

AN OVERVIEW OF VARIOUS TYPES OF BANANA PRODUCTION AND ITS MARKET VALUE IN INDIA

Joyita Mallick¹, Neha Das¹, Keya Roy¹, Saikat Mazumder¹

¹Department of Food Technology, Guru Nanak Institute of Technology, Kolkata, West Bengal, India

Abstract- Banana(Musa sp.) is one of the major fruits grown in India. Banana is enriched with potassium and dietary fiber. Banana is consumed all over the world for its health benefit. India is the highest Banana producing country in the world. Almost 29 million tonnes of Banana are produced per year in India. 20 different variety of banana is cultivated in several states of India. Tamil Nadu is the highest Banana producing state in India with the amount of 6.2 million tonnes per year. A huge production causes a huge waste also. 20-30% of total production is being wasted per year. An ineffective Cold chain and inefficient post-harvest practices are the main reason behind this much wastage. Apart from this, the production of Banana has been increased in the last ten years (26469.5 '000MT to 30808 '000MT). Implicating modern technologies in cultivation and post-harvest processing has been proved beneficial for production. India exports bananas to many other countries, mainly to the Middle East countries. Banana production has a huge contribution to the Indian economy also. Increase of production and yield, wastage of banana, beneficial policies by government, the impact of banana production on the Indian economy, Exportation, the Price increase will be the main focus of the review.

Key Words: Musa sp., Nutritional value, Banana production, Global scenario of banana production, Export, Policy, Price.

Introduction-

Banana is one of the most popular fruit in the world. And this is mostly because of its nutritional value, cheap price, and availability throughout the year [1]. Banana plants are succulent type, which means short rooted, and leaves and stems are always green. And the fruits the botanically consider as berries, to be more specific "Leathery Berry" [2,3]. Banana plants are grown either by tissue culture or by suckers. Sucker is a shoot that develops from a lateral bud. Most of the farmers use the suckers method (70%) but the sucker can easily be infected by pathogens and nematodes [4]. This method has many drawbacks and due to that reason, the tissue culture seedlings method is becoming popular these days. Plants that are grown from tissue culture is more productive, and not affected by many pathogens and diseases. Moreover, it can maintain the quality of the production constant [5,6].

October- November is the most ideal time for a banana plantation. Although different part of India has its own ideal time for Banana plantation. In North India, July to August is the suitable time to plant [7]. Whereas, in South India, banana trees can be planted any time of the year except summer. But in severe winter and during heavy rain Banana tree plantation should be avoided [8].

Bananas can be eaten in both ripe and unripe condition. Unripe bananas are mostly eaten after cooking. Calcium content in unripe Banana is higher than the ripe one. Also, it has high resistant starch content and less sugar content compared to a ripe banana [9]. Not only the inside part of Banana, but peels are also edible if it is prepared correctly. Banana peels have a good amount of Vitamins and minerals like potassium, magnesium, vitamin B-6, Vitamin B-12, etc. in it. Peels can be eaten as a smoothie, fried or baked chips, etc. [10,11]. In African countries, Banana consumption is the highest. In African countries, one individual consumes 40-45kg banana per year, whereas in India the consumption amount is 10-12kg/year/individual. Banana and plantain are the staple food of East and West African countries [12].

Being the largest producer of bananas in the world, India needs to take good care of the storage of bananas. Green and unripe bananas can be stored at room temperature and it is the ideal temperature to ripe the Banana. There are also some methods, that can speed up the ripening process like storing them with other ethylene producing fruit and vegetable, keeping them in a paper bag, etc. [13]. To stop the ripening process both unripe and ripe bananas should be kept in the refrigerator. At room temperature, unripe Banana remains fresh up to 2-5days and in refrigerator up to 20-25 days. And in room temperature ripe bananas remain fresh up to 1-3 days and in the refrigerator up to 5-7 days [14]. For exportation purposes, shipping containers, telescopic boxes, fiber boxes, and cardboard boxes are used [15].

Not only the fruit, but the whole banana tree can also be utilized in various ways. Recently many industries are using banana peels in Bio-fuel production, Bio-sorbents, pulp and paper, cosmetics, energy-related activities, organic fertilizer, etc.[16].

Table 1: The use of Banana [17]

PARTS	DOMESTIC USES	INDUSTRIAL USES
1. Pulp	Chips, Power, Flour, Jam, Puree, Flakes, Jelly, Spread, Figs, Fritters, Juice, Beer, Wine & Animal feed	Ethyl alcohol
2. Peel	Jelly, Marmalade, Animal feed	Ethyl alcohol, Dye, Biogas, Shoe-polish & paste
3. Flower	Vegetable and Fry flower arrangement	_____
4. Rhizome	Vegetable, Starch & Animal feed	Medicine, Paper, and Dye
5. Pseudo stem core	Vegetable, Starch & Animal feed	Fiber
6. Leaves	Eating plates, Wrapping material, Medicinal, Animal feed	Fiber

Nutritional Value of Banana-

Banana is a tropical fruit that contains many healthy compounds. A medium-sized ripe banana almost contains 358mg of potassium in it. And because of the presence of a high amount of potassium, it can lower blood pressure and is good for heart health. Another important component of Banana is carbs. In unripe Banana, it occurs as starch (80%) and in ripe bananas, most of it turned into sugar (sucrose, fructose, glucose, 16%). A high amount of fiber can be found in a ripe banana. The type of this kind of fiber is Resistant Starch, which means this kind of fiber passes undigested through the digestive system. This kind of fiber that is present in bananas is pectin. Both pectin and resistant starch can increase the blood sugar level in the body right after eating a banana. Banana is also enriched with several kinds of vitamins and minerals, like vitamin B-6, vitamin C, etc. Some bioactive plant compounds like Dopamine and Catechin is also present in banana. These two compound acts as an antioxidant, which causes various health benefit including reduced risk of heart disease. 1-2 bananas per day can provide about 10-12% of daily fiber requirement and 10% of daily potassium requirement [18]. Banana peels are also edible and enriched with vitamin B-6, vitamin B-12, magnesium, potassium, and some amount of fiber and protein [19]. The flowers of banana have huge medical value. Cooked banana flower is good for diabetics patients. The ashes of unripe peel and the leaves are taken in dysentery and diarrhea and used for treating malignant [20].

Table 2: Components present in Banana & their health benefit [21]

COMPONENTS	BANANA (UNRIPE)	BANANA (RIPE)	HEALTH BENEFIT
Sugar	12.23gm	15gm	Improves brain health
Water	74.91gm	75gm	Helps to maintain the balance of body fluids
Dietary Fibre	2.6gm	3gm	Improves gut health
Saturated Fat	0.112gm	0.112gm	Makes bones stronger
Polyunsaturated Fat	0.073gm	0.073gm	Lowers LDL cholesterol
Monounsaturated Fat	0.032gm	0.032gm	Lowers LDL cholesterol
Protein	1.09gm	1gm	Builds body muscle and oxygenate
Vitamin A	04.001gm	2gm	Important for normal vision, immune system, reproduction & helps to work body organ properly
Vitamin C	0.0087gm	15gm	Maintains healthy skin, blood vessels, bones, cartilage & heals wound faster
Vitamin B-6	0.0004gm	0gm	Reduces symptoms of

			depression, mood swings, PMS & improves brain health
Sodium	0.001gm	0gm	Maintains fluid & blood volume in the body
Potassium	0.358gm	0.45gm	Regulate fluid balance, muscle contraction, nerve signals, reduces blood pressure & stroke risk, prevent osteoporosis & kidney stones, improve heart health.
Magnesium	0.027gm	0.0319gm	Supports muscle and nerve function & energy production
Iron	0.00026gm	2gm	Helps to make healthy oxygen-carrying red blood cells in the body
Dopamine	2.5-10mg	2.5-10mg	Important chemical for brain regulates mood and feelings.
Catechin	6.23mg	6.30mg	Protects brain health, heart health, aids weight loss, prevent cancer.

Last 10 years Banana production in India-

The largest producer of Banana in the world is India according to "Horticulture Statistics At A Glance 2017". India produces over 29 million tonnes of Banana per year, which is a 29.19% share of the world's total banana production [22]. In the last 10 years, banana productivity has been increased from almost 35 MT/HA to 37 MT/HA. The area of cultivation has been also increased from 770 '000Ha to 884 '000Ha(Table 3)

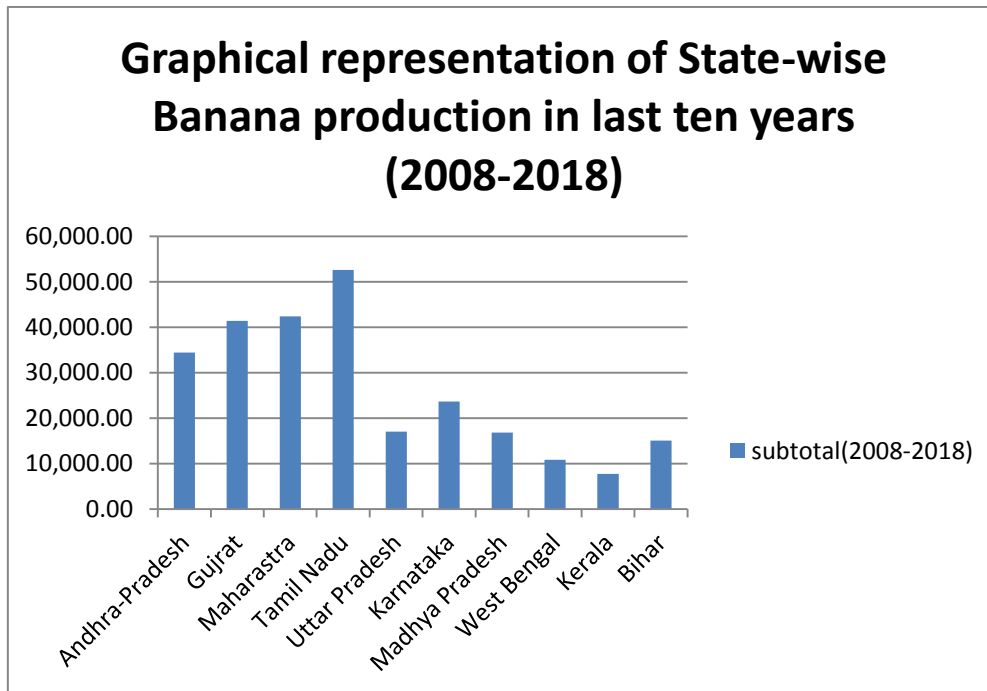
Table 3: Last 10 years Banana production in India [23]

YEAR	AREA (000'HA)	PRODUCTION (000'MT)	YIELD(MT/HA)
2008-2009	708.8	26217	36.98
2009-2010	770.3	26469.5	34.36
2010-2011	830.0	29780.0	35.87
2011-2012	796.5	28455.1	35.72
2012-2013	776.0	26509.1	34.16
2013-2014	802.6	29724.6	37.03
2014-2015	821.8	29221.4	35.55
2015-2016	841.2	29134.8	34.63
2016-2017	860.0	30477	35.43
2017-2018	884	30808	34.85

In India, Production is highest in Tamil Nadu followed by Maharashtra, Gujrat, Andhra Pradesh, Karnataka, etc. The annual banana production of Tamil Nadu is 6.2 Million Tonnes and the average yield is 100 metric tonnes per hectare, with 300,000Ha cultivation area. Tirunelveli district in Tamil Nadu is famous for its banana plantation. From western ghat to Tirunelveli everywhere, there is a banana tree. Karur is also one of the largest Banana producing cities in Tamil Nadu [24]. Andhra Pradesh is one of the most important states for banana production. Tones of banana are exporting from Andhra Pradesh every year. In the last two years, there is an exponential growth in banana export from the state. Green Cavendish Banana is very famous from this state and is being exported to the countries such as UAE, Bahrain, Egypt, Saudi Arabia, Qatar, Iran, and other middle eastern countries. Some states like Beluguppa, Narpala, Puttur, Eleanor, Tadimarri, Yadiki, etc. are growing Grand Naine to export them to aboard [25]. Previously Maharashtra was the highest Banana producing state in India. Now it's annual production is 3924.1 '000MT. Jalgaon district is known as the "Banana City of India". This

district is located in North Maharashtra. Jalgaon produces on average half of the total production of Maharashtra. A suitable amount of rainfall (700-750mm), Ideal type of soil, suitable humidity, and the temperature is the key to this huge production of Jalgaon [26]. Gujrat, Bihar, Karnataka, Kerala, Orissa, Assam- these states are also producing a significant amount of bananas per year [27].

Figure 1: State-wise Banana production in last 10 years [28]



Global scenario of Banana production-

Bananas are grown in more than 150 countries in the world. Approximately 113,212,452 tonnes of banana are produced per year. According to FAOSTAT, 5.6 million hectares of land are involved in banana cultivation (report,2017). Indian is the largest Banana producing country in the world with a production of 29,124,000 tonnes per year. And China is the second large banana producer with 13,324,337 tonnes of production per year. Production of Indonesia, Ecuador, Brazil, Philippines, Angola, Tanzania, Mexico is also very significant [29].

The main exporter of Banana is Ecuador across the world. Ecuador exports one-third of the total global Banana export. And European Union is the biggest importer of Banana (average 32% of global Banana imports), followed by the United States (25%), Russian Federation (8%) & Japan(6%) [30].

Table 4: Production of Banana in different Countries [31]

COUNTRY	PRODUCTION (TONES)	AREA (HECTARE)	YIELD (KG/HECTARE)
1.INDIA	29,124,000	846,000	34.425
2.CHINA	13,324,337	430,046	30.983
3.INDONESIA	7,007,125	139,964	50.067
4.BRAZIL	6,764,324	469,711	14.401
5.ECUADOR	6,529,676	180,337	36.208
6.PHILIPINES	5,829,142	456,641	12.765
7.ANGOLA	3,858,066	131,455	29.384

8.GUATEMALA	3,775,150	78,206	48.271
9.TANZANIA	3,559,639	468,470	7.598
10.RWANDA	3,037,962	322,009	9.434
11.COSTA RICA	2,409,543	42,410	56.815
12.MEXICO	2,384,778	78,322	30.448
13.COLOMBIA	2,043,668	84,637	24.146
14.VIETNAM	1,341,935	120,041	16.177
15.EGYPT	1,341,478	27,632	48.548

Varieties of Banana grown in India-

More than 20 different types of bananas are cultivated in more than 15 different states of India. Some famous types are-

Grand Naine is the most accepted international variety. One plant of Grand Naine can produce up to 200-220 fruits which can weigh around 32-35kg. The length and girth of the fruit are 15-21 cm and 12-13cm respectively.

Robusta is another very popular variety of bananas. The fruit of this plant is thick-skinned and length is around 15-20cm and girth is around 12cm. Robusta banana is also called Cavendish banana. It's large in size and green when unripe and turns into yellow when ripe.

Red Banana, as the name indicates, the colors of the peel are purplish Red. One plant can give up to 80 fruits which weighted around 20-25kg. This type of banana is very popular for its unique color and delicious taste.

Dwarf Cavendish is a type of Banana that cannot be exported. But it is a very popular type of banana across the world for its taste. The plant gets its name for its short stalk. The fruit is thick-skinned and the fruit tapers gradually towards the tip. Cavendish is the most cultivated variety in the world.

Nendran is green color when it is unripe, then turned into buff yellow on ripening. The fruit is thick-skinned and starchy. One plant and give up to 6-12 kg of fruit [32].

These are the most cultivated and popular varieties of Banana. Other than that, Barsal, Singapuri, poovan, sonakela, Elakkibale, Rasthali, Lady finger, Bhimkol, ThellaChakkarakeli, Karpuravalli, Malbhog, etc. are also cultivated in different states of the country. Among these, Poovan is the most important commercial variety. Chiniya is also a very famous variety of bananas from Bihar State [33].

Table 5: Varieties of Banana produced in different states of India [34]

STATE	AREA	VARIETIES OF BANANA
1.WEST BENGAL Districts- Hooghly, Nadia, North 24 Paraganas	3000acres	Champa, Mortman, Dwarf Cavendish, Giant Governor, Kanthali, Singapuri
2. ANDHRA PRADESH Districts- East Godavari, West Godavari, Kurnool, Cuddapah	60,000Ha	Dwarf Cavendish, Robusta, Rasthali, Amritpant, Thellachakrakeli, Karpooa Poovan, Chakrarel, Monthan, and YenaguBontha
3. MADHYA PRADESH Districts- Khandwa, Badwani, Khargaon, Dhar	7065Ha	Basrai
4.ASSAM Districts- Goalpara, Nagaon, Sonitpur, Foothills of Garo hills	42,104Ha	Jahaji (dwarf Cavendish), ChiniChampa, Malbhog, Borjahaji (robusta), Honda, Manjahaji, Chinia (manohar), Kanchkol, Bhimkol, Jatikol, Digjowa, Kulpait, Bharat Moni

5. BIHAR Districts- Vaishali, Katihar, Kishanganj, Bhagalpur (Naugachia) and Purnia	2000Ha	Dwarf Cavendish, Alpon, Chiniya, ChiniChampa, Malbhig, Muthia, Kothia, Gauria
6. JHARKHAND Districts- Ranchi, Sahebganj	995Ha	Basrai, Singapuri
7. ORISSA Districts- Ganjam, Puri, Kuroda, Gajpati, Cuttack, Dhenkanal, Angul, Sundargarh, Sambalpur, Bargarh, Deogarh, Koraput, Keonjhar, Raygada, Mayurbhanj	27490Ha	Dwarf Cavendish, Robusta, Champa, Patkapura (rasthali)
8. KARNATAKA Districts- Bangalore, Chitradurga, Shioroga, Hassan, ChikkaMangloor	53.8 '000Ha	Dwarf Cavendish, Robusta, Rasthali, Poovan, Monthan, Elakkibale
9. KERALA Districts- Thiruvananthapuram, Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Wynadu, Kannur, Kasargod	28.1 '000Ha	Nendran (plantain), Palayankodan (poovan), Rasthali, Monthan, Red Banana, Robusta
10. TAMIL NADU Districts- Thoothukudi, Tiruchirapalli, Coimbatore, Tirunelveli, Karur, Erode, Kanniyakumari	2.12Lakh acres	Virupakshi, Robusta, Red Banana, Poovan, Rasthali, Nendran, Monthan, Karpuravalli, Sakkai, Peyan, Matti
11. MAHARASHTRA Districts- Jalgaon, Ahmednagar, Buldhana, Pune, Wardha, Dhule, Nanded, Parbani, Nandurbar, Satara, Sangli, Osmanabad, Buldhana, Akola, Yeothmal, Amravati, Thane, Kurla, Alibag	59.7 '000Ha	Dwarf Cavendish, Basrai, Robusta, LalVelchi, Safed Velchi, Rajeli Nendran, Grand Naine, Shreemanti, Red Banana
12. GUJARAT Districts- Surat, Vadodara, Anand, Kheda, Junagadh, Narmada, Bharuch	66,309Ha	Dwarf Cavendish, Lacatan, Harichal (lokhandi), Gandevi selection, Basrai, Robusta, G-9, Harichal, Shrimati

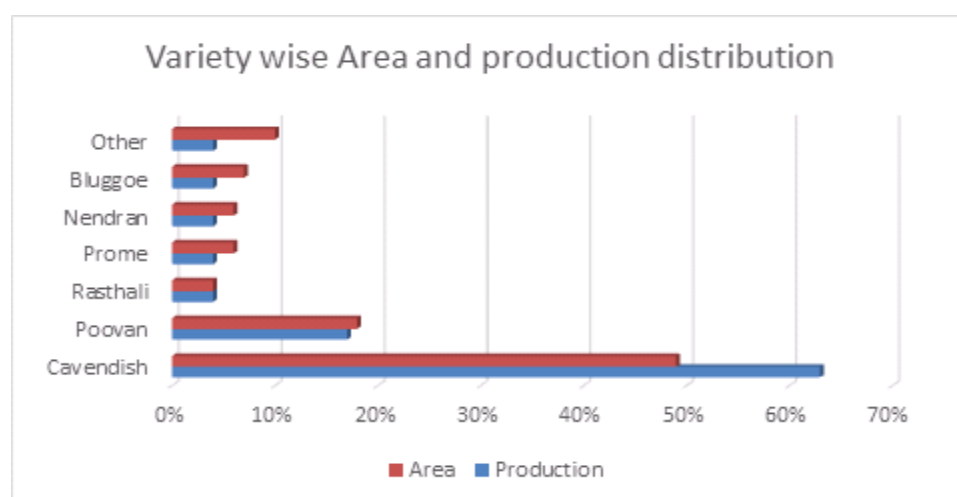


Figure 2-Variety wise production and distribution in India [35]

Wastage of Banana in India-

Almost 20-30% of bananas that are produced in India, estimated to go to waste due to an ineffective Cold chain. Despite being the largest producer of bananas, various studies show that inefficient post-harvest practices lead to massive waste every year [36]. Banana produces a high amount of ethylene (Airborne hormone) which causes the very first

ripening process. When the fruit and ethylene come into contact, ethylene reacts with the acids that are present in the banana and the fruit starts to become softer. This process (Green banana to ripe yellow banana) takes 24 hours to 3 days [37]. That is why Banana needs to be stored in a suitable atmosphere (14°C in ethylene free air), right after the harvesting process. But India has an ineffective Cold chain. And this is the main reason behind this much wastage. The amount of Banana wastage is calculated by the weighted average method [38]. Not only the fruit wastage, but the Banana tree itself also produced a lot of waste (12%). A banana tree gives fruit once a year and then dies. So the whole tree with, leaves, root, stem, etc. goes to waste after harvesting. Though the peel is edible and enriched with minerals, also goes to waste. Only effective post-harvest practices and awareness among people can change this scenario. In this current situation when the world's population is increasing day by day & every single bit of food is important, this much wastage should be controlled [39].

Policy on Banana production issued by Indian Government-

Banana is that kind of fruit which is available throughout the year. India produces on average 29 million tonnes of banana every year. So to improve productivity and ensure better utilization of the products and resources, there are several policies launch by the Indian Government.

Pradhan Mantri Fasal Bima Yojana (PMFBY) has been launched on the 18th of February 2016. This scheme was formulated by replacing two earlier policies- "National Agriculture Insurance Scheme" (NAIS) and "Modified National Agriculture Insurance Scheme" (MNAIS). PMFBY incorporates the best features of these two schemes and eliminates their inherent drawbacks. This policy aims to support sustainable production in agriculture by providing financial support to the farmers and stability to their income.

Pradhan Mantri Krishi Sinchai Yojana (PMKSY) was launched on 1st July 2015 with the motto of "Per drop more crop". In India out of 140.02 million Ha of sown area, 45% (about 65 million Ha) is covered under spatter. Rainfall makes cultivation in unirrigated areas high risk and less productive. To solve this problem PMKSY was launched. This scheme promises to ensure access to protective irrigation to all agricultural farms in India.

Pradhan Mantri Kisan Sampada Yojana (PMKSY) came intending to supplement agriculture and modernize processing and decrease agro-waste. The central policy scheme for Agro-marine processing and development of agro-processing clusters (SAMPADA) that was approved in May 2017 was renamed as- Pradhan Mantri Kisan Sampada Yojana. This scheme ensures a total development of agriculture by applying modern technology to post-harvest processing.

Pandit Deendayal Unnat Krishi Shiksha Scheme was launched in the year of 2016. The main base of the economy in India is agriculture. So it is important to have correct agricultural knowledge among the farmers. This scheme came to promote agriculture education, natural farming, and organic farming. This scheme was launched by the agricultural and farmer welfare department.

Project CHAMAN was launched to help the horticulture segment of Indian agriculture in the year 2014. This project makes use of Geo-informatics to help the farmers and also the Agricultural policymakers of India [40].

Good Agriculture Practices or GAP is very much important for the Banana industry. It ensures sustainable production, minimization of environmental impact, harvesting, packaging, transport activities, hygiene, and good quality safe fruit [41].

Export and import of Banana in India-

Banana production in India booked the top slot by producing almost 2,75,000 tonnes of bananas. Though India produced a large number of bananas like 29% of world production it does not gains the position as one of the banana trading nations of the world. From India, bananas are exported mainly to the middle-east countries like UAE, Saudi Arabia, Oman, Nepal, Maldives, etc. The new research on "Banana export from India in 2017" proved this. As India export bananas to the Maldives but their share is very much low. Research says that India's total export of bananas is 0.3 million. Many countries export bananas. The topmost name for banana import is the United States [42]. From the other perspective here the European are the highest dollar consumer for banana import which is \$8.6 billion (640,33,32,10,000.00 in Indian Rupee). For the second-place North America importers with Asia can also be noted. There is much competitiveness that has to be enhanced. The following points need to be maintained for making a good quality of bananas for international standards.

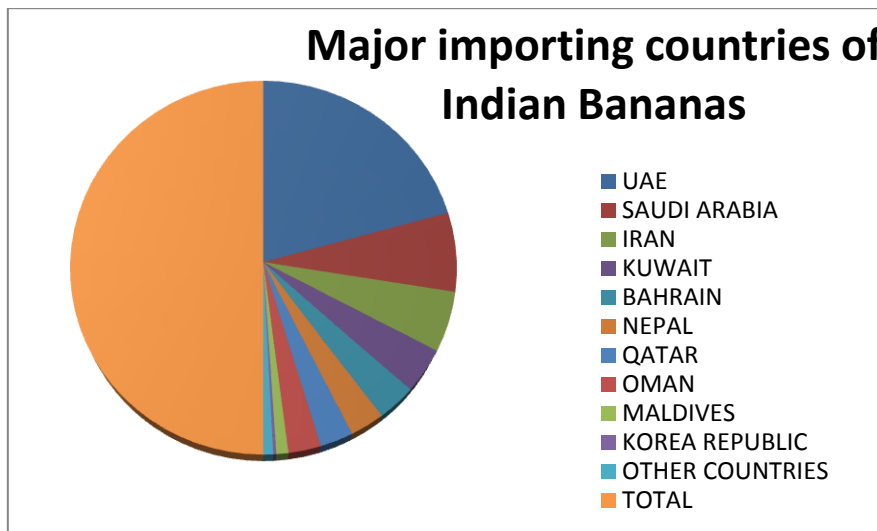
1. The production technology on modern lines needs to be shown to the growers on a large scale.
2. Farmers need to be more educated and all the export and import requirements and international quality standards.

3. In the filed a group of farmers is needed to shift the bunches of bananas to the packhouse. Because all the banana storage is very small in India and it is totally impossible to take wires under them and then transport the banana bunches to the packhouse. So, more farmers need to be motivated to take part in transporting the banana bunches to the packhouse and then for further processing packaging.

4. The packhouse workers need good training on post-harvest technology.

As, India produces a huge amount of banana throughout the year, so the list for banana import is not very large [43]

Figure 3: Major importing countries of Indian banana [44]

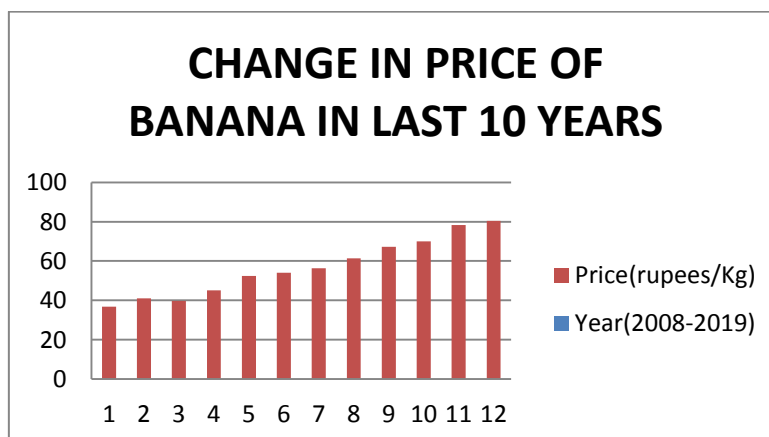


Last 10 years average change in Banana prices in India-

Population growth, improving per capita income, demographic change, urbanization, and globalization of food habits are causing rapid growth in demand for fruits. As the demand is increasing the price of fruits is also increasing and Banana is not an exception to that [45]. The demand for fruit is highly increasing in urban areas. Per capita consumption of fruits and vegetables in India is only around 46gm and 130gm against a minimum of about 92gm and 300gm respectively, recommended by the Indian Council of Medical Research and National

Institute of Nutrition, Hyderabad. Bananas are the most traded fruits in the world. In the last 10 years, there is a huge price change for banana prices. There are huge ups and downs in price which is clearly shown that depending on the export policy [46]. The average price of Banana per kg reaches from Rs.36.70 (2008) to Rs.78.35 (2018) (Fig.4). Loading charges from field to vehicle, transportation charges, Commission, weighing charges, wastage- these parameters are also to be considered in case of a change in the price of Banana in several years. The problems that farmers are facing most are- lack of assured price, low price per unit, high transportation charges, perishability of the banana, collusion among the trader, absence of clod storage & lack of ripening chamber [47].

Figure 4: Price of Banana in Last 10 years [48]



Conclusion-

Banana is one of the most cultivated fruit in India. Bananas are a very valuable commodity in the economic, social, environmental, and political fields. Since the 1900s, Banana is playing a major role in the Indian economy. As India is the highest banana producing country, a large amount of production is exported per year across the world. Several people depend on this Banana cultivation for their livelihood. Banana cultivation and post-harvest processing give many employment opportunities to a large number of people. In the last few years, various types of modern technologies were applied in banana production and the post-harvesting process. From tissue culture to temperature and moisture sensor to aerial images to GPS Technology to Robots, everything has been applied to banana production, which causes more production and hygienic-safe fruit in several years. Other than modern Technologies, some very beneficial policies were also issued by the government of India for better production, less wastage, and more export. In a country like India, where Agriculture provides 17% of the total GDP and employment to 60% of the total population, the whole agricultural structure should have been more advanced. For banana production, the mode of exportation should be faster, the method of storage should be more effective, and last but not the least, the people who are attached with the cultivation process and the post-harvesting process should have proper Agriculture Education.

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