

A Survey of Agricultural Value Chain: A Case Study of Bangladesh Banana Industry

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Abstract

Agriculture is the backbone of Bangladeshi economy. It accounts for 17% of total Bangladeshi GDP and contributes 36% of domestic market share. This survey focuses on bananas, one of the most important and popular fruits of the country and analyzes the complete value chain (VC) functions and relationships, targeting the producers, intermediaries and consumers' willingness to pay (WTP) for quality produce in three municipalities, Barisal, Faridpur, and Dhaka districts respectively. A total of 177 survey questionnaires were distributed amongst the three groups of VC key participants, out of which 130 were usable. The data collected were subjected to analysis of frequency of response using chi-square test in SAS v. 9.2 (SAS Institute, Cary, NC USA), zero responses were excluded from the statistical analyses of Chi-square. Our results show that 8% of the respondents in Barisal were willing to pay from 11-15 BDT/Kg of bananas compared to 43% in Faridpur and 49% in Dhaka. Furthermore, our result also illustrated that 100% of the farmers actually sold their bananas at prices ranging from 151-250 BDT, thus, an average price of from 193-225 BDT/bunch despite the quality of the produce. Finally, the major problems observed were lack of good agricultural practices, which affects overall quality, distribution, and marketing of this important fruit.

Key words: Agricultural Production, Agricultural Value Chain, Willingness to Pay, Growers, Consumers.

Introduction

Agriculture is very important to Bangladeshis economy as it contributes 17% of its total GDP. According to Bangladesh Statistics, banana is the only fruit crop available year round with the highest per capita consumption compared to the over 118 different fruits crops produced in the country. Banana is considered "one of the finest fruits and the most important" in terms of food value, food security, food availability and above all, it is a crop that has a positive impact due to its profitability margins aimed at increasing household income and alleviating poverty. Most importantly, the "super fruit" crop is not only economically important, but has the best nutritional value as well - all in one".

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The popularity of banana is partially due to its “low price and multiple uses” i.e., as vegetable and as a dessert fruit. It is a rich source of carbohydrate and having plenty of vitamins particularly vitamin B. It is also a good source of potassium, phosphorus, calcium and magnesium (Fonsah and Chidebelu, 2012; Fonsah et al. 2007a; 2007b; 2007c). Ripe banana mixed with rice and milk is the traditional dish for the Bangladeshis. Banana powder is used as the first baby food. It helps in reducing risk of heart disease when used regularly and is recommended for patients suffering from high blood pressure, arthritis, ulcer, gastroenteritis and kidney disorders” (Bangladesh Statistics, 2014; Fonsah and Chidebelu, 2012). This survey investigates the factors affecting banana agricultural value chain in Bangladesh from the producers to the end users (Fonsah et al., 2007a).

Current Production Trend, Situation and Outlook

Banana alone represents 20% of all the over 118 fruits crops produced in Bangladesh with a market share of 36%. From 2003 to 2006, harvested acreage, production and yields experienced steady increased and reached its peak in 2007 with a total of 145,300 acres, producing 1,004,500 metric tons (MT) and obtaining an optimum yield of 6.9 MT/Acre (BBS Yearbook, 2015) (Table 1).

Table 1: Acreage, Production and Yield Trends of Banana in Bangladesh, 2003-2012

Year	Acreage (in '000')	Production (in '000' MT)	Yield Rate (MT)
2003-04	121.7	706.6	5.8
2004-05	133.0	898.7	6.8
2005-06	138.4	909.1	6.6
2006-07	145.3	1004.5	6.9
2007-08	131.6	877.1	6.7
2008-09	132.4	836.2	6.3
2009-10	133.3	818.3	6.1
2010-11	130.6	779.4	6.0
2011-12	121.7	745.9	6.1

Source: Yearbook of Agricultural Statistics of Bangladesh-2008, 2011 & 2012) BBS.

These trends were quite significant although lower than the world’s averages. However, since 2007, all three economic indicators; acreage, production and yields have maintained a nosedive downward sloping trend. For instance, in 2012, 121,700 acres were harvested and 745,900 MT produced with a yield of 6.1 MT was reported. This translates to 16%, 26 % and 11% decrease in planted acreage, production and yields respectively in almost a decade. The reasons for these declines were: (1) The cyclone that devastated all the farms from 2007-2008, (2) Population explosion that is converting farm land to residential properties, (3) Pests and diseases, (4) Adopted outdated agricultural practices, (5) Increased Pre and Post-harvest losses, (6) Quality, (7) Lack of general farm management skills, (8) Lack of post-harvest management skills, (9) Lack of improved planting materials, (10) Lack of cold storage and ripening facilities. That explains why the government found it necessary to subsidize and lend support to the industry with inputs such as fertilizers, irrigation, pest and disease controls respectively.

Material and Methods

Three different sets of questionnaires were developed during the summer of 2015 at the beginning of a two month project funded by USAID/DAI’s Banana Agricultural Value Chains (AVC) in Bangladesh. The project was aimed at designing study methodology and implementation plan endorsed by food value chain to end market analysis, mapping value chain functions and relationships. However, this survey was specifically design to investigate the factors affecting banana agricultural value chain in Bangladesh from the producers to the end users. The Agricultural Value Chain Team developed a series of questions that were tested several times in Dhaka, Faridpur, and Barisal. Some of the questions included: What is the size of your banana farm? What else do you cultivate beside bananas? What variety of bananas do you cultivate? How much do you sell a bunch of bananas on the average? How much are you willing to pay for a good quality bunch of any variety of bananas? Thereafter, the questionnaires were modified based on the responses from the field tests. The production questionnaires were designed to find out present agricultural practices, production trends and growers behavior vis-à-vis willingness to adopt new technology. The second questionnaire was for the intermediaries also known as middlemen. This questionnaire was aimed at determining market and distribution level-channels, wholesaler’s price determination, wholesaler’s attitude and perception vis-à-vis willing to pay (WTP) premium price for high quality bananas. The third survey was design for the customers and/or end-users.

The survey was aimed at studying consumer behaviors vis-à-vis willing to pay (WTP) for quality bananas, determination of customers preferences for different banana cultivars/varieties and consumer preferences vis-à-vis quality attributes.

Data Collection

A total of 177 survey questionnaires were distributed amongst the three groups of VC key participants, out of which 130 were usable. Forty-one production survey questionnaires were distributed to farmers in Jessore, Jdeniada, Harinakunda, Jhinaidah Sadar, Sailkupa, Kinshargoni, Narayangoni, Shyllet, Barisal and Faridpur. Only 26 were usable. More-so, 33 questionnaires were distributed to intermediaries/wholesalers and retailers in Khamarmundia, Kaligonji, Jhedaideh, Shinhutola Bazar, Hakimpur, Chaugacha, Jessore and Dhaka. Only 25 were usable. Furthermore, out of 103 survey sent out to consumers/end-users, 79 were usable. Finally the consumer survey study areas were Dhaka, Barisal, and Faridpur.

Data Analysis and Empirical Model

The data collected from the three different segments of the Bangladesh banana VC, i.e., production (farmers), intermediaries (wholesalers and retailers) and consumers (end-users) was inputted in an Excel spreadsheet. Data were subjected to analysis of frequency of response using chi-square test in SAS v. 9.2(SAS Institute, Cary, NC USA), zero responses were excluded from the statistical analyses of Chi-square. The chi-square “goodness-of-fit” test was used in this banana agricultural value chain (AVC) survey study simply due to the fact that our questionnaires were distributed and the data was collected from the targeted group of Bangladesh banana producers (farmers), intermediaries and consuming (end-users) population. As such, we adopted the equation:

$$x^2 = \sum_{i=1}^k \frac{(y_i - e_i)^2}{e_i}$$

Where y_i = observed number of outcomes in the i th banana value chain operative category and e_i = expected frequency and x^2 is a positive number.

Results

Farmers' Perception and Farm Size

In a survey, growers were asked what their professions were. The question offered them three answer choices and/or combinations, thus: Farmer (F); Farmer/Retailer (F/R) or Farmer Wholesaler (F/WS). The results show that a significant number were strictly farmers (77%) compared to 19% who were F/R and 4% were F/WS. The chi-square estimate shows that $X^2 = 23.15$; and $p < 0.0001$.

On the other hand, the respondents of the production survey were asked what their farm size were. Most of the respondents (30.8%) had farm size range of 26-50 decimals (67m² or 720 ft²). The others (19.2%) had farm size of 51-75 decimals, while 23.1% of them had farm sizes of 1 acre (0.405 hectare). Interestingly, a good number (22.3%) of the respondents had farm sizes ranging from 1-13 acres (0.405 – 5.261 hectares). The number of new farmers and expanded farm size observed and the decrease in jute farm size was a clear indication that farmers were gradually switching from jute plant cultivation to bananas. Another classic example was that the 3.8% of the respondent who had farms less than 25 decimal were probably the new entrants. Our chi-square estimation depicted that $X^2 = 15.84$ and $p = 0.03$.

Adopted Production System

Bangladesh banana farmers were involved in mix cultivation. The respondents were asked what else they cultivate beside bananas. Out of the total respondents, a significant number (26.4%) cultivated rice while 25% grew jute plants. On the other hand, 13.9% of the farmers grew mangos while 11.1% were involved in mixed vegetables. Other important crops such as potatoes and sugar cane were significantly lower compared to the previous one 11.1% and 4.2% respectively. Our statistical estimation showed that $x^2 = 70.08$ and $p < 0.0001$.

What variety of bananas do they grow?

In addition, the survey also depicted the farmers were interested in different banana cultivar production. The results of our survey also depicted that 30.8% of the respondent cultivated Sabri-kola, 21.2% Rongin Sagor-kola and 15.4% for Champa-kola; 3.1% were involved in Green / cooking bananas.

Other significantly less cultivated varieties were: Thota-kola (3.8%); Bangla-kola; Bitchi-kola and Baishara-kola with 1.9% respectively. Statistically $\chi^2 = 39.07$ and $p < 0.0001$.

Farm Gate Prices for a Bunch of Bananas

Farmers in the survey were asked the price they obtain for a bunch of bananas. This question was aimed at determining what the growers receive and to compare to what the consumers are willing to pay (WTP). More-so this information was important for determining profitability margins. There was no significant difference in the results. Out of the total respondents, 38.5% stated that they receive 151-200 Bangladeshi Taka (BDT) per bunch (\$1.87 - \$2.48) compared to 43.3% who sold their bananas at 201-225 BDT (\$2.49-\$2.79) per bunch. Furthermore, the results depicted that 19.2% received 226-250 BDT (\$2.80 - \$3.10) per bunch of bananas. This result also illustrated that 100% of the farmers actually sold their bananas at prices ranging from 151-250 BDT (\$1.87 - \$3.10) or on an average price of from 193-225 BDT (\$2.34 - \$2.79) per bunch despite the quality of the produce. Statistical results showed $\chi^2 = 2.38$ and $p = 0.30$.

Growers Age Group

A question was asked to determine the age group of the farmers. A significant low number of them (11%) were still between 20-30 years of age and 11% of them were in their mid-age (41-50). However, the majority, an outstanding 63% were still in their prime, i.e. 31-40 years old. Our statistical results were $\chi^2 = 31.33$ and $p < 0.0001$. This could partially explain why, the majority of them (80.80%) were willing to adopt new technology. Empirically, we observed that the growers were eager to learn new agricultural practices during our visit to their various banana orchards. They asked several pertinent questions about diseases, and general agriculture.

Intermediaries (VC) Survey Results

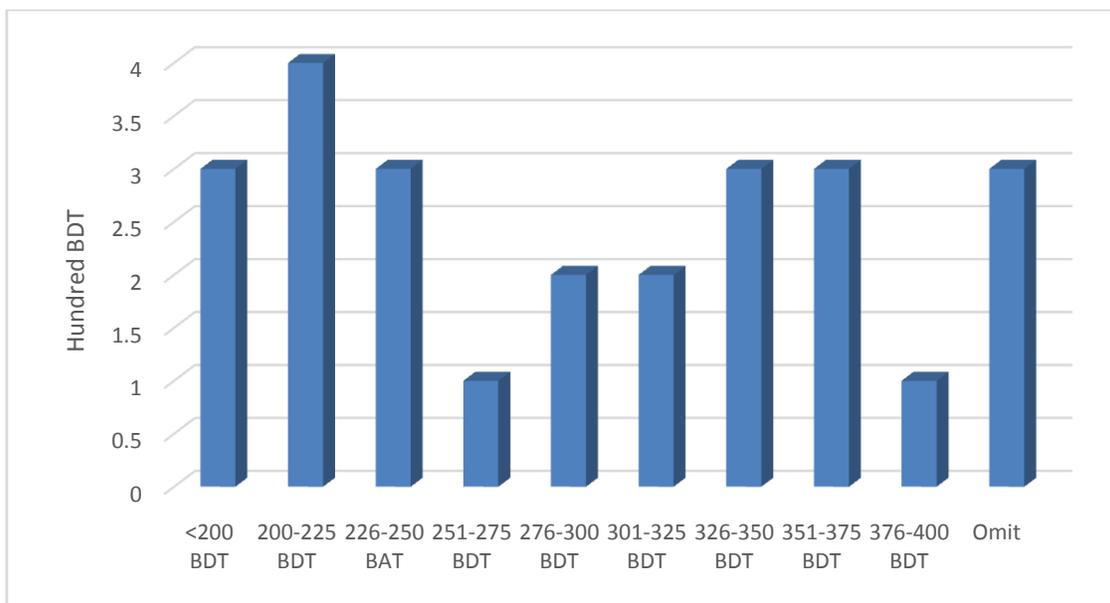
Intermediaries Distribution Channels

This question had four answers thus: Retailer (R); Wholesaler (WS); Wholesaler/Retailer (WS/R) and Farmer/wholesaler/Retailer (F/WS/R) respectively. The result of this question depicted that a significant number (60%) of the respondents were Rs while 24% were WS. We also discovered that 12% of them were WS/R at the same time while 4% were F/WS/R, thus serving in three different categories of the banana VC. The intermediaries distribution channel statistic result was $\chi^2 = 718.38$ and $p < 0.0004$. Further investigation showed that there were three levels of wholesalers (WS): Rural Wholesaler (R/WS); Urban Wholesaler (U/WS); and Supermarket Wholesaler (S/WS). Our results showed that 40% of the respondents said their business location was in the cities (U/WS) like Dhaka while 32% reported that their locations were in the rural areas (R/WS) like Khamarmundia, Kaligonji or Jhedaideh. At the same time 28% of the respondents claimed to be S/WS. There is no significant difference in the intermediaries location response in this survey as $\chi^2 = 0.56$ and $p = 0.75$.

Willingness to Pay (WTP) For a Good Bunch of Any Variety of Bananas

The WTP question had eight different price ranges starting from <200 BAT to 350 BAT and an "omit" category for those who were not willing to reveal their prices. The answer to this question was important to determine if the growers still had enough room to increase their profitability. It was welcoming news to find out that 76% of the intermediary respondents were willing to pay from 200-400 BDT (\$2.48 - \$4.96) per bunch of good quality bananas and only 12% of them indicated they would pay less than 200 BDT (\$2.48) per bunch, thus $\chi^2 = 2$ and $p = 0.98$. Although there were mixed price preferences amongst the intermediaries, 16% indicated they would pay 200-225 BDT (\$2.48 - \$2.79) per bunch of bananas while 12% indicated they would pay 326-350 BDT (\$4.04 - \$4.34) and 401-425 BDT (\$4.97 - \$5.27) respectively. A resounding 36% indicated they would pay from 326-425 BDT (\$4.04 - \$5.27) for any variety of good quality bananas (Fig 1). This was a clear indication that adopting new technology and good agricultural practices (GAP) would be beneficial to the growers in terms of increasing their household income. It will also be beneficial to the complete banana VC as intermediaries will also benefit while consumers get good quality fruits (Fonsah, 2002).

Figure 1: A Survey of Intermediary Willingness to Pay (WTP) for Good-Quality Bunch of Any Variety of Bananas in Bangladesh, 2015.

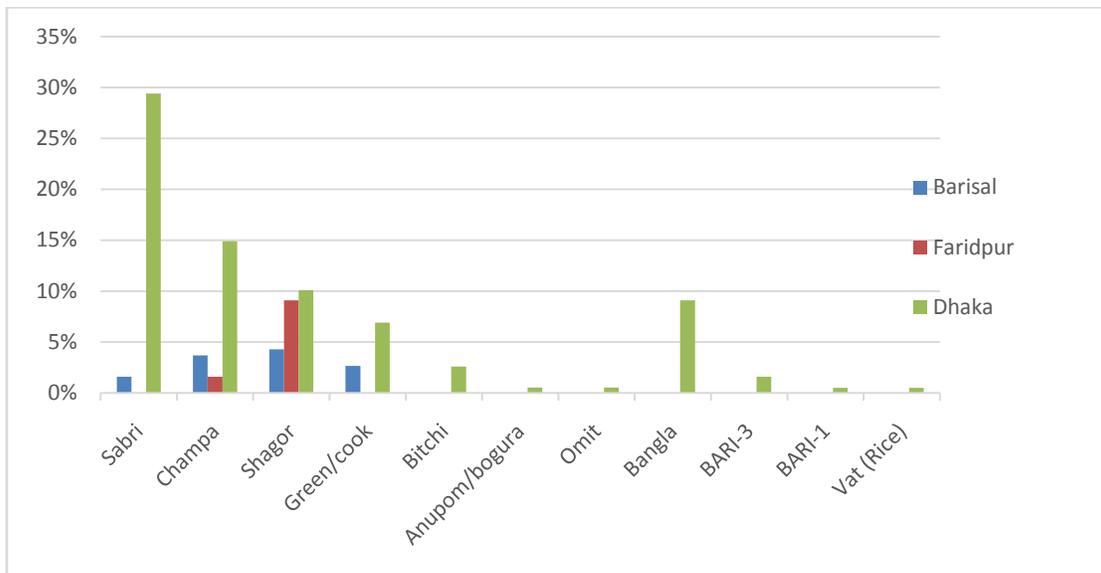


Consumers (VC) Survey Results

Which of the locally grown bananas do you prefer to buy?

It was amazing to find out the differences in consumer behaviors and preferences in the three distribution districts: Barisal; Faridpur and Dhaka respectively. There was a significant difference in the behaviors and preferences between consumers in urban and local areas respectively. For instance, when asked which locally grown bananas they preferred to buy, 38% in Dhaka city preferred Sabri compared to 0% in Faridpur and 13% in Barisal. On the other hand, 30.4% of the respondents in Barisal preferred Champa variety compared to 19% in Dhaka and 15% in Faridpur (Figure 2).

Figure 2: A survey of Locally Preferred Banana Cultivars in Three Cities of Bangladesh, 2015.



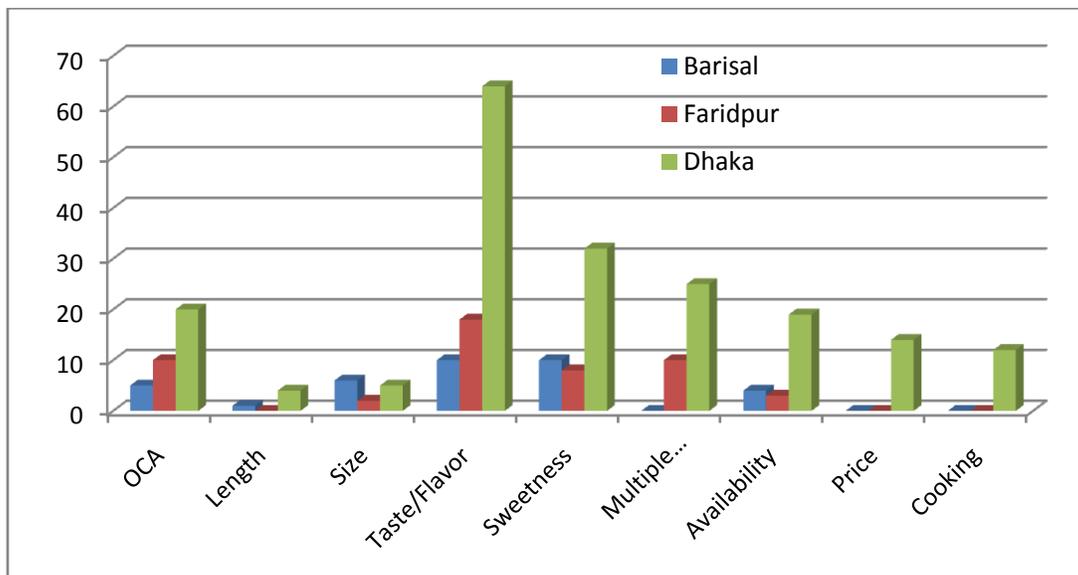
More-so, 85% of the respondents in Faridpur preferred Shagor compared to 34.8% in Barisal and 13% in Dhaka. Other significant differences were in the preferences for the Green/Cooking bananas which were preferred by 21.7% of the respondents in Barisal compared to 0% in Faridpur and 9% in Dhaka.

Finally, 12% of the respondents in Dhaka preferred Bangla compared to 0% in Faridpur and 0% in Barisal. It is worth mentioning here that Faridpur and Barisal are both fairly rural areas while Dhaka is urban (Figure 2).

Why do you prefer the selected local cultivars?

When asked the reasons for the consumer preference of the selected cultivars, 20%, 10% and 5% from Dhaka, Faridpur and Barisal respectively said it was due to the taste/flavor (Figure 3). Also, the respondents in Dhaka ranked high in all the consumer preference categories such as sweetness, multiple uses, availability, price, cooking and overall cosmetic appearance (OCA). Faridpur district ranked 2nd followed by Barisal (Figure 3).

Figure 3: A Survey of Consumer Preferences for Selected Banana Cultivars in three Localities in Bangladesh, 2015.



On the other hand, an estimation of the WTP selected locally grown variety of bananas in Barisal, Faridpur and Dhaka showed that taste/flavor $x^2 = 55.39$ and p -value = 0.0001 while for sweetness $x^2 = 21.28$ and p -value = 0.0001. For overall cosmetic appearance, $x^2 = 10.00$ and p -value = 0.007 (Table 2).

Table 2: Estimation of Willingness to Buy (WTB) a selected locally grown variety of bananas in three localities in Bangladesh using Chi-Square, 2015.

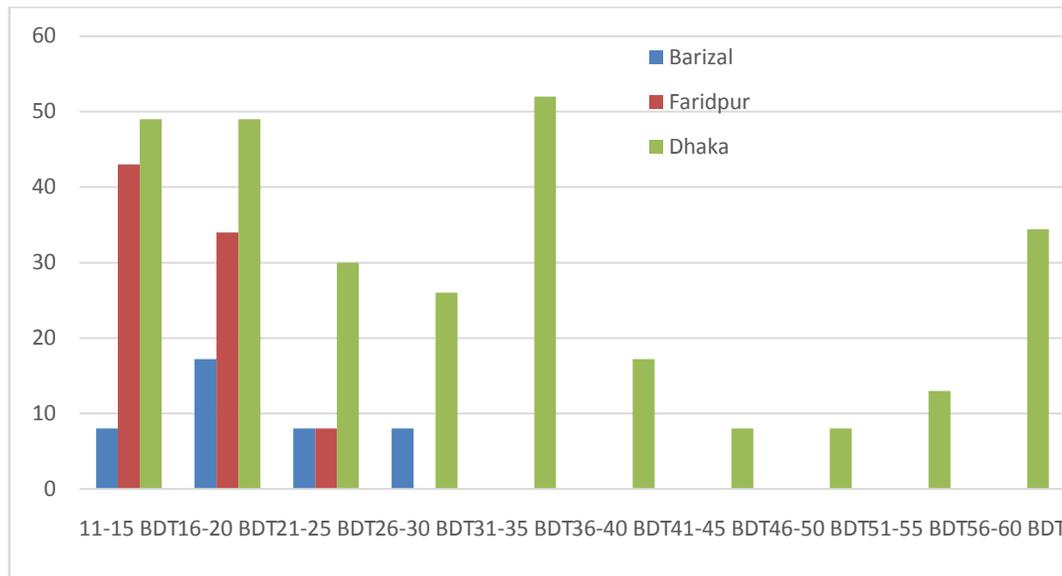
Quality Attributes	Barisal	Faridpur	Dhaka	X ²	P-value
OCA	5	10	20	10.00	0.007
Length	1	0	4	-	-
Size	6	2	5	55.39	0.37
Taste/Flavor	10	18	64	55.39	0.0001
Sweetness	10	8	32	21.28	0.0001
Multiple Uses	0	10	25	-	-
Availability	4	3	19	18.54	0.0001
Price	0	0	14	-	-
Cooking	0	0	12	-	-
	36	51	195	-	-

Willingness Pay For a Kg of Bananas

This question was aimed at determining the purchasing power of the consumers in Dhaka, Barisal and Faridpur. Dhaka ranked highest in all the categories followed by Faridpur and lastly by Barisal. For instance, 8% of the respondents in Barisal were willing to pay (WTP) from 11-15 BDT per Kg of bananas compared to 43% in Faridpur and 49% in Dhaka. When the price was increased to 16-20 BDT, 17% in Barisal, 34% in Faridpur and 49% in Dhaka were willing to pay respectively in the three locations.

At the price of 31-35 BDT, 52% of the respondents in Dhaka were still willing to pay for a Kg of bananas whereas those in Barisal and Faridpur were not interested at all. Even at the highest price of 56-60 BDT per Kg of banana, as high as 34% of the Dhaka city dwellers were still willing to pay whereas no one in Barisal and Faridpur was willing to pay that much for a Kg of banana (Fig 4).

Figure 4: A Survey Results of Willingness to Pay (WTP) for a Kg of Banana in three Cities in Bangladesh, 2015.



Conclusion

Our results show that 8% of the respondents in Barisal were willing to pay from 11-15 BDT/Kg of bananas compared to 43% in Faridpur and 49% in Dhaka. It also illustrated that 100% of the farmers actually sold their bananas at prices ranging from 151-250 BDT, thus, an average price of from 193-225 BDT/bunch despite the quality of the produce. Although there were mix price preferences amongst the intermediaries, 16% indicated they would pay 200-225 BDT/bunch of bananas while 12% indicated they would pay 326-350 BDT and 401-425 BDT respectively. Finally, the major problems observed were lack of good agricultural practices, which affects overall quality, distribution, and marketing of this important fruit.

Bangladesh has the potentials to become producer, marketer and exporter of premium quality bananas. Domestically there is a growing market demand and per capita consumption is more than 4.3 kg/annum. With a population growth rate of 1.6%, the demand for bananas, which is their most favorite fruit crops out of over 118 different fruits, will continue to increase, especially that the fruit is used for multiple functions including medicinal and health reasons. The problems plaguing the industry are pest and disease and lack of modern agricultural practices in producing quality bananas for both local and export market. Survey results across the complete banana VC indicate a willingness to adopt new technology and willingness to purchase (WTB) any variety of quality bananas at higher prices. A Total Quality Management (TQM) strategy, which is an integrated banana management approach, is recommended to revamp the whole industry (Fonsah and Bani, 2017).

Policy Implications

The “Shabri” variety that was one of the preferred cultivar happens to be the Cavendish clone which is vulnerable to Tropical Race 4 (TR4), one of the most destructive banana disease that is currently spreading in Asia, Africa and Central America even though no symptoms were observed during the study period (Garcia-Bastidas et al., 2014). However, the banana bunchy top virus (BBTV) and black sigatoka were conspicuously present in most of the grower’s farms. These two diseases are so dangerous and are capable of destroying the entire banana production in Bangladesh in a very short time. For instance, when BBTV infested Hawaii in 1999-2000, the banana growers were forced to abandon their farms until adequate control measures were adopted. If curative or preventive measures are not taken to control these two diseases, it could affect the livelihood of small and limited resource farmers in Bangladesh in particular, and the world banana industry in general, especially those whose livelihood is dependent on this crop as a source of income and staple food source.

Other noticeable problems plaguing the Bangladesh Banana industry are pests and the lack of modern agricultural practices in producing quality bananas for both local and export market. It is crucially important that policy makers in the Ministry of Agriculture and Extension Services develop specific training for Extension Agents through the development of a demonstration research plot where they can be given practical training of the multifaceted operations involved in modern banana production such as bagging and propping, deleafing, fruit obstacle removal, sucker pruning, irrigation, fertility, harvesting and packaging. More-so, Extension Agents and all the actors involved in the complete VC should be introduced to the concept of total quality management (TQM), an integrated banana production and management philosophy that is needed to revamp the whole industry (Fonsah and Bani, 2017).

Survey results across the complete banana VC indicate a willingness to adopt new technology and willingness to buy (W/TB) any variety of quality bananas at higher prices. Bangladesh has the potentials to become producer, marketer and exporter of premium quality bananas. Domestically there is a growing market demand and per capita consumption is more than 4.3 kg per annum. With a population growth rate of 1.6%, the demand for bananas, which is their most favorite fruit crops out of over 118 different fruits, will continue to increase, especially that the fruit is used for multiple functions including medicinal and health reasons. To successfully accomplish this, the Bangladeshi government has to be proactive in funding research and training of Extension Agents who will eventually train the farmers on all production, postharvest and marketing of quality bananas. This example can be applied to other banana producing countries around the world.

Acknowledgement

This study was funded by USAID/DAI Feed the Future Bangladesh Agricultural Value Chains Project/ DAI Oracle Purchase Order number: 24790 #1002221-IC-15-24790-00 for which the authors are indebted and grateful. We are equally thankful to the top management and staff of DAI Bangladesh for all their support throughout this work.

References

- Bangladeshi Taka (BDT): 1BDT = US\$0.013 (September 27, 2016).
- Bangladesh Bureau of Statistics and Information, Statistics and Informatics Division, Ministry of Planning. (2014). Report on the Productivity Survey of Banana Crop, 2013. Available online: Accessed May 30, 2018. <http://192.168.218.65/WebTestApplication/userfiles/Image/LatestReports/ReportBanana2013.pdf>
- Fonsah, E. G., and B. Amin (2017). "Evaluating Overall Performances of the Banana Industry in West Bengal State, India." *J. of Food Distr Res*: 48(1): 16-21 (March).
- Fonsah, E. G. (2002). "An Integrated Quality Control Management Strategies in Banana Production, Packaging and Marketing." *J. of Food Distr Res*: 34(1): 99-106.
- Fonsah, E. G., A. C. Adamu, B. Okole, and B. Mullinex. (2007b). "Field Evaluation of Two Conventional and Three Micropropagated Cavendish Banana Cultivars over a Six Crop Cycle in a Commercial Plantation in the Tropics." *Fruits* 62(4):205-212.
- Fonsah, E. G. and A. S. N. D. Chidebelu. (2012). *Economics of Banana Production and Marketing in the Tropics: A Case Study of Cameroon*. Bamenda, Cameroon: Langaa RPCIG.
- Fonsah, E. G., G. Krewer, R. Wallace, and B. Mullinex. (2007a). "Banana Production: An Alternative Crop for Niche and Ethnic Market in Georgia." *J. of Food Distr Res*: 38(3):14-21.
- Fonsah, E. G., J. Roshetko, J. Tukan, E. Nugraha, and G. S. Manurung. (2007c). "Fruit and Vegetable Industry in Indonesia: Production and Limited Access to Market." *J. of Food Distr Res*: 39(1):62-66.
- García-Bastidas, F., N. Ordóñez, J. Konkol, M. Al-Qasim, Z. Naser, M. Abdelwali, N. Salem, C. Waalwijk, R. C. Ploetz, G. H. J. Kema, 2014. "First Report of *Fusarium oxysporum* f. sp. *cubense* Tropical Race 4 Associated with Panama Disease of Banana outside Southeast Asia". *Plant Disease* Vol. 98 (5) 694.
- Wikipedia (2016). Decimal (unit). Available online: Accessed May 30, 2018 [https://en.wikipedia.org/wiki/Decimal_\(unit\)](https://en.wikipedia.org/wiki/Decimal_(unit))