

# Mango Supply Chain and Value Chain Analysis from Farm to Market

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**Abstract** - The study evaluates the traditional mango fruit supply chain and finds opportunities and challenges of traditional practices, and analyses the value chain mango from farm to market. The study also estimates the Benefit Cost Ratio (BCR) for mango farmers and examines the distribution of the added value among the value chain actors-farmers, traders and retailers. A value chain model was developed and confirmed by more than two hundred respondents comprises of all the value chain actors, including farmers, traders, retailers, consumers, and other stakeholders. Both primary and secondary data were used in this research, and a simple statistical techniques were used for analysing the data. The study reveals that there was a huge potential for farmers in growing mango fruit, while the post-harvest loss was found very high and a lots of middlemen were exist in the chain. The result of the value chain analysis shows, farmers' share of the added value was the lowest, while the retailers were bagging the highest. The research outcomes need to be applied by the policy makers, researchers and the implementers for the betterment of the farmers and consumers.

**Keywords** – mango supply, market, value chain, BCR, Bangladesh

## I. Introduction

Due to the favourable climatic condition Bangladesh abounds with a large variety of tropical and sub-tropical fruits. The most widely cultivated fruits are mango, jackfruit, pineapple, banana, litchi, guava, papaya, watermelon, jujube etc. However, mango (*Mangifera indica*) is the most common, important and popular fruits in Bangladesh. The fruit is also known as the "king of fruits" because of its delicious taste, captivating flavour with multifarious colour and nutritious values. Therefore, mango is considered as high value crop and it is widely cultivated fruit in Bangladesh.

Fruits are important in the daily diet as they contain micronutrients, including vitamins, minerals, fibres, and other bioactive components. For example, ripe mango contains high quality of beta carotene (pro vitamin A) and vitamin C. A large number of people in Bangladesh suffer from

inadequate micronutrient intake which is the consequence of low dietary delivery and limited consumption of nutrient dense foods [9].

Available statistics of the Ministry of Food of the Government of Bangladesh, over the past decade reveals that there has been nearly 25 percent increase in the consumption of fruits and vegetables between year 2000 and 2010. However, the average per capita fruit and vegetable consumption in 2010 was still lower (211 g/capita/day) compare to the desirable intake of 400 g/capita/day. As fruits are a natural source of micronutrients essential for proper functioning of human body, these must be delivered through diet.

In Bangladesh traditionally farmers are not organized and the supply chain is usually long, as it incorporates many middlemen in different stages from production to consumption. Getting the right agricultural inputs for production at the right time at a reasonable price is not easy for the individual farmer. On the other hand, there is a dominating role of the intermediaries (Collectors, Farias, and Commission Agents, etc), hence farmers' bargaining power is very weak. As farmers do not have direct contact with the marketing companies or traders, and they usually do not add value to their produce before sending the produce to the market, ensuring fair price is uncertain. Therefore, farmers' income is usually low in the traditional supply chain of fruits and vegetables.

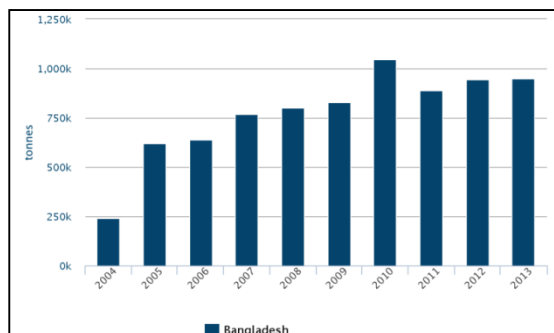
This paper attempts to review the existing fruit supply chain, evaluate the prevailing practices and their mode of operations, and finding constraints and opportunities. The study also analyses value chain of the most popular fruit - mango in Bangladesh, identifies the financial Benefit Cost Ratio (BCR) for mango farmers, and analyses the distribution of the added value among the value chain actors, including farmers, traders and retailers.

## II. Literature Review

Bangladesh produces a large number of superior varieties of mangoes and these have wide demand in the market and are commercially important. Prominent cultivars among the elite varieties of mango are *Fazli*, *Langra*, *Gopal-bhog*, *Laksman-bhog*, *Mohan-bhog*, *Raj-bhog*, *Himsagar*, *Chousha* and *Amrapali* etc. As per FAO statistics, total transaction or exchange value of mango in the

domestic market stands at around US\$ 1 billion. It replaces many snack items during mango season. The current consumption of fresh mango is almost one million tons and is growing with the growth of GDP and population [4].

Mango production has been increasing at an average rate of approximately 5.5 percent per year from 2005 to 2013. Between 2005 and 2013 annual production of mangoes



**Figure 1.** Production of Mango in Bangladesh

Proper post-harvest management is the need to deliver good quality mango to the market and ultimately to the consumer to command buyer attention and gives the grower a competitive edge. In Bangladesh postharvest losses were 30-35 percent [8] and 27.2 percent (Azad, 2001) due to faulty Post-harvest practices during harvesting, packaging, storage, grading etc [1].

In Bangladesh, mangoes are ripened widely by using Calcium Carbide, which is a toxic chemical and extremely hazardous, fruits do not ripen uniformly and quality of fruits remains inferior. Calcium Carbide should not be used for ripening of fruits. But unfortunately it is the most economical way to ripen a mango. It would be better to treat the fruits with ethylene gas (100 ppm) in an airtight room by exposing them for 24 – 48 hrs under controlled conditions of temperature and humidity, for ripening purpose.

Hasan (2010) reported, since ethylene is considered the only gaseous hormone to trigger fruit ripening, emphasis must be given on the inhibition of ethylene production to ensure safe and long postharvest life of climacteric fruits. Anti-ethylene compounds have been used for a long time in the extension of the postharvest life of horticultural commodities. Hassan (2010) also reported that 4-16% of the growers were involved in ripening of mango using chemicals. Calcium carbide was used by 4-20% mango growers followed by Ripen-15 (0-12%). Results also showed that 4-32% growers used straw for enhancing ripening, and they (60-92%) mainly sold unripe mature-hard mangoes. It was found that 8-20% of the 'Beparies' were involved in chemical fruit ripening, whereas the value was 6-8% in case of the wholesalers[5].

Alternatively, fruits may be ripened with dip treatment of ethrel / ethephon solution (250 –750 ppm) in hot water (52±20C) for 5 minutes. The same solution could be used four times. Premature fruits (fruits harvested up to 2 weeks prior to maturity) can be ripened to an acceptance quality by dipping the fruits in 750-ppm ethrel solution. Similarly, less mature and mature fruits can be ripened by dipping the fruits in 500 and 250-ppm ethrel solution, respectively. These treatments ripen the fruits uniformly with attractive colour [5].

Surface transport is the preferred to other modes of transportation due to its easy approach from the orchards to market. In surface transportation, head load, animal pack, bullock carts, rickshaw, auto rickshaw, lorry, mini trucks and trucks are the means of transportation. The use of a surface depends upon the geographical location of the orchards, distance from the markets, etc.

For long distance transportation, consigner prefers trucks even though trucks sometimes exert lots of pressure on the fruits. It is observed that the temperature, humidity and ethylene production during the transportation affect the quality of the fruits, which leads the fruit to rot and dehydration. Therefore, for long distance transportation and export purposes, the refrigerated vans are used to reduce the post-harvest losses.

Hasan (2010) reported, in Bangladesh mangoes are transported from the growers' field to the local assemble markets by rickshaw, van and bicycle and to the distant markets by truck. The truck is found to be the main transport vehicle to carry mango from the place of purchase to the distant markets. No 'Bepari' is found to use a refrigerated vehicle to carry perishables despite the fact that refrigerated vehicle is used to carry perishables in developed countries as part of cool chain management. The retailers mainly use vans to carry mangoes from the wholesale to retail markets. A large proportion of the retailers also use trucks to carry mango from the wholesale to the distant retail markets. The destination markets of the mangoes produced in Chapai Nowabgonj and Rajshahi districts are spread all over Bangladesh. However, the overwhelming majority of the produced mango from Chapai Nowbgonj and Rajshahi is delivered to different wholesale markets of Dhaka.

Storage is essential for extending the shelf life of mangoes, regulating their supply to the market and for transportation to long distances. But modern storage of fruits and vegetables is virtually absent in Bangladesh. Cold storage facility is only available for potato, except a very few multi-chambered and privately-owned low temperature storage facilities in Bangladesh, where the

wholesalers keep high-value fruits, particularly the imported apples, orange, dates, pears and grapes. Very few growers and intermediaries adopt any technologies to prolong shelf life of fruits [9].

According to Kader (2002), mature green mangoes should be stored at 13°C, while the partially-ripened mango should be stored at 10°C. Though low temperature storage significantly extended storage life of mangoes, temperatures as low as 8°C caused considerable damage due to chilling injury, which is characterised by uneven ripening, poor colour and flavour, surface pitting, grey scald-like skin discolouration, and increased susceptibility to decay and flesh browning [7].

### III. Research Methodology

The study is descriptive and inferential in nature, and concerned with describing the characteristics of a particular group of farmers, traders and retailers and consumers of fruits, particularly mango in Bangladesh. A combination of qualitative and quantitative research methods is used for the study. Both primary and secondary data are used in this research. Primary data are collected from various stakeholders, including growers, collectors or middlemen, wholesalers, retailers and the final consumers. Secondary data related to production, processing, marketing are consulted from established public and private research and professional institutions, and other national & international NGOs, development agencies, research articles and relevant books.

A purposive sampling framework is used for collecting data from seven (7) mango clusters, covering all over Bangladesh. Using a structured questionnaire, a total of two hundred and forty five (245) interviews are accomplished. The interviewees are selected through a stakeholder analysis. Moreover, Focus Group Discussion (FGD) and Key Informant Interview (KII) are also conducted for to validate the data. Simple statistical tools are also used for the analysis of data.

### IV. Mango Supply Chain in Bangladesh

There are several actors involved in the production and marketing of mango. Supply chains represent the participants involved in the flow of product from farm to market (including traders, processors and exporters). Mango supply chain and its market actors in Bangladesh is presented in Figure 2.

In order to reach delicious mango to the consumer, there are quite a good number of activities involved that are performed by a wide range of stakeholders. The main actors in the mango supply chain are - research & extension

departments, input suppliers, producers, traders (collection, wholesale & retail) and consumers.

**Research and Extension:** The National Agricultural Research System (NARS) is composed of Bangladesh Agricultural Research Council and 10 national agricultural research institutes. Bangladesh Agricultural Research Institute (BARI) is the largest multi-crop research institute conducting research on a wide variety of crops. Under BARI, Horticulture Research Center (HRC) is working for the improvement of mango production through evolving new varieties of mangoes and planning and execution of basic, applied and adaptive research outcome.

The Department of Agricultural Extension (DAE) is to providing efficient and effective needs based extension services to all categories of farmer, to enable them to optimize their use of resources, in order to promote sustainable agricultural and socio-economic development. In 1996 the government adopted the New Agriculture Extension Policy (NAEP) to conduct a well-planned Agriculture Extension Service in Bangladesh.

**Input Supply:** Ensuring availability of good quality agricultural inputs, including seed, fertilizer, crop protection products (CPP) and farm machineries at reasonable prices is important for good quality mango production. Both public and private organizations are active in input supply chain in Bangladesh. Bangladesh Chemical Industries Corporation (BCIC) and the Bangladesh Agricultural Development Corporation (BADC) are the public organizations dealing with agro-inputs in Bangladesh. Macro nutrient (Urea, TSP, DAP and MOP) business is fully controlled by public sectors. But a good number of companies are involved in micronutrients, seed, CPP and the farm machinery business.

Public sector import and produce agro-inputs and supply those to the farmers through their selected distribution channel. The large agro-input companies also produce and import seed, micro nutrients, CPP, and farm machinery in Bangladesh. They also have their own distribution channel included wholesalers and retailers. Some multinational companies are also involved in agro-input business in Bangladesh. Mango farmers either produce or purchase grafted plants from nursery.

**Production:** Farmers are the main actors in the mango supply chain. There are small, medium and large mango farmers in the mango growing areas in Bangladesh. Mango farmers who own land usually rent land to other mango growers for a span of three to four years. DAI (2014) reported that only about 20 percent of farmers remain engaged in whole mango production cycle starting from planting orchard trees, then nurturing them, and finally selling mangoes. About 50 percent farmers leases land for mango cultivation

for a fee. Mango farmers who own land usually rent land to other mango growers for a span of three to four years.

Farmers believe that the quality of the fruits is depending on the varieties, and quality may differ from one tree to another. The quality of

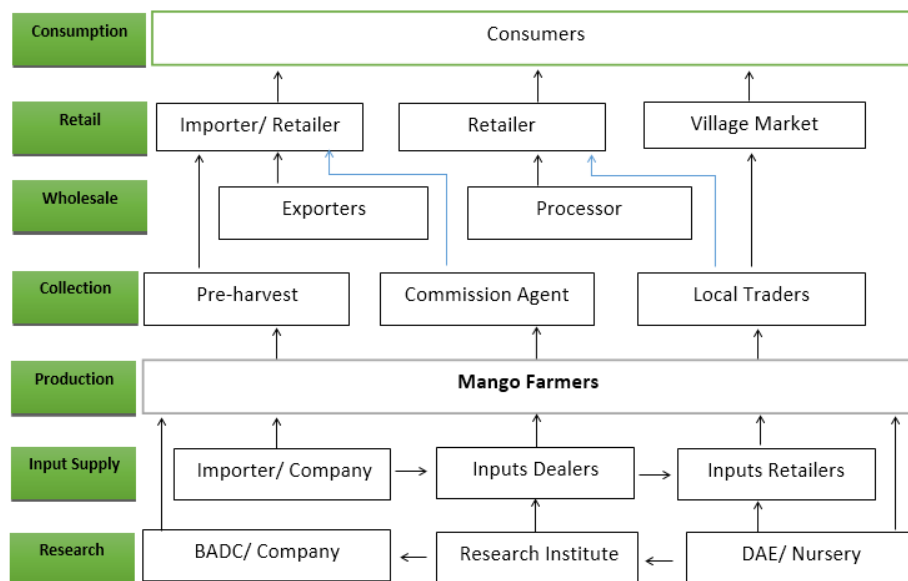


Figure 2. Mango Supply Chain

mango increases with quantity of irrigation and manure. Farmers usually take the decision of harvesting by looking at the fruits' colour and size, and only harvest the mature fruit from the trees. Most of the farmers conduct harvesting manually by using their hands or by using sticks with a hook attached to the end. A mango harvester developed by BARI is also rarely used by the farmers. None of them found using carry picker that is used in the developed countries. Farmers who harvest themselves also store the fruits mostly at their homestead before selling them. They store the mango for maximum one week and the fruits are packaged in bamboo baskets. But the post-harvest losses are found high during transportation and storage due to over ripening, physical damage from harvest and mice attack. Farmers usually transport mangoes from field to house or to the local market by human labors or use a rickshaw van. At the time of transport to the local market, most of the farmers put mango in a bamboo basket. Very few of them use plastic crate, which is recommended for reducing post-harvest losses. The mango farmers require new varieties of mango, improved harvesting techniques and improved transportation and packaging.

**Collection:** Pre-harvest contractor, Commission Agent and Local Traders are involved in collecting mango from farmers. Farmers either sell mangoes after harvest or they sell fruit-bearing trees for the season to pre-harvest contractor. Many entrepreneurs are engaged in purchasing and selling mango orchards at different stages of production. Sale of orchards under cultivation by farmers at

either flowering or fruit-bearing stage is common. Pre-harvest contractor purchase an orchard at flowering stage engage in the further cultivation of the orchard until it comes to fruiting stage and may further resell the trees once again after fruiting. The final buyer of the trees, then takes care of the orchard, harvests the fruits, and finally them to mango customers. Farmers also sell mangoes to different value chain actors, including *beparis* (small traders), large traders, *arathdars* (commission agents) and sometimes to processing company suppliers. Farmers also sell mangoes directly to the consumers [2].

**Wholesale:** Pre-harvest contractor, Commission Agent and Local Traders sell the mango to the wholesalers, exporters and processors. Wholesalers operate at the regional and national level and often occupy fixed space in urban wholesale markets. They procure mangoes in bulk from local *arathdars* and large traders and sell directly to retailers. All transactions take place in cash. Supply Agents collect supply fresh mangoes for processors as per the procurement requirements, and purchase mangoes from farmers, small and large traders. The transaction takes place in cash. Company suppliers also perform grading and sorting of fresh mangoes as per processors' requirements.

**Retail:** There are different kind of retailers operating for retailing mango. Mangoes are widely sold by small fruit retailers, who are retailing fruits all year around. There are some seasonal retailers who also retail mangoes during the harvesting seasons. Super markets are also selling mangoes

during the mango seasons. A good number of consumers also collecting mangoes directly from the farmers. Retailers purchase mangoes on cash, and often purchase products jointly with other retailers to reduce transportation costs.

## V. Value Chain Analysis

Farmers, who do not lease out their mango trees to wholesalers or brokers, sell mangoes to home customers or retailers at farm gate, while others send harvested mango to the local market. The main problem in the supply chain is a lack of

market access by the farmers. The poor packaging, overloaded transports, low prices for the producers and wholesale monopoly are considered as the other problems in the chain. Most of the farmers believe that brokers and wholesalers have the most influence in the supply chain. The prices and market access can be improved with farmer cooperatives, eliminating the brokers, direct contact between farmers and wholesalers, and establishing processing industry. The Mango value chain for is presented in Figure 3.

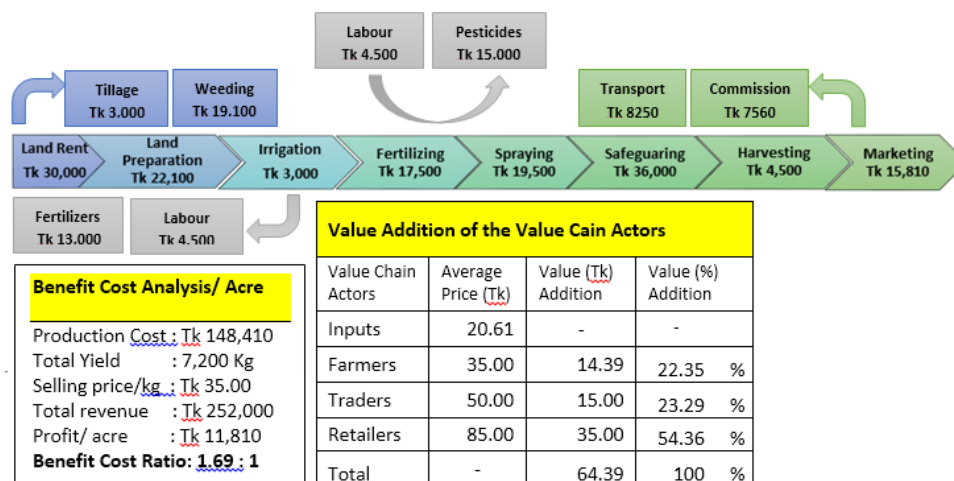


Figure 3. Value Chain Analysis of Mango (one acre)

The data for value chain analysis were collected from three different areas, presented as Area 1, Area 2 and Area 3. Then the average figures were considered for analysis. The value chain data for mango is presented in Table 1.

Farmer's total production cost was Tk 148,410, and total yield in one acre land was 7,200 Kg. The farmer's average selling price of mango was Tk 35.00 per Kg, while farmer's total cost was Tk 20.61 per Kg. Hence, farmer's value addition

was Tk 14.35 per Kg, and financial Benefit Cost Ratio (BCR) for the mango farmer was 1.69 : 1.

Even though consumer pay Tk 85.00 per Kg, but the total value addition by the value chain actors (farmers, traders, and retailers) was Tk. 64.39 per Kg. Out of total revenue of Tk 85.00, the retailers' share was the highest Tk 35.00, which is over 54 % of the total added value. The next large margin was Tk 15.00, made by traders, which was also over 23 % of the total added value. The farmer added the least margin of Tk 14.35, which was only 22.35 % of the total added value.

## VI. Conclusion

This study includes reviewing the existing supply chain of fruits and analysing value chain of mango in Bangladesh. The study reveals that there

is a huge potential for farmers in growing fruits in Bangladesh. In the existing supply chain, post-harvest loss is very high (between 20% and 40 %) and lots of middlemen are there. As farmers are not organized and there are dominating roles of the middlemen, fair price for farmers is uncertain. Hence, farmer's income is low.

The result of the value chain analysis shows that the financial Benefit Cost Ratios (BCR) for mango farmers is 1.69: 1. Only 22.35 percent of the total added value is taken by the mango framers, while 23.29 percent and 54.36 percent of the total added value are taken by traders and retailers respectively.

The supply chain and value chain analysis has identified the constraints and opportunities of the high-value crops. The study suggests some recommendations for the policy makers, researchers and the implementers, who are concerned about the development of agricultural sector in Bangladesh:

- Organizing farmers in groups for enhancing their bargaining power and reducing the role of the middlemen.
- Linking farmers with banking and non-banking financial institutes for credit facilities with easy terms and condition.
- Ensuring capacity building support for farmers on modern production technology, production management process, intercropping technique and ripening methods.
- Providing training on modern harvesting and post-harvest management practices, and ensuring availability of modern transportation and storage facility.
- Linking farmers to the market in order to eliminate or reduce the intermediaries, and creating awareness on food safety issues among farmers and traders.
- Strengthening Department of Agricultural Marketing (DAM) and Hortex Foundation for ensuring better access to local and international market.
- Supporting entrepreneurs for investing in agro-based industry, including processing plants, transportation and storage facilities etc.
- Improving law and order situation so that the supply chain actors can avoid paying unofficial tolls at different stages of the supply chain.

The implementation of the above recommendation will assist farmers, traders and other stakeholders to address different issues, and facilitating them to take corrective measures for improvement. But policy support is essential for overcoming these issues and making the value chain more effective.

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