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Abstract

Bangladesh has immense potential in agricultural sector given the abundance of mango production due to its healthy soil and weather. Therefore, the present study was conducted in value chain analysis of mango that consisting value adding activities in supply chain from input suppliers to end users. The necessity of value chain analysis is to figure out exactly how much value and cost added in each stage of supply chain. Data were collected regarding supply chain from secondary sources and also from a few conducted interviews which were generated from Bangladesh Agricultural Research Institute (BARI) and were analyzed statistically. Mango value chain mapping of Rajshahi and Khagrachari districts gave a clear understanding of how the cost were added in different stages of the supply chain. There are several types of supply chain of mango in hill district including supplied rank of importance showed to understand the costing and importance that could be different in various supply chain systems. Data indicated that the average cost of mango cultivation in a year was Tk. 133,889 per hectare of which 57% was variable cost and the 43% was fixed cost. The farmers received an average Tk. 175,244 per hectare as net return and Tk. 233,039 as gross margins from mango cultivation. The study also found that only the intermediaries in supply chain were not responsible for cost increasing but the farmers were responsible for the cost increase for not following the agricultural specialist's suggestions. The necessity of value chain analysis of mango may help the business persons, government and non-governmental experts, policy makers and academicians who were directly or indirectly involved in agribusiness to understand how the cost can be minimized. Furthermore, this baseline study will help in designing and implementing appropriate strategies to promote mango value chains in Bangladesh. However, researchers are in need of extensive or in depth data, which are not available now but will be in future for better conclusive results.

Keywords: Agriculture, Value Chain, Mango, Bangladesh, Supply Chain.

1. Introduction

Bangladesh is a predominantly agro-based developing country in the world and its fertility status of soil and weather are very expedient for harvesting different varieties of agricultural products. These various types of agricultural yielding are grown in the rural areas in a large agricultural land for both domestic consumption and international export. This helps in revenue generation, value addition, employment, etc. Among the entire agricultural products (fruits, vegetables, grain etc.) in Bangladesh, mango is one of the most popular fruit, though it was first introduced in West Africa in 1824, but could be introduced long before 1824 (Rey et al., 2004). In addition, mango is the most important source of nutrients and energy (Mukherjee et al., 2009) because it is rich in amino acids, carbohydrates, fatty acids, minerals, organic acids, proteins and vitamins, mainly vitamins A and C (Moore, 2004). In Bangladesh, mango is called the king of all fruits but it is native to the Indian subcontinent. The English word “mango” originated from the Tamil word ‘Mangai’. Mango is being considered as an important tree for job creation and poverty alleviation in many countries. The largest amount of mangos are produced in India, China, Thailand, Indonesia, Bangladesh, Pakistan, Mexico, and Brazil. Nowadays, its worldwide trading is increasing, especially in the USA and European markets that pay a high price but demand a better quality and higher standards. However, the economic potential of this tree fruit is still untapped largely; this situation is due to high wastage and poor handling at post-harvest stage preventing farmers from meeting the quality standard for different markets (Arinloye et al., 2017; Orjuela-Castro et al., 2017). Bangladesh produces a variety of mangoes including Fajli, Langra, Gopalbhogh, Misribhogh, Arshini, Laksman-bhogh, Mohonbhogh, Raj-bhogh, Himsagar, Chokanan, Khirshapat, Shurjapuri, Chosha, Hari Bhanga, Shatapora, Kachamitha and Mollika. These varieties are mostly grown in Rajshahi, Dinajpur and Nawabganj; Rajshahi region alone produces over 270 varieties of mangoes. This area’s mango has huge demand in the market both domestically and commercially but there is no large industry in the north western region. Most of the people are employed in different jobs like nursing, harvesting, giving area of production in Rajshahi, Chapainowabgonj, Dinajpur, Rangpur, Kushtia, Nator is ranges from 35,000 hectares to 50,000 hectares per year and 50, 000 people are involved in mango production. It is the 19.25% 2nd most produced fruit in Bangladesh (BIFT, 2016). Now a day, Khagrachori and Bandarban are also producing huge quantities of mangos. There are some industries that are related to mango business including jute

bags, fertilizer, baskets, pesticides, transports, chemical, sticker, etc (Monoranjan, 2018; Chowdhury, 2018).

Mangoes are climactic and highly perishable fruits and represent the most appreciated tropical fruits in the world for their special taste and aroma; the general environmental, technical factors and its picking time also can be anticipated or postponed within the time frame of fruit maturation stage through supply chain structure. Chosen topic will help to get a clear concept about value chain in supply chain. Both published and unpublished literatures were reviewed from different sources. There are some recognizable stages where value is changing in exclamation of surprise. There are some commission agents in between *Bapari* (distributor) and local market those are grabbing huge amount of money (BIFT, 2016). Another remarkable way to changing value is transportations. Powerful logistic and innovations are a basic achievement factors for both farmer and retailer (Tarantilis et al., 2004). If product quality in each step of the supply chain can be predicted in advance, good flows can be controlled in a pro-active manner and better chain designs can be established resulting in higher product availability, higher product quality, and less product losses in retail (Vorst et al., 2014).

Lack of proper value chain analysis, makes it is very difficult to figure out exactly how much value and cost are added in each stage (supplier-distributor-wholesaler-retailer-customer) of supply chain. However, analysis of value chain related research in mango is exiguous and previously research was conduct regarding production or on export of mango. Therefore, the current research main objective to identify an appropriate value chain analysis techniques of mango supply chain in Bangladesh following six drivers such as facilities, inventory, transportation, information, sourcing, and pricing to minimizing cost, wastage and losses for the value chain.

2. Materials and Methods

Data were collected from secondary sources and different government agencies such as, Bangladesh Agricultural Research Institute, Gazipur, Mango Research Center, Department of Agriculture Extension (DAE) Khamar Bari Dhaka and field of agriculture, horticulture and their statistical records (Monoranjan, 2018). Some face-to-face interview has been done with the mango farmers and business person in Dinajpur. Finally, data were analyzed and summarized by both descriptive and inferential statistical techniques using Microsoft Excel software.

2.1 Profile of Mango (Bangladesh) and Value Chain

2.1.1 Time of Production

Mango trees blossom from end of December to February only a year or two after planting and starts giving mango. Most of the mangoes are picked from May to June, but some hybrid mangoes are picked from July to August. The first blossom after planting does not allow the trees to produce mango, it allowed to produce next year. In the meantime, farmers work hard and nurture the mango trees during the period for bumper production of mango.

2.1.2 Climate

Mango is generally a tropical fruit in Bangladesh but it also grows in the sub-tropical zone. The climate of mango cultivation depends on the latitude, altitude, rainfall and temperature. It can grow at an altitude of 1400 meter with no high humidity, rain, during the flowering. Mangoes grown within an area roughly 30 degree north to 30 degree south latitude but in Bangladesh it grows between 20.5 degree to 26.5 degree south latitude and this range of latitude and altitude is ideal for mango cultivation. It also grows well if the temperature ranges from 24 to 27 degree Celsius and Bangladesh's mean annual temperature is 18 to 30 degree Celsius with an average rainfall as low as 25 cm to as high as 250 cm, which is good for mango production.

2.1.3 Soil

Mangoes can grow on a wide range of soil type but with well drainage deep, fertile loamy soil of high to medium land with pH 5.5 to 7.5 and water table below 180 cm.

2.1.4 Land Preparation

For mango plantation, the site needs to be selected and cleaned from the wild growth, weeds, rocks, etc. Then the seedlings are planted during the rainy season in pits in well-levelled areas.

2.1.5 Distance

For mango cultivation, it is necessary to maintain specific distance between mango trees. This distance depends upon soil, variety, climate and system of orchard condition and orchard management. However, the typical planting distance for tall varieties of mango seedlings is 10 to 12 meters, whereas the

dwarf varieties require only 2.5 to 3 meters between the plants and the rows are 8 to 10 meters apart.

2.1.6 Planting time

Mid-May to mid-July is the best period for planting but mid-August to mid-October is also good for planting mango trees.

2.1.7 Harvesting

Nowadays, maximum mango cultivation is for business purpose. Consequently, mangoes are rarely allowed to ripe on trees. Fruits are harvested at the time when they show a slight yellowish color around the fruit stalk or when the specific gravity reaches 1.01 to 1.02 or when naturally one or two ripe fruits start dropping from the plant. Generally, fruits with stalk intact are harvested by hand or with a fruit picker, a long pole that has a bag at one end.

2.1.8 Variety

The mangoes of Bangladesh belong mainly in two groups. Firstly, the elite mango varieties propagated through grafting and other vegetative means, locally known as “kalam aam” and secondly, fruits are born by seedling trees, locally known as “guti aam”. Some of the common varieties of mango grown in Bangladesh are listed below.

2.1.8.1 Early variety

Early variety means the varieties, which can be harvested within mid-May to mid-June. Example: Gopalbhog, Himsagor, Khirsapat, Brindabani and BARI Aam-1.

2.1.8.2 Mid-season varieties

Mid-season variety means the varieties which can be harvested within mid-June to late-June. Example: Langra, Misribhog, Krisanbhog, Kohitoor, Lakhanbhog, Daseri and BARI Aam-2 and BARI Aam-3.

2.1.8.3 Late varieties

Late variety means the varieties which can be harvested within July to mid-August. Example: Fazli, Ashawina, Kuapahari, Mohanbhog, Chausa and BARI Aam-4.

2.1.8.4 Regular bearing varieties

Example: Neelum, Mollika (Neelum, Daseri) Amropali/BARI Aam-3.

2.2 Value Chain of Supply Chain

Through supply chains, producers in developing countries and emerging economies can access market information and knowledge to hone their value-added activities. For a perishable item, effective logistic capabilities of supply chain can reduce 50% of the losses (Orjuela-Castro et al., 2017). Nowadays, another problem is affecting the mango supply chain: The consumers are paying two to three times more than the producers (Arothdar), while the demand for mangoes remains the same. Therefore, analysing the value chain of the whole supply chain stage's activities become very important and the movement of cost and price in different stages of supply chain. In supply chain, intermediaries make links between farmers and customers but more intermediary involvement means slinking of a major portion customer's price as profit (Das and Hanaoka, 2014; Khandoker et al., 2015).

2.2.1 Grower

Growers are basically the farmers who cultivate and harvest the mango.

2.2.2 Faria

Faria are the small traders who deal with product within three or four local market and handle a small volume of product. They purchase product from farmers and sell the product either to the *bepari* or directly to the customer. They are usually landless labours or small farmers having full-time work in the farm (Tasnoova and Iwamoto, 2006).

2.2.3 Beparies

Beparies are professional traders who purchase agriculture products from the farmers or *farias* in the local market or in the village. They handle large volume of product than *faria*. Beparies sells their products to *Arothdar*.

2.2.4 Arothdars

Arothdars works as the fixed commission agents who have fixed establishment. They operate between *beparies* and retailers and charge a fixed commission by providing facilities.

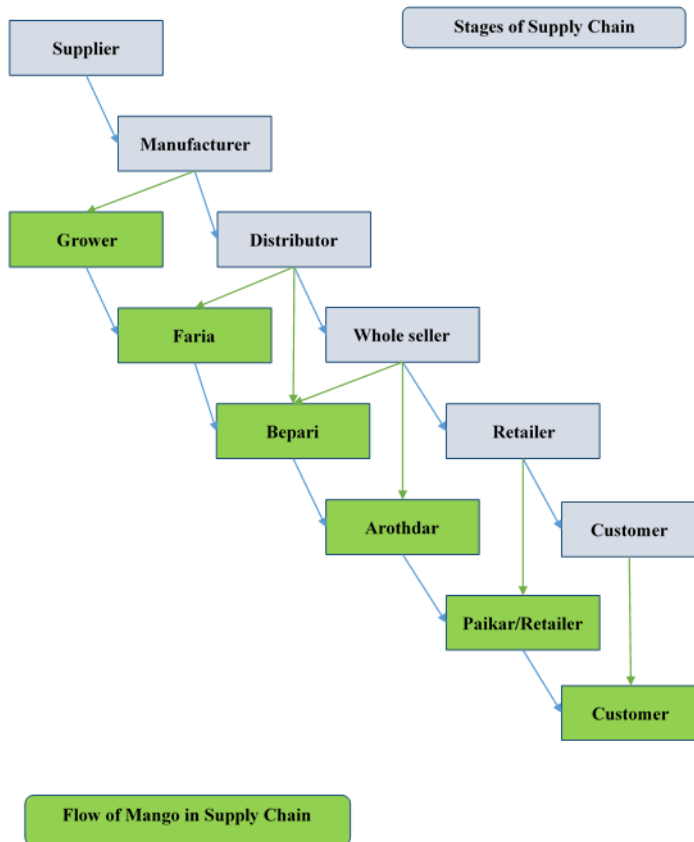


Figure 1: Comparison on flow of supply chain and flow of mango supply chain

2.2.5 Retailers

Retailers are the last link of the channel to deliver the product to the customer. They buy product from the beparies through *arothdar* and sell the product to the end customer.

2.2.6 Customer

Customers are the end user of the product.

3. Results and Discussions

3.1. Mapping the Value Chain

Value chain mapping gives a clear understanding of the sequence of activities and the key actors and the relationships involved in the value chain. In Khagrachari and Rajshahi district for mapping a value chain of mango, there involve different actors; like financial institutions, government institutions, traders, growers and customers. This chain also includes the flows of mango, knowledge and information. These flows can be both tangible and intangible, for instance, product, money, information and services. Value chain also added in some stages of marketing like grading, cleaning, packaging and transporting.

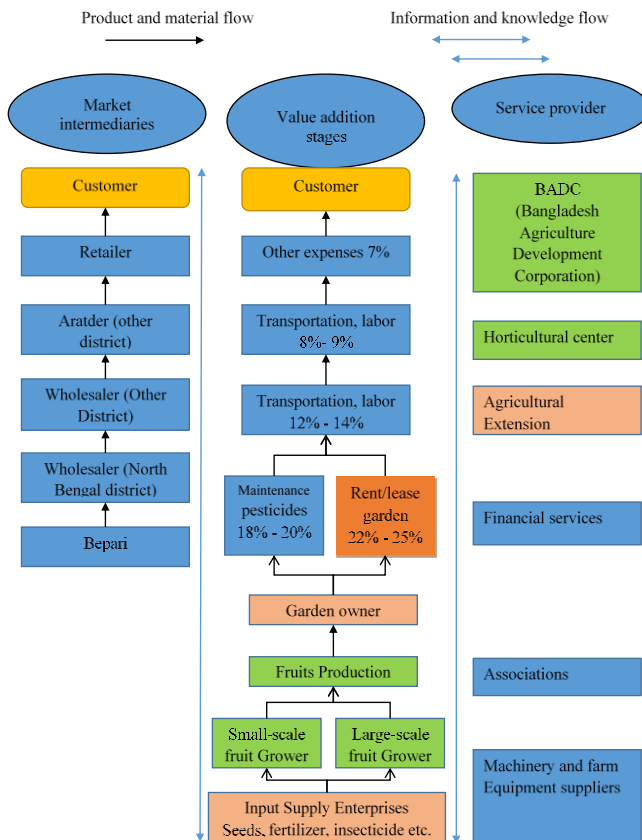


Figure 2: Schematic diagram of mango value chain in Rajshahi mango Hub

3.2. Mango Supply Chain of Hill District

In the hill district like Khagrashori nine type of supply chain of mangos were found. These supply chains were based on percentage of volume that passed through each supply chain (Dewan et al., 2016).

3.3. Existing Supply Chain of Mangoes in Accordance with Field Survey in Khagrachori Hill Districts

Grower → Customer (local): This supply chain represented 34.83 % of total Mango supplied to the market during the survey period. This supply chain was found as the first important supply chain in terms of importance.

Grower → Wholesaler (local) → District Market → Customer (local): This supply chain represented 20% mango supplied in the Survey area and it placed second most important mango supply chain in the study area.

Grower → Bepari (local) → District Market → Customer (local): According to survey, this supply chain accounted for 13.95% of total mango supplied to the market. The supply chain was found to be the third most important mango supply chain in the study area.

Grower → Bepari (local) → Aratder (Chittagong Market) → Bepari (Chittagong market) → Retailer (Chittagong market) → Customer (Other district): It accounted 10.25% of total mango supplied to Chittagong market and placed fourth most important supply chain in the district.

Grower → Bepari (local) → Bepari (other district) → Customer (other district): The supply chain accounted 6.25 % of mango supplied and found fifth most important mango supply chain.

Grower → Retailer (local) → District Market → Customer (local): This supply chain accounted 6.45% of total mango supply during the survey period and it found to be sixth important mango supply chain in Khagrachari Hill District.

Grower → Aratder (Chittagong Market) → Bepari (Chittagong market) → Customer (Other district): This supply chain placed seventh most important Supply chain of mango and supplied 5.81% of total supplied.

Grower → Faria (local) → Retailer → Customer (local): Represented 3.30% of total mango supplied to market and found to be eight mango supply chain in the survey area.

Grower → Faria (local) → Customer (local): This supply chain represented 3.15% of total mango supplied to the customer and found to be ninth most important mango supply chain.

4. Findings

- Nine types of supply chain are followed by Khagrashori hill district to deliver the mangoes from grower to customer, based on percentage of mango delivered and supplied rank of importance.
- By mapping, the value chain of Rajshahi and Khagrashori district, it gives a clear understanding about the flow of percentage of cost from grower to customer.
- Area and production of mangos by district from the year 2013 to 2016 were given. It is found that a total production of mango inside and outside garden in Bangladesh were 1,161,685 M. Tons, with a highest production of 277,058 M. Tons in Rajshahi district and a lowest production of 14153 M. Tons in Barisal district.
- Based on the secondary data on farmers' perception, 56 percentage farmers mentioned that cost of mango cultivation was almost similar to other competitive crops and only 14 percent of farmers said that cost of mango cultivation was higher than other crops.
- Based on the secondary data on farmers' perception, 49 percent of farmers, among 100 respondents, told that mango was much highly profitable, while 41 percent of the farmers told that mango was slightly higher profitable crop compared to other crops. Besides, a very small 10 percent of farmers told that profitability of mango cultivation was almost equal to other crops.
- From the secondary data of cost of cultivation of mango shows that the average cost of mango cultivation in entire year was Tk. 1, 33, 889 per hectare, of which 57 percent were variable cost and the rest 43 percent, were fixed cost. Higher cost was observed in the 16 to 20 years of age of garden (Tk. 1, 52,010) followed by 11 to 15 year (Tk. 1, 48,952). It might be due to the cost of human labor, cost of intercrop and high use of insecticides.
- From the secondary data of profitability of mango cultivation, it shows in both 1st and 2nd year, farmers did not find any yield and started to get yield from 3rd year of age garden. The highest gross return of mango was found

16 to 20 year (Tk. 7, 94,490 ha⁻¹) and the lowest was found in 3rd year (Tk. 11,430 ha⁻¹). Farmers spent on an average Tk. 14 to produce 1 kg mango.

- From different problems in mango cultivation, it is found that about 47% of the farmers mentioned that the infestation of diseases hampered higher yield of mango. About 35% of farmers opined that lack of storage facilities was also a huge problem. Lack of transport facilities (23%), price fall (19%) is also big constraints to cultivate mango. Farmer does not have the proper knowledge in mango cultivation procedure. They are not following agricultural specialist's training. Most of them are illiterate. They only concern about the production quantity not the quality. They do not know the use of information.
- There is no single supply chain system, which is ideal for all, to follow. There are various types of supply chains, which are followed by different type of distributors. Thus, there is no constant fixed price. Uses of excessive chemicals (pesticides) are increasing the price, by adding cost, in production level.

5. Conclusions

It is evident from the secondary data and interviews that to find out the necessity of value chain analysis of mango supply chain in Bangladesh will help the students and business person who are involved with agro business and to understand how values are added in different stages in the supply chain. It will also help the farmers and the business persons where they should minimize the cost to earn more yield to be more efficient and to be more responsive to the customer with quality mangoes with an affordable price. It is also evident that not only the intermediaries in supply chain are responsible for price increasing, but also farmers are responsible for that. Because of not following the rules and regulations on production and maintenance process, costly transportation, absence of fruit market information, inadequate government investigations, more intermediaries in supply chain are the main influences for increasing the price of mango when it is sold into the market to the end customer.

Government must take affordable initiatives to train the local farmer for being them educated on agriculture education, so that they can understand all ins and outs about the importance of quality. An appropriate training is needed regarding the use of pesticides should be done by every farmer. Building consumer awareness and knowledge is necessary. Government should be

strict to reduce the extortions by giving proper security on the transportation mode and in the market. Farmers should follow the agricultural specialist's guideline for better quality of production, thus their cost will not be increase, and for sure, it will decrease. Extensive field data is required for getting more conclusive findings, which could not managed, due to limited time period of research.

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