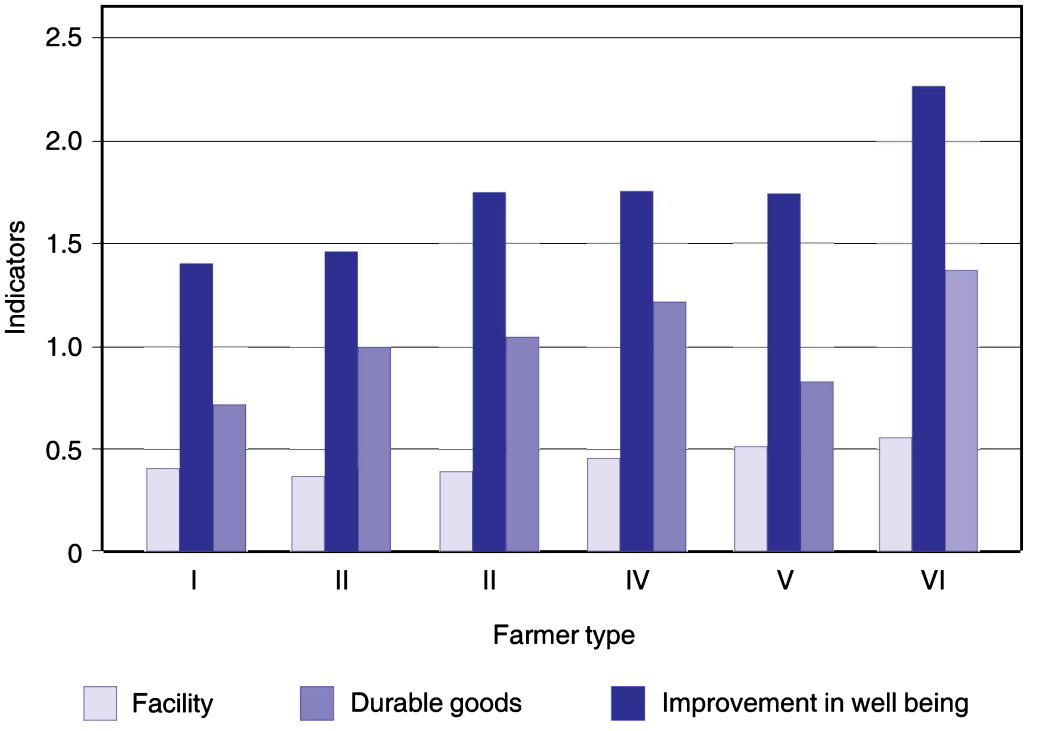
Table 31 shows indicators at the household level, including a facility welfare index and a durable goods index. These indices weigh the sum of goods and facility indicators owned by households by the probability of owning them. Although the total number of durable goods owned is higher in Jessore, the durable goods index is slightly higher in Savar, indicating greater equality in access. On the other hand, the share of households owning livestock and the facility welfare index are higher in Jessore, as compared to Savar. The last indicator, the well-being improvement index, summarizes the improvements in well being that households have experienced over the past five years. The index has the same size for Savar and Jessore. On average, 90.3% of households (92.7% in Savar and 88.0% in Jessore) experienced an improvement in their life.

Table 31. Household welfare indicators by district

Welfare indicator	Jessore		Savar		Total sample	
	Mean	SD	Mean	SD	Mean	SD
Monthly p.c. household expenditure	443.4	118.7	421.1	125.2	432.2	122.3
Total number of durable goods	4.5	1.5	3.9	2.0	4.2	1.8
Durable goods index	1.7	0.7	1.8	1.0	1.8	0.9
Share of household owning livestock	78.7	41.1	70.0	46.0	74.3	43.8
Facility welfare index	0.6	0.4	0.3	0.2	0.5	0.3
Well being improvement index	1.1	0.7	1.1	0.6	1.1	0.6

Source: Survey conducted in collaboration between AVRDC and BARI. N=300 farmers.
Note: Based on McCulloch and Ota (2002). Durable goods index: $D_h = \Sigma\, d_{ih}\,(1 - P_i)$
$P_i = n_i / n$
Where $d_{ih} = 1$ if household h possesses durable i; P_i is the probability of having durable good i; n_i = number of households which have durable i; and n = total number of households.
Facility welfare index: $F_h = \Sigma\, f_{ih}\,(1 - P_i)$
$P_i = n_i / n$
Where $f_{ih} = 1$ if household h has access to facility i – the facilities are: access to electricity; having a corrugated iron steel roof, having brick walls; P_i = probability of having facility i; n_i = number of households which have a facility i; n = total number of households.
Well-being improvement index: $W_h = \Sigma\, w_{ih}\,(1 - P_i)$
$P_i = n_i / n$
Where $w_{ih} = 1$ if household h has experienced improvement i in household well being, including child education, housing, clothing, food, accumulation of savings, purchase of land; n_i = number of households which have experienced the improvement i in well-being; n = total number of households.

The welfare indicators by farmer type do show an increasing trend as farmers have access to larger land areas (Figure 15). Smaller farms in terms of land ownership have a lower facility index, a lower durable goods index, and a lower well-being improvement indicator. The only other group of farmers experiencing a well-being indicator similarly low to farmer of TYPE I are those of TYPE V (land-rich, but cultivating small areas). These farmers also had lower incomes compared to the other farmer types.



Source: Survey conducted in collaboration between AVRDC and BARI. N = 300 farmers.

Figure 15. Welfare indicators by farmer type

9 Conclusion

Vegetable production in Bangladesh has increased at an average rate of 2.8% over the past 23 years. In some areas of Bangladesh (namely Jessore, greater Dhaka region, and Rangpur and Dinajpur districts), this growth has been tremendous and has contributed to a change of existing farming practices, replacing traditional crops as jute, pulses and rice. However, horticultural exports from Bangladesh remain negligible, and the supply of horticultural products can barely address the country's domestic requirements. Similarly, agro-processing industries, particularly for fruits and vegetables, remain limited in number. Nevertheless, farmers are faced with good market opportunities.

The government continues to deliver farmers' support systems (irrigation facilities, rural infrastructure, improved technologies and varieties, and others), which have helped Bangladeshi farmers achieve dramatic increases in agricultural production. Eager to increase their production, many farmers (91%), regardless of farmer type, invested in some new vegetable technology over the last five years. Based on the sample, 72% of the adopted vegetable technologies in Jessore and Savar were improved open-pollinated and hybrid seed varieties. The average rate of farmers who adopted an improved technology of the USAID-funded AVRDC project was 43%, and the average adoption rate among all technologies was 31%. In terms of farmers' receptiveness to these improved technologies, small-scale farmers, particularly small landowners with large cultivated areas, tend to be late adopters compared with larger-scale farmers.

Increased vegetable production has also resulted in large employment effects for the community: (1) new employment opportunities; (2) substitution of family labor for hired labor; and (3) increased wage income. The average hired labor man-days in the cultivation of vegetables is 170 man-days per ha (excluding labor from contracted companies), half of the total labor requirements. Likewise, the total value added in wages is approximately US$400 per ha, 7.5 times higher than valued added through employment in rice. In particular, small-scale farmers benefit from additional employment opportunities. In small-landowning households cultivating small areas, more than half of men and 16% of women seek employment outside their own farm, wherein one-third of these employment opportunities are vegetable-related. So far, these off-farm employment activities are mainly at the production and post-harvest levels since vegetable processing and the food manufacturing sector is not yet fully developed.

Local support industries are also benefiting from an expansion of vegetable cultivation both on the input and output side. A higher degree of input commercialization was observed for vegetables as compared to cereals. This is particularly true for all inputs such as seed, inorganic fertilizers, pesticides, farm manure, plastic mulch, mesh netting and bamboo sticks. In general, a higher share of vegetable output is sold on markets as compared to the production of cereals. Vegetable farmers are highly integrated into markets, selling a large share of their products and retaining a small portion for home consumption. This is true for all farmers. Supermarkets continue to play a minor role in

Bangladesh, and most vegetable produce are sold either in the local markets or to wholesalers.

In general, this study found that vegetable production has contributed to widespread welfare effects. A comparison of income data between an earlier study and this one leads to the conclusion that "late adopters" have also been able to capitalize on improved vegetable technologies, and in the process have leveled down initial income differences between households. While total household incomes have not changed much compared to the earlier study, a much larger share can now be attributed to vegetable-related farm production.

While nearly all communities agreed that they were benefiting from increased vegetable production (either in terms of enhanced consumption, enhanced investment or saving opportunities, or increased welfare), the farm level data also showed that larger-scale farmers have been able to capitalize more. On average, 90.3% of households experienced an improvement in their life over the past five years, but large-scale farmers reported greater increases in well being as compared to smaller farmers. The single most important improvement mentioned was the ability to send children to school, followed by improvements in housing condition. The average school attendance ratio of this sample is much higher than the average for Bangladesh.

The current state of vegetable production can continue to expand to other regions in Bangladesh if export and processing markets are tapped and affordable post-harvest and processing technologies to the agro-processing sector are introduced. Some current limitations, though, cannot be dealt with by vegetable research and development alone, such as transportation and other infrastructure (i.e. cold storage). The availability of quality vegetable seed remains a major bottleneck and the standards of quality demanded by major importers such as EUREPGAP in Europe will be difficult for farmers, processors and marketers to meet.

While this study has shown that increases in vegetable production are leading to widespread welfare increases in target communities, the study has also shown more impact can still be expected, particularly if agro-processing industries and food manufacturing develop further.

References

ADB (Asian Development Bank). 2001. Rural development priorities for poverty reduction in Bangladesh. Dhaka, Bangladesh Resident Mission: 51.

Ahsan, M.N. and M.N. Ahmed. 2003. Country paper: Bangladesh. Impact of land utilization systems on agricultural productivity. Tokyo: Asian Productivity Organization. pp. 131–142.

Ali, M. and V.T.B. Hau. 2001. Vegetables in Bangladesh. Technical Bulletin No. 25. Shanhua, Taiwan: Asian Vegetable Research and Development Center.

Anderson, J.R. and J.A. Roumasset. 1996. Food insecurity and stochastic aspects of poverty. Asian Journal of Agricultural Economics 2(1):53–66.

Anonymous (2004). Performance of small-scale industries: employment generation.

AVRDC (Asian Vegetable Research and Development Center). 2000. AVRDC-USAID Bangladesh Project. Completion Report. Shanhua, Taiwan: AVRDC.

Barrientos, S., C. Dolan, and A. Tallontire. 2003. A Gendered Value Chain Approach to Codes of Conduct in African Horticulture. Food Policy 31(9):1511–1526.

Barron, M.A. and F. Rello. 2000. The impact of the tomato agroindustry on the rural poor in Mexico. Agricultural Economics 23:289–297.

BBS (Bangladesh Bureau of Statistics). 2002. Census of Agriculture - 1996 Zila Series: M.O.P. Planning Division. Dhaka: BBS.

BBS (Bangladesh Bureau of Statistics). 2002. Report of the Labour Force Survey: Bangladesh 1999–2000. Dhaka: BBS.

BBS (Bangladesh Bureau of Statistics). 2003. 2001 Statistical yearbook of Bangladesh. M.O.P. Planning Division. Dhaka: BBS.

Bharadwaj, L. and J.L. Findeis. 2003. Off-farm work among farm women: motivations, earnings and benefit receipt. Annual Meeting of the American Agricultural Association, Montreal, Canada.

Crawford, E., V. Kelly, T.S. Jayne, and J. Howard. 2003. Input use and market development in Sub-Saharan Africa: an overview. Food Policy 28(4):277–292.

Dirven, M. 1999. Dairy clusters in Latin America in the context of globalization. The International Food and Agribusiness Management Review 2(3–4):301–313.

Dolan, C.S. 2002. Gender and witchcraft in agrarian transition: the case of Kenyan horticulture. Development and Change 33(4): 659–681.

Dolan, C.S., J. Humphrey, and C. Harris-Pascal. 1999. Horticulture commodity chains: the impact of the UK market on the African fresh vegetable industry. IDS Working Paper 96. Brighton, Institute of Development Studies.

FAO (Food and Agriculture Organization of the United Nations). 2003. FAOSTAT data. <http://www.fao.org>. Rome: FAO. Last accessed in 2004.

Faruqee, R. 1998. Bangladesh agriculture in the 21st century. Dhaka: University Press.

Gill, K. 2001. Diversification of agriculture and women's employment in Punjab. The Indian Journal of Labour Economics 44(2):259–267.

Government of the Republic of Bangladesh. 2003. Bangladesh Economic Review. M.O.F. Economic Adviser's Wing, Ministry of Finance.

Hall, T.Y. and R.K. Skaggs. 2003. Economic impact of southern New Mexico vegetable production and processing. New Mexico Chile Task Force Report No. 9. College of Agriculture and Home Economics, Cooperative Extension Service, Agricultural Experiment Station, New Mexico State University, Las Cruces, New Mexico.

Hallman, K., D. Lewis, and S. Begum. 2003. An integrated economic and social analysis to assess the impact of vegetables and fishpond technologies on poverty in rural Bangladesh. FCND Discussion Paper No. 163. Washington: International Food Policy Research Institute.

Hodges, A., D. Mulkey, and E. Philippakos. 2001. Economic impact of Florida's fruit and vegetable industries. Department of Food and Resource Economics, Florida Cooperative Extension Office, Institute of Food and Agricultural Services, University of Florida, Gainesville, Florida.

Hoque, M.E. 2000. Crop diversification in Bangladesh. In: M.K. Papdemetriou and F.J. Dent (eds.). Crop diversification in the Asia-Pacific region. Bangkok, Thailand: Food and Agriculture Organization of the United Nations.

Hossain, M.A. 2004. Country case Bangladesh. Sub-Regional Workshop on Environmental Requirements, Market Access/Entry and Export Competitiveness for Horticultural Products from Bangladesh. Bangkok, Thailand.

Humphrey, J., N. McCulloch, and M. Ota. 2004. The Impact of European Market Changes on Employment in the Kenyan Horticultural Sector. Journal of International Development 16:63–80.

International Labor Organization India. 2004. Paid employment in manufacturing. <http://www.laborsta.ilo.org/cgi-bin/brokerv8.exe>. Accessed October 2004.

Key, N. and D. Runsten. 1999. Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production. World Development 27(2): 381–401.

Kuehn, A., K. Weinberger, J-F Wang. (forthcoming). Farmer's willingness to pay for control measures to tomato bacterial wilt. Journal of Agricultural and Applied Economics.

Liu, F.-S. 1994. Building an agricultural marketing system in a developing country: the Taiwan experience. Taipei, Taiwan: Maw Chang Book Company.

Marra, M., D.J. Pannell, and A.A. Ghadim. 2003. The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: where are we on the learning curve?" Agricultural Systems 75(2–3): 215–234.

McCulloch, N. and M. Ota. 2002. Export horticulture and poverty in Kenya. IDS Working Paper 174. Brighton, Sussex, IDS.

Minot, N. and M. Ngigi. 2004. Are horticultural exports a replicable success story? Evidence from Kenya and Côte d'Ivoire. EPTD Discussion Paper No. 120, MTID Disc. Paper No. 73. Washington D.C.: International Food Policy Research Institute.

Pingali, P. and M. Rosegrant. 1995. Agricultural commercialization and diversification: processes and policies. Food Policy 20(3):171–185.

Quasem, M.A. 2003. Exports of fresh horticultural crops from Bangladesh: problems and prospects. Dhaka: Bangladesh Institute of Development Studies.

Quayum, M.A. and B.A.A. Mustafi. 2001. Rice and wheat yield gap determination under different soil and crop management practices at Chuadanga research site. Gazipur, Bangladesh, Agricultural Economics Division, Bangladesh Rice Research Institute. pp. 1–45.

Rahman, S. 2000. Women's employment in Bangladesh agriculture: composition, determinants and scope. Journal of Rural Studies 16: 497–507.

Reardon, T. and C.B. Barrett. 2000. Agroindustrialization, globalization, and international development: an overview of issues, patterns, and determinants. Agricultural Economics 23:195–205.

SDNP (Sustainable Development Networking Programme). 2003. Agriculture emerging issues: fresh produce and processing in Bangladesh. <http://www.sdnbd.org/sdi/issues/agriculture/index.htm>. Last accessed 2004.

Shahabuddin, Q. and P. Dorosh. 2001. Comparative advantage in Bangladesh Crop Production. MSSD Discussion Paper No. 47. Washington D.C.: International Food Policy Research Institute.

Singh, S. 2003. Contract farming in India: impacts on women and children. Gatekeeper Sereies No. 111. London: International Institute for Environment and Development.

Spring, A. 2001. Positive effects of agricultural commercialization on women: a new paradigm. In: P. Webb and K. Weinberger (eds.). Women farmers: enhancing rights, recognition and productivity. Frankfurt: Peter Lang. pp. 13–36.

Unnevehr, L.J. and H. H. Jensen. 1999. The economic implications of using HACCP as a food safety regulatory standard. Food Policy 24(6): 625–635.

von Braun, J. 1995. Agricultural commercialization: impacts on income and nutrition and implications for policy. Food Policy 20(3):187–202.

Weinberger, K. and J. Msuya. 2004. Indigenous vegetables in Tanzania: significance and prospects. Technical Bulletin No. 31. Shanhua, AVRDC.

White, S. 1999. Women's employment in the agro and food processing sector: South Asia and East Africa. Ottawa, Ontario: Aga Khan Foundation Canada.

World Bank. 1997. Bangladesh: the non-farm sector in a diversifying Rural Economy. Washington D.C.: World Bank.