PRODUCTION, MARKETING SYSTEM, STORAGE AND FUTURE ASPECT OF POTATO IN BANGLADESH

Utsarika Singha¹ and Shigenori Maezawa²*

¹ United Graduate School of Agricultural Science, Gifu University, 1-1 Yanagido, Gifu 501-1193, Japan
² Faculty of Applied Biological sciences, Gifu University, 1-1 Yanagido, Gifu 501-1193, Japan

ABSTRACT

Potato (Solanum tuberosum), is the most consumed vegetable in Bangladesh throughout the year round. Due to the suitable environment, potato production is increased day by day and in 2019 Bangladesh became the seventh largest potato producing country in the world. Now the amount of production is more than the demand and hence from recent few years Bangladesh starts to exports potato and its associated food products to the different countries in the world. Unemployment problem is very common in the developing countries like Bangladesh but potato gives an opportunity to solve the problem and also help to eradicate the situation of hunger. Though bumper harvest of potato is very common in Bangladesh but the growers are sometimes devoid of to get the fair price due to the extreme margin by the middlemen. Hence, the aim of this study is to examine the present situation of potato production, storage, marketing system, and export. The major findings of this study are as follows: Firstly, poor transportation system, inadequate storage facilities, lack of capital, lack of knowledge of farmers about market price, illiteracy, and syndicate system of middlemen are some key factors for inefficient marketing system of potato in Bangladesh. Secondly, giving the increased important in potato is not the ultimate solution, instantly improve the marketing mechanism of potato is required for Bangladesh. Finally, it is exigent that government needs to take the obligatory steps for the sustainable production and marketing system of potato in Bangladesh.

Keywords

Export, Marketing channel, Price variation, Production, Storage

1. Introduction

In Bangladesh more than 100 vegetables are produced (Rubayet and Jony, 2016). Among a huge variety of vegetables, potato stands first by choice of farmers after introducing some preservation facilities like cold storage and so on (Moazzem and Fujita, 2004). Whole year round demand of potato by consumers and the high perishable rate of other vegetables due to lack of preservation facilities are also responsible for the higher production within last few years though the cultivation of potato was started at late 19th century in Bangladesh (Baset et al., 2009) in contrast to 17th century in Indian sub-continent (Pandey et al., 2000) and commercial production of crops was started from 1920 (Hossain et al., 2008). The geographical suitability of Bangladesh is also responsible for the increase production of potato in every year (Nunn and Qian, 2011). Generally lower-income people consume more potatoes rather than other vegetables (Pitt, 1983; McCracken and Marotz, 1989) and as a whole the potato consumption stands third position among other cereal crops, just after rice and wheat (Thomson and Kelly, 1957). As a result the cultivation of potato is increasing day by day in Bangladesh. According to Department of Agriculture Extension (DAE, 2016) of Bangladesh, 8.95 million metric tons potato was produced in the fiscal year (FY) 2013-2014 which was 0.345 million metric tons higher than the previous FY. For this tremendous production, now Bangladesh is the seventh largest potato producer’s country in the world followed by the production of China, India, Russian Federation, Ukraine, United States, and Germany and third in Asia (FAOSTAT, 2019). The increased cultivable land along with the increased per hectare yield were helped to achieved this remarkable production (BBS, 2016).

Thus potato consumed as vegetable in Bangladesh rather than staple food in other first world country (Hong et al., 2017) and in relation to per capita consumption Bangladesh stands second by consuming 23 Kilograms (Kg) after China, where the consumable amount was 32 Kg (Reardon et al., 2012); but as a most used vegetable, potato consumed over 100 countries of the world (Hajong et al., 2014). From the nutritional aspect, potato is one of the cheapest sources of carbohydrates and furnishes appreciable amount of vitamin B6 (Pyridoxine) and C as well as some minerals (King and Slavin, 2013). Potato provides twice as much as calories per unit
area of land and in a shorter period of time compared to rich and wheat (Guenthner, 2010). There are lots of palatable foods made from potatoes. Some processed food from potato are now available in the market of the Bangladesh, like chips, crackers, crisps, French-fries and starch but it is negligible in compared to developed country, where 10 percent of their production is converted to processed food and 4 percent is processed for starch (Keijbets, 2008). In addition, some processing industries such as production of alcohol, glucose, dextrin and citric acid for textile and paper industries, inks, dyes and soap industries use potato as their raw materials (Abouzied and Reddy, 1986). Potato is also used for the production of bio-ethanol (Azad et al., 2014). Uses of potato and other agricultural product were also described in different paper (e.g. Fadel, 2000; Yamada et al., 2009; Izmirlioglu and Demirci, 2012; Mukul et al., 2013; Hossain and Abdullah, 2015; Hossain and Abdullah, 2016 and Hossain et al., 2016; Pacifico and Paris, 2016). So the continuous increased demand insists to produce huge amount of potatoes. In addition, potato is a high productivity crops (Azimuddin et al., 2009) and helpful to eradicate hunger from Bangladesh to achieved Millennium Development Goals within 2015 (Hossain and Abdullah, 2016).

Though this huge production, the farmers were devoid of a good margin from their cultivated product. Maximum growers sell their product immediate after harvesting due to small amount of storage facilities, ignorance about market price and cash need (Hajong et al., 2014). Basically this distressed sale occurred during pick production season at March to April (BIDA, 2016). Along with this, some other risk factors such as consumers taste and priorities, weather instability, storing infestation of diseases and so on helps to change the market situation rapidly (Hall et al., 2006) which also triggered farmers to sell their product immediate after harvest. Middlemen are waiting for this situation and buy potatoes from farmers and stored, then sold them in high pricing month of October to December (BIDA, 2016). Due to the interrupted supply of the electricity, temperature of the cold storage can’t be maintain properly; as a result shrinking, sporulation and some potato become rotten, which reduce the weight of the potato (Hajong et al., 2014). Sometimes it becomes less than 70 percent of its original size (Walker et al., 1999). About 2-9 percent of cold stored potato affected by diseases (Khan et al., 1973) which is equal to 80 million Bangladeshi currency/ taka (BDT) (Azimuddin et al., 2009). These diseases occur in the cold storage due to over density because freeness of the diseases of potato depends directly proportional to its preservation space (Scott and Suarez, 2011, 2012). By this way, about one third of annual production of potato waste every year which hamper our economy badly (Chakraborty and Roy, 2016) otherwise sharing of GDP from agricultural products will increase. Due to the above said circumstances, the terminal consumers need to pay more money for buying the product but farmers share on this wages is very low. This sort of inefficient marketing system doesn’t assure a remunerative prices to the farmers. This type of problems present most of the developing countries due to presence of excessive number of intermediaries between producer and consumer (Huq et al., 2004) but their role in marketing can’t be demoralized (De and Bhukta, 1994). So it is very important to find out the alternative ways to benefit the farmers and also not to squeeze the income opportunity of other persons like intermediaries. Hence, the aim of this study is to analyze the present situation of potato production, storage, marketing system and export with its constraints which become acquainted with some previous efficient works.

2. Socio-economic status of potato cultivation farmers

The socio-economic status of farmer’s influences the production of potato (Mukul et al., 2013). This status includes age, educational quality, farm size, farming experience, ability of understands for choice of variety of potato according to the soil quality and so on of farmers. Basically, major portion of farmers are illiterate and young. Among potato cultivating farmers, 53.3% were illiterate, average age in between 20-35 years, and working experience in between 1-10 years (Mukul et al., 2013). Notable thing was no higher educated people in Bangladesh were directly involved in the cultivation of potato. Generally potato cultivating farmers can be grouped in to 4 groups- landless (0 acres), small farm size (0.01-0.49 acres), medium farm size (0.50-1.49 acres) and large farm size (≥1.50 acres) (Moazzem and Fujita, 2004). They found that 25% farmers were landless but they cultivate other land that’s why they known as borgachasi. Landless and small farm sized farmers generally collect money as loan from other rich person or from some organization like as bank to cultivate potato. But for the landless farmers it is difficult to loan money from bank as a result they borrow money from other rich person with a high interest. They have to return the borrowed money immediate after harvesting their cultivated crops. That’s why farmers need cash and they sold their product in low price during the harvesting period. As a whole by cultivating potato they are not benefited properly.

3. Available types of potato in Bangladesh

Two varieties of potato were cultivated in Bangladesh- high yielding varieties and local varieties (Uddin et al. 2010). Among high yielding variety, major types were Diamant, Cardinal, Granola, Multa, Patrones, Origo, Binella, Heera, Asterix, Elvira, Ultra, Provento, Kufrisinduri and so on, on the other hand, Shilbilati, Indurkani, Lal pakri, Pakri, Surjamukhi were major types of local va-
Among these two types of varieties, farmers of Bangladesh try to cultivate high yielding variety because the quality seeds are not available and also prone to infected by pest and different types of diseases of local varieties. Among different types of high yielding variety, farmers prefer to cultivate Granola because its production rate was more than other types (Uddin et al. 2010).

4. Potato production in relation to cultivated area

The ideal potato growing temperature is 45° to 80°F and in Bangladesh potato mainly cultivate in winter season when the temperature stands in between 64° to 84°F (Haverkort, 1990; Khurana and Garg, 2003). Severe damage of potato may occur when temperature drops below 32°F (Hijmans, 2003). So, for the suitable environment, every year Bangladesh produced and consumed large quantities of potatoes (Hossain and Abdulla, 2016). In production and consume perspective, potato is the third and second largest food crops in Bangladesh, respectively (FAOSTAT, 2014). Using of potato as processed and fresh food forms are increasing day by day in Asian countries as well as in Bangladesh (Brown, 2005) for its nutritional impact. Potato contains 75-80% water, 16-20% carbohydrates, 2.5-3.2% crude protein, 1.2-2.2 true protein, 0.8-1.2% minerals, 0.1-0.2% crude fats, 0.6% crude fiber and some vitamins (Schoenemann, 1977). The increasing trend of potato production is also triggered by continuous demand of processing industries (Iritani, 1981). Now a day, Bangladesh exports some portion of its produced potato and potato oriented food to other countries. So, good variety of potato is very much essential to maintain the quality in exports and also in processing industries which will ensure the good price (Connor, 2001). Generally, in every FY, potato cultivated area increased consequently in Bangladesh (BBS, 2016; FAOSTAT, 2019). Table 1 showed the total harvested potato area in contrast to total harvested cropped area during FY 2000-01 to 2014-15. Harvesting pattern of potato also showed in Table 1. Potato cultivating land increased rapidly in comparison with total cropped area in those FY with a little exception in FY 2001-02, 2006-07, 2008-09, and 2011-12 due to the natural calamities. These data strongly suggest that potato production and cultivation is increased in day by day due to the increased demand.

Table 1: Total harvested cropped and potato area with harvesting pattern over FY 2000-2001 to 2014-2015 in Bangladesh. Source: BBS, 2015; FAOSTAT, 2019.

| Fiscal Year (FY) | Total harvested cropped area (hectors) | Total harvested potato area (hectors) | Increasing potato harvesting area (%) |
|-----------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 2000-01         | 707217                                | 248988                                | -                                     |
| 2001-02         | 687790                                | 237600                                | -4.57                                 |
| 2002-03         | 693734                                | 245318                                | 3.25                                  |
| 2003-04         | 703761                                | 270740                                | 10.36                                 |
| 2004-05         | 846999                                | 326291                                | 20.52                                 |
| 2005-06         | 890723                                | 375200                                | 14.38                                 |
| 2006-07         | 864752                                | 345000                                | -7.55                                 |
| 2007-08         | 875914                                | 402000                                | 16.32                                 |
| 2008-09         | 876316                                | 395000                                | -1.74                                 |
| 2009-10         | 920483                                | 435000                                | 10.13                                 |
| 2010-11         | 975186                                | 460197                                | 5.79                                  |
| 2011-12         | 980237                                | 430446                                | -6.47                                 |
| 2012-13         | 920379                                | 443934                                | 3.13                                  |
| 2013-14         | 946158                                | 461710                                | 4.00                                  |
| 2014-15         | 984174                                | 471013                                | 2.01                                  |

5. Demography of potato production in Bangladesh

In consideration of production, potato is one of the most promising crops in Bangladesh. Along with the increasing potato cultivated area, production was also increased. In every fiscal year department of agricultural extension, Bangladesh fixed the production targets of every cultivated crop. Most of the times, the actual production of the potato is higher than the target production. Decreased intensity of the natural calamity like as flood, supply of high quality seed, fertilizer, pesticide and proper facility of management provided by the agricultural officers are helpful to achieve the over production during the last couple of years. Table 2 showed the information about actual production and production pattern of potato in every FY from 2000-01 to 2014-15. The department of agricultural extension, Bangladesh, fixed the production target of potato in every FY but generally the actual production becomes higher than the target (DAE, 2016). Except some exception, actual production of potato increased in every FY with a high increase in FY 2009-10. Previously we discussed that the continuous increased demand of potato is initiating the farmers to produce more amount of potato. Along with the increasing cultivated land for potato, the production was also increased. The productive curve was dramatically increased from the beginning of 21st century with a bit variation (Fig. 1).
Table 2: Actual production and production pattern of potato in every FY from 2000-01 to 2014-15. Source: DAE, 2016; FAOSTAT, 2019.

| Fiscal Year (FY) | Actual production (tonnes) | Production increased (%) |
|------------------|-----------------------------|--------------------------|
| 2000-01          | 3216000                     | --                       |
| 2001-02          | 2994000                     | -6.90                    |
| 2002-03          | 3385910                     | 13.09                    |
| 2003-04          | 3907120                     | 15.39                    |
| 2004-05          | 4855377                     | 24.27                    |
| 2005-06          | 5368400                     | 10.57                    |
| 2006-07          | 5167000                     | -3.75                    |
| 2007-08          | 6648000                     | 28.66                    |
| 2008-09          | 5268000                     | -20.76                   |
| 2009-10          | 7930000                     | 50.53                    |
| 2010-11          | 8326389                     | 4.99                     |
| 2011-12          | 8205470                     | -1.45                    |
| 2012-13          | 8603000                     | 4.84                     |
| 2013-14          | 8950000                     | 4.03                     |
| 2014-15          | 9254285                     | 3.39                     |

Fig. 1: Increased production tendency of potato during FY 2000-2001 to 2014-2015. Source: BBS, 2016; FAOSTAT, 2019.

6. Preservation system of potatoes in Bangladesh

The purpose of potato storage is to maintain their most edible and marketable condition and also to provide a uniform flow of potato to market and processing plants throughout the year (Eltawil et al., 2006). But it must be realized that some damage can be happened even if the optimum storage facility is provided. Temperature, humidity, CO₂ and air movement are the most important factors during storage (Harbenburg et al., 1986) and potato have a tendency to high storage loss during first three months of storage (Varns et al., 1985). However, before storing, the storability of potatoes should be determined by such factors like- cultivar, growing techniques, type of soil, weather conditions during growth, diseases before harvesting, and maturity of potatoes at the time of harvesting, damage to tubers during lifting, transport and filling of the store (Rastovsky, 1987; Burton et al., 1992).

In Bangladesh, different methods of potato storing are used. Some small scale farmers of northern Bangladesh use traditional method but it is not well established method for preservation of potato in Bangladesh. In southern part of Bangladesh, some innovative storage system is used, namely- ambient type potato storage and coolbot storage by the help of The United States Agency for International Development (USAID), International Potato Center (CIP), World Vegetable Center (AVRDC), Bangladesh Agricultural Research Institute (BARI) and some Non-Government organization (NGO) - BRAC and PROSHIKA. But most popular and new storing system is cold storage. According to DAM, 2016; out of 375 cold storages, 343 are now active and provide their service for
storing potato. In 2014, 346 cold storages were providing their service but in 2015, 3 cold storages were out of their service.

In 2014, the available storing capacity was 2617948 tonnes but only 1998631 tonnes was stored. On the other hand the storing capacity was decreased to 2598948 in 2015 and the storing volume was increased to 2022135 tonnes (Fig. 2). Proper management, relatively low fare and the non-stopping electricity supply can enhance the storing volume of cold storage. The cold storage owners are busy with their storing business but previously they were engaged with trading and contract framing with farmers also (Lewis, 1991). In recent few years Bangladeshi farmers and potato marketing associated peoples become habituated with this new technology of preservation in cold storage. Therefore, we cannot manage data before FY 2013-14. So, it will be interesting enough if future research will go by this way- efficacy of cold storage in potato preservation in Bangladesh.

Fig. 2: Preservation scenario of potato in cold storage during two succeeding FY. Source: DAM, 2016.

7. Role of different intermediaries in potato marketing

A large number of intermediaries are associated with the marketing channel of potato. All intermediaries are essential for the proper supply of potato because they collect the segregated production and distribute throughout the country. In a developing country like Bangladesh where the unemployment problem is available, long potato marketing gives the opportunity to work some people easily. Their specific function was described previously by some researchers (e.g. Das and Hanaoka 2014) and briefly as follows:

Faria: Faria is a pretty trader who handled small volume of product and purchases potato from the farmers. After that sells it to bepari. Sometimes he sells product directly to the local consumers also.

Bepari: Bepari is a professional wholesale trader who purchases from faria, bring their consignment to the urban wholesale market and sells them to paiker and retailer through aratder (commission agent). Occasionally, he goes to village for purchasing potato from farmers.

Aratdhar: Aratdhar is a commission agent who has a fixed establishment and operates between bepari and retailers, or farmer and paiker, or bepari and paiker. Aratdhar charges a fix commission for providing storage facilities.

Paiker: Wholesaler of the consuming area is known as paiker, who purchases potato from bepari through aratdhar and sell those to retailer or consumer.

Retailer: Retailer is the last link in the marketing channel before consumer, buys potato from aratdhar or wholesaler and sells to consumers. Retailer is independently organized and has permanent shop in the market.

8. Present marketing system of potatoes

Bangladesh Agricultural development corporation (BADC) supplies quality seed to the farmers to yield maximum production. In addition, some farmers store seed potato for next year cultivation. In Bangladesh, several intermediaries play different kind of role in the potato supply chain. The common marketing channel of potato is little bit asymmetric in rural and urban areas (Fig. 3). During the harvesting period in March, farmers sell their product to all of the intermediaries and some part directly to the consumers of the
rural areas. Some portion also stored in the cold storage. The channel which is mediated by all of the intermediaries, consumers need to pay more money for buying potato. On the other hand, in urban consuming area, paiker collect potato from the rural bepari and then sold to aratder or retailer. Finally the urban consumer can get the product for consume. Transaction cost including transportation, rent, packaging, loading-unloading, marketing tools of different intermediaries are responsible for the high pricing of potatoes in consumer’s level. After crossing a long marketing channel, potato reaches urban areas from rural farmers. Thus consumers need to pay more and the farmers share on the consumers pay become law. So, most of the author told that the distribution system of potato is inefficient in Bangladesh.

9. Marketing margins of potatoes

In marketing system, marketing margin has been defined as the difference between the price received by the producers and the price paid by the final consumers which is composed of two components, marketing cost and net margin or profit (Huq et al., 2004). In a specific stage of marketing channel, the difference between the purchasing price and the selling price is called the marketing margin of that stage. Investment in the potato market is characterized by high risk and high return. Therefore, high profitability is not unlike in potato marketing due to the involvement of the high price risk (Moazzem and Fujita, 2004). Previously we discussed that the distribution channel of potato in Bangladesh is generally long. The conventional claim is that the middlemen are slicing off a major portion of the consumer’s price as profit (Sarker and Sasaki, 1999a). Contrary to this statement, it was found that the long distribution channel in Bangladesh was economically effective (Sarker and Sasaki, 1999b) due to scarcity of employment. The average farm gate, wholesale and retail price of potato in Bangladesh is increasing in recent FY than earlier (Fig. 4).

10. Seasonal price variation of potato

Seasonal price variation of potato in Bangladesh is very high. During the harvesting period, price becomes very low in contrast to other time. February and March are the harvesting time for potato in Bangladesh. Major portion of potato is harvested during March. So, in March the price becomes very low and sometimes farmers cannot get fair price (Sabur, 1990). We divide our analyzed data in to three groups: 2000-2005, 2006-2010, and 2011-2015 for understanding the price variation in every 5 years (Fig. 5). The price variation is higher in 2011-2015 than other two groups which suggested that the production cost of the recent years increase rapidly.

11. Exports of potato

The tuber crops research center of Bangladesh Agricultural Research Institute has already released 66 high yielding variety of potato (Roy et al., 2017) which also responsible for the huge production of potatoes in Bangladesh. Bangladesh produces more potato than its demand. So, Bangladesh exports potatoes to other countries from few years ago (Fig. 6). Now, Bangladesh exports potato and potato oriented items to different countries like as United Arab Emirates, Belgium, Brunei, Bahrain, Canada, Netherlands, Russia, and Singapore and so on (BEPB, 2016). In recent years Japan also import potato from Bangladesh. Bangladesh earned 33822638.25 USD $ during the FY of 2013-14. Though the exports decreased in the FY of 2014-15 and 2015-16 but we hope the

Fig. 3: Common marketing channel of potato in Bangladesh. (Modified from Moazzem and Fujita, 2004 and Huq et al., 2004).

Fig. 4: Common marketing channel of potato in Bangladesh. (Modified from Moazzem and Fujita, 2004 and Huq et al., 2004).
export will increase from the next FY. Due to the excess amount of potato production 9.2 million metric tons against the demand of 7.0 million metric tons in recent years; Bangladesh is capable to export a considerable amount of good quality surplus potato to other countries (BBS, 2016).

12. Alternative use of potatoes

Bangladesh is a densely populated country. To ensure the food security of all people of Bangladesh, the Government of Bangladesh tries to promote to change the food habit of people and influence them to eat more potato than rice because the nutrition value is more or less similar. To use as a staple food in Bangladesh, Department of Agricultural Marketing took some innovative strategy and also give some different types of recipes which can easily made from potatoes.

13. Future aspect of potato cultivation

To eradicate malnutrition and hunger from developing countries, potato plays a vital role after rice, wheat and maize (Swaminathan, 2001; Arun et al., 2015) but produces more food/hector/day than wheat, rice and maize (Kumar and Pandey, 2008). In addition, due to the increasing population pressure, growing urbanization and rapid changes of consumers demand and market preferences, sustainable changes in potato consumption in developing countries has been identified (Pandey et al., 2005). These things trigger to increase production of potato which makes Bangladesh one of the potatoes producing leading country in the world. In Bangladesh, land quality, availability of quality high yielding varieties seed and government policy also helpful to increase the total potato production in future. So, export of potato and potato oriented industry will also increase in Bangladesh which will help to generate new employment to the people. In addition, it is evident that to increase the farmers share from the marketing system, co-operative marketing system will be a good solution (Pandey et al., 2005). To increase the potato cultivation for increased production, government can introduce co-operative marketing system among rural farmers to maintain the sustainable production. To develop more sufficient flow of potatoes in the market, more research is needed. Research institutes can take initiatives to develop overall situation of potato.
Conclusion

The potato production of Bangladesh is confirmed as advantageous, sustainable and profitable. There is potential to improve the performances of potato through identifying the opportunities to leverage the development of potato sectors. Cultivation of potato and post-harvest operations establish an important source of employment and income in developing countries. In Bangladesh where land is limited with a huge labor force, potato is ideally suitable to grow. However some major problems such as, poor transportation system, price uncertainty, inefficient marketing system, poor communication, lack of capital, high cold storage charges and so on.

Fig. 5: Seasonal fluctuation of potato price in wholesale market. Data showed in taka/quintal. 1 quintal= 100 kg. Source: DAM, 2016; Hajong et al., 2014.

Fig. 6: Scenario of potato export in USD $ during the FY of 2000-2001 to 2014-2015. Source: BEPB, 2016; FAOSTAT, 2019.
affect both the growers and the consumers. So, it is very much important to take necessary steps by Government and related associations to ensure the flow of good solution from potato’s cultivation to marketing. Market demand of potato is high and increasing. To hold this situation and remain potato in second leading main crops to meet the demands of increasing populations, it is needed to develop the all potato associated sectors in Bangladesh.

REFERENCES
Abouzied MM and Reddy CA (1986) Direct fermentation of potato starch to ethanol by cocultures of Aspergillus niger and Saccharomyces cerevisiae. App. Envir. Mic., 52(5): 1055-1059.
Arun KB, Chandran J, Dhanya R, Krishna P, Jayamurthy P and Nisha P (2015) A comparative evaluation of antioxidant and anti diabetic potential of peel from young and matured potato. Food Bio., 9: 36-46.
Azad AK, Yesmin N, Sarker SK, Sattar A and Karim R (2014) Optimum conditions for bioethanol production from potato of Bangladesh. Adv. Bios. Biotech., 5: 501-507.
Azimuddin M, Alam QM and Baset MA (2009) Potato for food security in Bangladesh. Intl. J. Sus. Crop Prod., 4(1): 94-99.
Bangladesh Bureau of Statistics, BBS (2016) Yearbook of agricultural statistics of Bangladesh, 2010. Statistics Division, Ministry of Planning, Government of the People’s Republic of Bangladesh. www.bbs.gov.bd
Bangladesh Export Promotion Bureau, BEPB (2016) Statistical data for 2015-2016, Ministry of Industry, Government of People’s Republic of Bangladesh. www.epb.gov.bd
Bangladesh Investment Development Authority, BIDA (2016), Potato processing. Publications on agribusiness, potato: 1-7, Government of People’s Republic of Bangladesh. www.bida.gov.bd
Baset MA, Karim MR and Akter M (2009) Measurement and analysis of total factor productivity growth in modern potato variety. J. Agric. Rural. Dev., 7(1-2): 65-71.
Brown CR (2005) Antioxidant in potato. Am. J. Potato. Res., 82: 163-72.
Burton WG, van Es A and Hartmans KJ (1992) The physics and physiology of storage. In: The potato crop: The scientific bases for improvement. (Harris PM eds). pp. 608-727. Chapman & Hall, London.
Chakraborty R and Roy T (2016) Threats faced by brown rot of potato in Bangladesh. Microb. Res., 7(1): 8-12.
Chowdhury MD and Chowdhury AH (2015) Problems and prospects of potato cultivation in Bangladesh. Asi. Bus. Rev., 5(10): 28-32.
Connor CJ, Fisk KJ, Smith BJ and Melton LD (2001) Fat uptake in French fries as affected by different potato varieties and processing. J. Food Sci., 66: 903-908.
Das R and Hanaoka S (2014) Perishable food supply chain constraints in Bangladesh. Int. J. Food Sup. Cha., 5: 13-29.
De AK and Bhukta A (1994) Marketing of potato in West Bengal: An economic view. Agril. Mar., 36(4): 36-44.
Department of Agriculture Extension, DAE (2016) Annual report 2015-2016. Ministry of Agriculture, Government of the People’s Republic of Bangladesh, Khamarbari, Farmgate, Dhaka. www.dae.gov.bd
Department of Agriculture Marketing, DAM (2016) DAM annual report/2015. Ministry of Agriculture, Government of the People’s Republic of Bangladesh, Khamarbari, Farmgate, Dhaka. www.dam.gov.bd
Eltawil M, Samuel D and Singhal O (2006) Potato storage technology and store design aspects. Agricultural Engineering International: the CIGR Ejournal. Invited Overview No. 11 (8): 1-18.
FAOSTAT (2014) Statistical database. Food and Agricultural Organization of United Nations (FAO), Rome, Italy. www.fao.org/faostat/en
FAOSTAT (2019) Statistical database. Food and Agricultural Organization of United Nations (FAO), Rome, Italy. www.fao.org/faostat/en
Fadel M (2000) Alcohol production from potato industry starchy waste. Egypt J. Microbiol. 35: 273–287.
Guenthner J (2010) Past, present and future world potato markets: An overview. Potato J., 37(1-2): 1-8.
Hajong P, Moniruzzaman M, Mia MIA and Rahman MM (2014) Storage system of potato in Bangladesh. Uni. J. Agrl. Res., 2(1): 11-17.
Hall C, Brooker J, Eastwood D, Epperson J, Estes E and Woods T (2006) A marketing systems approach to removing distribution barriers confronting small-volume fruit and vegetable growers. Choices 21(4):259-264.
Harbenburg RE, Watada AE and Wang CY (1986) The commercial storage of fruits, vegetables and florist and nursery stocks. U.S. Department of Agriculture, www.ars.usda.gov
Haverkort AJ (1990) Ecology of potato cropping systems in relation to latitude. Agril. Sys., 32(3): 251-272.
Hijmans RJ (2003) The effect of climate change on global potato production. Am. J. Potato Res., 80: 271-280.
Hong Z, Fen X, Yu W, Hong-hai H and Xiao-feng D (2017) Progress of potato staple food research and industry development in China. J. Integ. Agril., 16(12): 2924-2932.
Hossain MA, Hasan MK and Naher Q (2008) Assessment of technical efficiency of potato producers in some selected areas of Bangladesh. J. Agril. Rural. Dev., 6(1-2): 113-118.
Hossain MM and Abdulla F (2015) On the production behaviors and forecasting the tomatoes production in Bangladesh. J. Agril. Econ. Dev., 4(5): 66-74.
Hossain MM and Abdulla F (2016) Forecasting potato production in Bangladesh by ARIMA model. J. Adv. Stat., 1(4): 191-198.
Hossain MM, Abdulla F and Majumder AK (2016) Forecasting of banana production in Bangladesh. Am. J. Agril. Biol. Sci., 11(2): 93-99.
Huq ASMA, Alam S and Akter S (2004) Marketing efficiency of different channels for potato in selected areas of Bangladesh. Bangladesh J. Agric. Econ., 27(1): 67-79.
Iritani WM (1981) Growth and pre-harvest stress and processing quality of potatoes. Am. Potato J., 58: 71-80.
Izmirlioglu G and Demirci (2012) Ethanol production from waste potato mash by using Saccharomyces cerevisiae. Appl. Sci., 2: 738-753.
Keijbets M (2008) Potato processing for the consumers: developments and future challenges. In. Potato Res., 51: 271-281.
Khan AA, Rahman S and Kamaluddin G (1973) A preliminary survey of the diseases of potatoes in cold storages in Bangladesh. Bangladesh J. Biol. Agril. Sci., 2(2): 17-18.
Khurana SMP and Garg ID (2003) Potatoes in warm climates. In: Loebenstein G and Thottappilly G (eds) Virus and virus-like diseases of major crops in developing countries. Springer, Dordrecht, pp. 167-193.
King JC and Slavin JL (2013) White potatoes, human health, and dietary guidance. Adv. Nutr., 4(3): 393S-401S.
Kumar A and Pandey SK (2008) Potato processing: harbinger of agricultural sustainability. Indian Farm., 58 (9): 3-7.
Lewis DJ (1991) Technologies and transactions: a study of the interaction between new technology and agrarian structure in Bangladesh. Center for Social Studies, Dhaka University, Dhaka, Bangladesh.
McCranken VA and Marotz CC (1989) Consumer potato demand. J. Food Dist. Res., 20(2): 1-12.
Moazzem KG and Fujita K (2004) The potato marketing system and its changes in Bangladesh: from the perspective of a village study in Comilla district. The Dev. Econ., 42(1): 63-94.
Mukul AZA, Rayhan SJ and Hassan MM (2013) Farmer's profitability of potato cultivation at Rampur district: the socio-economic context of Bangladesh. Intl. J. Econ. Finan. Manag. Sci., 1(3): 136-144.
Nunn N and Qian N (2011) The potato's contribution to population and urbanization: evidence from a historical experiment. Quar. J. Econ., 126(2): 593–650.
Pacifico D and Paris R (2016) Effect of organic potato farming on human and environmental health and benefits from new plant breeding techniques. Is it only a matter of public acceptance? Sustainability 8: 1054.
Pandey SK, Khurana SMP, Singh SV, Kumar D and Kumar P (2005) Evaluation of Indian and exotic potato varieties for sustaining processing industries in north western plains of India. Indian J. Hort. Sci., 62: 155-159.
Pandey SK, Shekhawat GS and Darkar D (2000) Quality attributes of Indian potatoes for export: priorities and possibilities. Potato J., 27(3-4): 101-111.
Pitt M (1983) Food preferences and nutrition in rural Bangladesh. Rev. Econ. Stat., 65(1): 105-114.
Rastovsky A (1987) Storage losses. In: Storage of potatoes. Post-harvest behavior, store design, storage practice, handling. (Rastovski, A, Van Es, A. eds.) Pudoc. Wageningen, The Netherlands.
Reardon T, Chen K, Minten B and Adriano L (2012) The quiet revolution in staple food value chains. ADB and IFPRI, Mandal-nyong Philippines.
Roy TS, Chakraborty R, Parvez MN, Biswas S and Chakraborty S (2017) Development of sustainable gross national income from potato export in Bangladesh- a perspective review. Univ. J. Agril. Res., 5 (1): 46-51.
Rubayet K and Jony B (2016) Value stream analysis of vegetable supply chain in Bangladesh: a case study. Intl. J. Manag. Val. Supp. Cha., 7(2): 41-60.
Sabur SA (1990) Production and price behavior of vegetables in Bangladesh. Bangladesh J. Agric. Econ., 8(1-2): 81-91.
Sarker AL and Sasaki T (1999a) Performance of fruit and vegetables marketing system - the case of Bangladesh. J. Rural Prob., 35(3): 107-119.
Sarker AL and Sasaki T (1999b) Role of middlemen in marketing system – the case of potato and banana marketing in Bangladesh. The Farm Manag. Socie. Japan, 37(2): 147-152.

Schoenemann JA (1977) Grading, packaging and marketing potatoes. In: Potato production, storing processing, 2ndEdition (O. Smitheds.). The AVI publishing company Inc., West port, pp. 470-505.

Scott G and Suarez V (2011) Growth rates for potato in India 1961-2009 and their implications for industry. Potato j., 38(2): 100-112.

Scott G and Suarez V (2012) The rise of Asia as the centre of global potato production and some implications for industry. Potato J., 39(1): 1-22.

Swaminathan MS (2001) Food security and sustainable development. Curr. Sci., 81 (8): 948-954.

Thomson HC and Kelly WC (1957) Vegetable crops. McGraw Hill Book Company Inc., New York.

Uddin MA, Yamin S, Rahman ML, Hossain SMB and Choudhury RU (2010) Challenges of potato cultivation in Bangladesh and developing digital databases of potato. Bangladesh J. Agril. Res., 35(3): 453-463.

Varns JL, Schaper LA and Preston DA (1985) Potatoes losses during the first three months of storage for processing. Am. Potato J., 62(2): 91-99.

Walker T, Schmiediche P and Hjimans R (1999) World patterns and trends in the potato crop: An economic and geographic survey. Potato Res., 42: 241-264.

Raper HS (1928) The anaerobic oxidases. Physiol. Rev., 8:245–282

Roméro-Graillet C, Aberdam E, Clément M, Ortonne J P and Ballotti R (1997) Nitric oxide produced by ultraviolet-irradiated keratinocytes stimulates melanogenesis. J. Clin. Invest., 99:635-642

Ryu YB, Ha TJ, Curtis-Long MJ, Ryu HW, Gal SW and Park KH (2008) Inhibitory effects on mushroom tyrosinase by flavones from the stem barks of Morus thou (S.) Koidz. J. Enzyme Inhib. Med. Chem., 23:922–930

Saha B, Singh SK, Sarkar C, Bera R, Ratha J, Tobin DJ and Bhadra R (2006) Activation of the Mitf promoter by lipid-stimulated activation of p38-stress signaling to CREB. Pigment. Cell Res., 19: 595-605

Salsberg JM, Weinstein M, Shear N, Lee M and Pope E (2016) Impact of Cosmetic Camouflage on the Quality of Life of Children with Skin Disease and Their Families. J Cutan Med Surg 20:211-215

Schallreuter KU, Kothari S, Chavan B and Spencer JD (2008) Regulation of melanogenesis-controversies and new concepts. Exp. Dermatol., 17:395–404

Silvers WK (1979) The Coat Colors of Mice. A Model for Mammalian Gene Action and Interaction. New York: Springer Verlag.

Solomon EI, Sundaram UM and Machonkin TE (1996) Multicopper Oxidases and Oxygenases. Chem. Rev., 96:2563–2606

Spinola V, Mendes B, Câmara JS and Castilho PC (2013) Effect of time and temperature on vitamin C stability in horticultural extracts. UHPLC-PDA vs. iodometric titration as analytical methods. LWT-Food Sci Technol, 50:489–495

Takeda K, Yasumoto K, Takada R, Takada S, Watanabe K, Udono T, Saito H, Takahashi K and Shibahara S (2000) Induction of melanocyte-specific microphthalmiaassociated transcription factor by Wnt-3a. J. Biol. Chem., 275:14013–14016

Tan X, Song YH, Park C, Lee KW, Kim JY, Kim DW, Kim KD, Lee KW, Curtis-Long MJ and Park KH (2016) Highly potent tyrosinase inhibitor, neoauflavane from Campylotropis hirtella and inhibitory mechanism with molecular docking. Bioorg Med Chem., 24: 153-159

Tepper AWJW, Lonardi E, Bubacco L and Canters GW (2011) Structure, Spectroscopy, and Function of Tyrosinase; Comparison with Hemocyanin and Catechol Oxidase. https://doi.org/10.1002/9781119951438.eibc0683

Ullah F, Hussain H, Hussain J, Bukhari IA, Khan MT, Choudhary MI, Gilani AH and Ahmad VU (2007) Tyrosinase inhibitory pentacyclic triterpenes and analgesic and spasmylocytic activities of methanol extracts of Rhododendron collettianum. Phytother. Res., 21:1076–1081

Vachtemheim J and Borovanský J (2010) "Transcription physiology" of pigment formation in melanocytes: central role of MITF. Exp Dermatol., 19:617-27

Van Gelder CW, Flurkey WH and Wickers HJ (1997) Sequence and structural features of plant and fungal tyrosinases. Phytochemistry 45:1309–1323

Wang G, Xia Y, Sui W and Si C (2018) Lignin as a Novel Tyrosinase Inhibitor: Effects of Sources and Isolation Processes. ACS Sustainable Chem. and Eng., 6: 9510–9518

Wang HM, Chen CY and Wen ZH (2011) Identifying melanogenesis inhibitors from cinnamomum subvenuhium with in vitro and in vivo screening systems by targeting the human tyrosinase. Exp Dermatol, 20:242–8
Wang N and Hebert DN (2006) Tyrosinase maturation through the mammalian secretory pathway: bringing color to life. Pigm. Cell Res., 19:3-18
Wilcox DE, Porras AG, Hwang YT, Lerch K, Winkler ME and Solomon EI (1985) Substrate analogue binding to the coupled binuclear copper active site in tyrosinase. J. Am. Chem. Soc., 107:4015-4027
Yamauchi K, Mitsunaga T and Batubara I (2011) Isolation, Identification and Tyrosinase Inhibitory Activities of the Extractives from Allamanda cathartica. Natural Resources 2:167-172
Yamauchi K and Mitsunaga T (2016) Melanogenesis and Melanosome Transportation Modulators from Medicinal Plants. Letters in Drug Design & Discovery, 13:742-751
Yokoyama K, Suzuki H, Yasumoto K, Tomita Y and Shibahara S (1994) Molecular cloning and functional analysis of cDNA coding for human DOPAchrome tautomerase/tyrosinase-related protein-2. Biochim. Biophys. Acta., 1217:317-321
Yoshimori A, Oyama T, Takahashi S, Abe H, Kamiya T, Abe T and Tanuma S (2014) Structure–activity relationships of the thujaplicins for inhibition of human tyrosinase. Bioorg. Med. Chem., 22:6193-6200
Zhang X, Hu X, Hou A and Wang H (2009) Inhibitory effect of 2,4,2',4'-tetrahydroxy-3-(3-methyl-2-butenyl)-chalcone on tyrosinase activity and melanin biosynthesis. Biol. Pharm. Bull., 32:86-90