

Towards Green and Socially-Sound Recovery in the Rural and Farm Sector

# CASE STUDY OF BANANA FARMERS IN ISMAILPUR VILLAGE IN HAJIPUR BLOCK, DIST. VAISHALI, BIHAR



# **ABOUT US**

Centre for Environment Education (CEE) was established in 1984 as a Centre of Excellence of the Ministry of Environment and Forests, Government of India. As a national institution, CEE's mandate is to promote environmental awareness nationwide.

CEE develops innovative programmes and educational material and builds capacity in the field of Education for Sustainable Development (ESD). It is committed to ensuring that Environmental Education (EE) leads to action for sustainable development. It undertakes field projects that demonstrate and validate the role education can play in sustainable development.

With partners including State Governments, Foundations and Corporates through CSR funding, CEE has undertaken projects in rural and urban development, waste management, biodiversity conservation, quality improvement in school education, marine conservation and others. Working with the government, CEE has made significant contributions to international negotiations in the area of ESD.

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# INTRODUCTION

Banana (*Musa acuminata*) is the second most important fruit crop after mango. Banana is a preferred fruit for direct consumption and processing because of its year-round availability, affordability, flavour, nutrition, and health benefits. Presently, bananas are cultivated in around 120 countries in warm tropical regions. Bananas emerged in the humid tropical regions of southeast Asia. There are around 300 varieties of bananas cultivated around the globe. In India,

15-20 banana varieties are cultivated commercially. Banana has a strong export potential as fruit and as processed foods, including as banana pulp or juice.

**INDIA'S BANANA-GROWING STATES** 

Though the banana season in India prevails throughout the year, banana arrivals begin to increase in April and peak between August and October. The crop is ready for harvest 12-15 months after planting, and the primary harvesting season for bananas is from September to April.

Among the Indian states, Andhra Pradesh is the largest banana producer followed by Maharashtra. The productivity of Andhra Pradesh is 65.7 tonnes/ha, which is considerably higher than the average national productivity of 34.1 tonnes/ha. In Bihar, banana is grown on around 27.2 thousand hectares, with a total production of about 550 thousand tonnes and with an average productivity of 20.0 tonnes/ha, which is much lower than the national average (CMIE, 2022).



Source: Uniyal, 2019

## **APPROACH**

- 1. The GHG emission for agriculture inputs and outputs supply chain inventories and primary processing (sorting, grading, storing) was calculated using the Cool Farm Tool (CFT). The data required for the Cool Farm Tool was collected using the GHG emission data collection tool.
- To study the value chain of banana both primary and secondary data were collected by interviewing various value chain intermediaries such as farmers, transporters, traders, and APMC commission agents and using datasets from the Centre for Monitoring Indian Economy (CMIE) and APMCs.

Photo: Neeraj Pal

# **STUDY AREA**

The study was conducted with banana farmers of Ismailpur village of Hajipur block in Vaishali district of Bihar situated on the banks of the Narayani (Gandak) river. People in these villages are largely dependent on agriculture as a source of livelihood. Bananas and paddy are popular crops in this region. Ismailpur village consists of people from general, SC, and OBC castes. As per the 2010-11 census, the demographic characteristics of the village are as follows:

### Demographic Characteristics of Ismailpur Village

Sr. No.	Characteristics	Description
1	Geographic Area	289 ha
2	No. of Households	1455
3	Total Population	8569
3.1	Male	4559
3.2	Female	4010

Source: (Registrar General of India, 2011)

# Vaishall \*

# **KEY HIGHLIGHTS**

# Production system at national, state and Vaishali district levels

- India is the largest banana-producing country. In the year 2020-21, 35.3 thousand ha of land in India was under banana cultivation with a total production of 1,612.60 thousand tonnes. Between the years 2000-01 and 2020-21, the area under banana cultivation increased by 117.9 per cent and the production of bananas increased by 374.3 per cent (CMIE, 2022).
- 2. The average yield of bananas in India has increased from 20.9 MT/ha in 2000-01 to 45.7 MT/ha in 2020-21 (CMIE, 2022).





- Andhra Pradesh has the maximum production (5,838.88 MT) (17.99%), followed by Maharashtra, Gujarat, Tamil Nādu, Karnataka, Uttar Pradesh, Bihar, West Bengal, Assam, and Chhattisgarh.
- 4. The commercial Indian banana varieties are Dwarf cavendish, Robusta, Poovan, Nendran, Red Banana, Ardharpuri, Ney poovan, Basrai, Karpuravalli and Rasthali.

State-wise production and share

	of banana (2020-21)					
.	State	Production	Sha			
).		(Tonnes)	(%)			

Sr. No.	State	(Tonnes)	(%)
1.	Andhra Pradesh	5838.88	17.99
2.	Maharashtra	4628.04	14.26
3.	Gujarat	3907.21	12.04
4.	Tamil Nādu	3895.64	12.00
5.	Karnataka	3713.79	11.44
6.	Uttar Pradesh	3391.01	10.45
7.	Bihar	1968.21	6.06
8.	West Bengal	1147.79	3.54
9.	Assam	1108.00	3.41
10.	Chhattisgarh	585.52	1.80

Source: (Directorate of Economics Statistics, 2021)

5. In Bihar, banana is grown on around 27.2 thousand ha in districts like Vaishali, Katihar, Kishanganj, Bhagalpur (Naugachia) and Purnia. The Hajipur chiniya variety (small size with special flavour) is a locally well known variety with high demand. The *Chiniya*, *Malbhog* and *Alpan* are preferred as fruit while the Muthiya and Barsayan varieties are used as vegetables.

Banana	Commonly	Harvesting
Variety	used as	Period
Chiniya	Fruit	
Malbhog		
Alpan		12-15 months
Muthiya	Vegetable	
Barsayan		

### Various varieties of bananas and their harvesting time

 Traditional varieties are far more popular among farmers than the tissue culture-based so called high yielding varieties like G-9. The traditional varieties owing to their cultural significance have greater demand especially during local festivals and religious ceremonies.

### Key findings from the study cluster

 Plantation of banana saplings is usually done between mid-May and July and the crop is ready for harvest within 12-15 months of plantation. The preferred soil type for bananas is loamy soil with good drainage and a pH between 6 and 7.5.



Banana Research Centre, Goraul, Dist. Vaishali has a vast collection of over 100 banana varieties and engaged in research and extension

- 2. To set up banana farms, farmers plant banana shoots of mother plants at an 8 ft distance of each other. Banana farm plots are generally irrigated using flood-irrigation method and diesel pumps are used to extract groundwater for irrigation.
- Of the farmers interviewed in the study cluster,
  30 per cent have agricultural land less than 3 acres, 55 per cent have between 3-7 acres and only 15 per cent have more than 7 acres.
- 4. The farmers in the sample together have cultivable land totalling to 85.5 acres, of which 65.6 acres (76.6%) of land is under banana cultivation. One individual farmer has 11 acres of land under banana cultivation which is the highest in the sample while another farmer has a minimum of 1.5 acres of land under banana cultivation.
- 5. Out of all the farmers cultivating bananas, 15 per cent are cultivating them on less than 2 acres, 65 per cent are cultivating on 2 to 4 acres, while 20 per cent are cultivating on more than 4 acres.
- 6. 80 per cent of the farmers in the study clusters have been cultivating bananas for the past 30 years, 10 per cent for more than 40 years and the remaining 10 per cent have been cultivating for about 20 years or less. The banana crop is preferred in this region because the soil is highly suitable for growing bananas and farmers opined that it is more profitable as compared to other crops.
- 7. All the farmers from the cluster use suckers as planting material. Sword suckers with a welldeveloped rhizome of conical or spherical shape, having actively-growing conical buds and weighing approximately 450-700 gm are commonly used as propagating material.
- 8. Farmers do not prefer tissue culture-based hybrid banana variety because consumers in Bihar prefer the native varieties both consumption as fruit, and vegetable as well as for ritualistic purposes. The hybrid varieties are dwarf and hence, are susceptible to *Neelgai* (Boselaphus tragocamelus) a major vermin animal which causes significant losses to the farmers.
- 9. The following graph presents the distribution of input costs per acre in banana farming in the study village in 2020-21.



- 10. Banana farming requires specialized planning, site selection, land preparation, layout, planting of saplings, as well as orchard protection and management. It is also a highly labourintensive crop. The yearly total expenditure for banana farming is Rs. 66,900. Of the total expenditure, 48 per cent is on labour wages and 33 per cent on fertilizers. After the fruit set, the majority of the expenditure is on labour for harvesting the crop.
- 11. None of the farmers in the cluster tested the soil before the application of fertilizers. The farmers usually apply fertilizers using their own judgements. They use mix of inorganic / synthetic and organic fertilizers such as DAP, potash, neem cake, mustard cake, urea and compost. The fertilizers are usually applied near the roots of banana plants. The average annual spending on fertilizer application is Rs. 22,000 per acre.



Average Annual Rainfall (mm) in District Vaishali, Bihar (2000-2021)

12. The average number of rainy/cloudy days in the Vaishali district is 45-50 days in a year. The average rainfall data indicates that the average rainfall in the Vaishali district is increasing. Vaishali is considered a flood-prone district. Floods generally occur from mid-August to mid August due to the overflow of the *Ganga* and *Narayani* rivers flowing through the Vaishali district.

- 13. With regards to the banana crop, the major losses associated with flooding and cloudy or rainy days are related to Nematode (*Nemathelminthes*) attack at the rhizomes due to water logging in the rainy season, attack of Panama wilt (*Fusarium oxysporum*), and fungal attack due to high moisture. Heavy rainfall and water logging in the year 2021 caused major losses to the banana farms. A few of the interviewed farmers reported around 90 per cent loss to their banana orchards due to waterlogging.
- 14. The main diseases of bananas reported by farmers in the study are Panama wilt (*Fusarium oxysporum*), anthracnose (*Gleosporium musarum*), leaf spot (*Sigatoka*) (*Mycosphaarella musicola* and *Cercospora musae*), shoot rot (*Ceratostomella paradoxa*) and viral diseases. The use of the Thimet pesticide and Glycel herbicide are very popular in the cluster. The average annual expenses per acre on pesticides and weedicides are Rs. 3,000 and Rs. 1,900 respectively.
- 15. As grid connectivity in the farmlands of the cluster is not good, farmers usually rely on diesel pumps. The banana farmers spend an average of Rs. 8,000 per acre on diesel in a year to run the pumps. The emission attributed to the use of field energy including the use of the diesel pumps is 7,259.6 kg CO<sub>2</sub>e.
- 16. The planted crop gets ready for harvest within 12 to 15 months of planting and the main harvesting season of bananas is from September to April. Bunches attain maturity from 90 to 150 days after flowering and it largely depends upon the banana variety, soil and weather conditions.
- 17. Bananas are harvested as per the distance of the market from the village. If the market is at a distance, harvesting is done when bananas are ripened up to 75-80 per cent. Farmers let the bananas ripen on the plants when the market is very near and harvest them just before sending them to the market.
- 18. The bananas are usually harvested as a whole bunch. The bunch consists of various numbers of rows and they are locally called *hattas*. The harvested bunches of bananas are stacked and wrapped in banana leaves and brought to the common aggregation site. They are usually protected from exposure to direct sunlight to avoid early ripening. The banana bunches are graded using the following criteria:

Grade	Characteristics
Grade 1 (Silver)	Bunches with eight rows and similar-sized fruit in all rows
Grade 2 (Shera)	Bunches with less than eight rows, medium-sized fruits
Grade 3 (Pauva)	Bunches with less than eight rows, small-sized fruits

### Various varieties of bananas and their characteristics

 The annual average production per acre is around 1,323 bunches. Of the total annual production, about 26 per cent of the produce falls in grade 1, while 49 per cent falls in grade 2 and 25 per cent falls in grade 3. In the study cluster, 30 per cent of farmers had a yield of above average while 70 per cent had below average yield in the cluster.

Grading of bananas	Percent of total production	No. of bunches	Number of rows (hattas)	Avg. weight per hatta (kg)	Total production (tonnes)
Grade 1 <i>(Silver)</i>	26	344	6943	12	83.3
Grade 2 (Shera)	49	648	12961	8	103.7
Grade 3 (Pauva)	25	331	6546	5	32.7

### Grade-wise productivity and production of bananas

20. The bananas are sold as graded bunches. Grade 1 bananas are sold at an average price of Rs. 185 per bunch, grade-2 at Rs. 92.5 per bunch and grade-3 at Rs. 61.7 per bunch. The total gross income from an acre of banana farming is Rs. 1,54,197.

Grading of	No. of bunches	Price received	Total gross	
bananas	per acre	per bunch	income	
Grade 1 (Silver)	344	185	63640	
Grade 2 (Shera)	648	92.5	59940	
Grade 3 (Pauva)	331	61.7	30617	

### Grade-wise productivity and production of bananas in kilogram

- 21. Good post-harvest handling practice is important in maintaining the quality and assuring the safety of the banana fruit as it moves through the supply chain from producer to consumer. Over-ripening and mechanical damage caused by bruising and compression are the main causes of losses in banana supply chains.
- 22. Transportation is a critical stage in the banana supply chain. Poor transport conditions, rough handling, and delays in transportation contribute to losses in banana supply chains. In the study cluster, the cost of transportation is borne by traders and middlemen.
- 23. A substantial proportion of the bananas produced in Bihar is consumed locally. Bananas

are available throughout the year. Marketing of fruits is done in different forms. A general trend in the study area is that middlemen/traders visit the orchards of farmers and purchase the produce at the farmgate itself. The traders then sell the bananas in the local wholesale market or directly to consumers. The traders also sell the produce to other traders from Delhi, West Bengal and other states.

24. As per the price data received from farmers, the average price of bananas varies as per grade. The gross profit per acre of the banana farm is Rs. 1,54,197. As APMCs in Bihar do not exist and middlemen/traders bear the cost of transport, the net profit of farmers is Rs. 87,297 per acre of a banana farm.

Farmer's Net Profit	Bihar
The average cost of cultivation (Rs/acre)	66900
Average yield (bunches/acre)	13225
Total gross income	154197
Net profit (Rs/acre)	87297

25. Banana farmers in the study cluster reported a loss of 60 per cent during the COVID-19 inducedlockdown. This was due to the unavailability of labour and the closure of the markets. The transportation service was available but not when required. Therefore, much of the banana production got spoiled at the farmgate.

# GHG EMISSION FROM BANANA FARMING

1. The total emission due to various activities at the pre-production, production and post-production levels of bananas in the form of carbon dioxide equivalent is as follows:

### GHG emissions from banana farming

Total	Emission	Average emission		
Emission	per acre	per kg		
400.9 MT CO <sub>2</sub> e	7977.9 kg CO <sub>2</sub> e	15.86 kg CO <sub>2</sub> e		

2. The banana farmland of marginal farmers who own land up to 2 acres produces fewer emissions, land of small farmers who own land of 2-4 acres has medium emissions while big farmers' banana farms produce the highest amount of average emission per kilogram banana. The big farmers tend to use a higher amount of agricultural inputs, therefore emissions from their farmland are higher.

Sr. No.	Landholding (acre)	Total emission (MT CO2e)	Emission per acre (kg CO₂e)	Average emission per kg of banana (kg CO2e)	
1	Up to 2	14.74	9214.7	16.17	
2	2-4	15.44	9345.9	17.31	
3	More than 4	48.01	9448.2	18.26	

### GHG emission from banana farming as per land holding

### GHG emissions from various activities from banana farming

Sr.	Sources	Up to 2 acres		2 - 4 acres		More than 4 acres	
No.		Per acre	Per kg	Per acre	Per kg	Per acre	Per kg
		of banana	of banana	of banana	of banana	of banana	of banana
1	Residue	2.68	0.007	2.82	0.008	2.86	0.008
	management						
2	Fertilizer	228.32	0.583	300.38	0.824	364.72	0.919
	production						
3	Fertilizer	352.43	0.899	376.96	0.979	394.49	0.914
	application						
4	Crop protection	1.13	0.004	1.78	0.005	6.17	0.15
5	Energy use (field)	8631.31	18.58	9373.1	18.50	9749.9	19.50

3. If we analyse the data of greenhouse gas emissions from various activities related to banana farming, the energy use in the field such as diesel consumption for diesel water pumps and use of tractors for ploughing produces the highest amount of greenhouse gases. The fertilizer application and production also produce a substantial amount of emissions. The emissions attributed to carbon stock and transportation could not be collected as data was not available.



# VALUE CHAIN OF BANANA

- The overall value chain of banana mainly comprised agriculture input suppliers, producers/farmers, commission agents, traders, wholesalers, retailers, exporters, processors and consumers.
- 2. There are two main supply chains of bananas in Bihar: (i) local retailers, traders, and commission agents and (ii) direct to consumers. If the price decreases substantially, farmers sell their produce to local retailers in Hajipur and Patna to recover at least their cost of production.
- 3. Small farmers sell part of their produce directly to consumers through roadside stalls near bus stations, railway stations and local fruit shops. For this, they set up small makeshift shops on the main highways from Hajipur to different locations. This provides for the immediate cash requirement of small farmers. Most of the time, farmers sell their produce directly to traders who come to their land to buy bananas directly from the farm. The overall value chain is depicted in the figure below:



- 4. Marketing of bananas is generally done by middlemen such as commission agents and traders. Traders are also wholesalers who purchase bananas directly from farmers and sell them to other markets within the state or in other states.
- 5. These middlemen in the agriculture supply chain are supposed to play a vital role in

matching demand with supply in the market. But as these middlemen have ample resources such as capital, cold storage facility and linkages with retailers and exporters, they buy bananas at a lower price when there is excess supply, store it in cold storage and sell the produce when prices are up in the market. The farmer's share of the profit is very little.

# CONSTRAINTS IN BANANA PRODUCTION, FAILURE AND DAMAGE

1. Floods are the main constraints during the monsoon season. The rivers in the area overflow



due to excess water and result in water logging of the farms; and if this remains for more than 15 days it could become dangerous for banana plants.

2. The problems faced by farmers are low productivity, rapid change in climatic conditions, lack of or inadequate availability of improved inputs and technology, losses due to insect pests and disease attacks and lack of credit and marketing. The fungal disease (Banana Wilt) causes great loss to the farmers as it spreads fast and destroys the production of the whole orchard.

# RECOMMENDATIONS

- Nurseries of local varieties of bananas can be set up in consultation with the banana farmers to conserve these varieties and make good quality planting material easily available.
- 2. The banana farmers are primarily dependent on diesel-based water pumps for irrigation rather than electricity. It is required to improve water use efficiency in the farming system and promote the use of solar pumps to reduce the carbon emission from field energy use and decrease the cost of production.
- 3. Warehousing and cold storage facilities need to be created for multiple commodities including bananas. This will help in integrated farm-level processing, transportation, and distribution of horticulture products to distant marketplaces within the state and other parts of India.
- 4. The wastage near the farmgate necessitates the installation of a processing unit near the farmgate. The bananas can be processed into several value-added products such as banana pulp and juice, chips, banana powder, and other products. There is also a substantial opportunity for using banana leaves and stem fibres to make eco-friendly cutlery items and other products.
- 5. Collectivization of banana farmers is important because currently they are farming individually due to which their input cost is higher and they do not have bargaining power in the market. Collectivization would also enable development of processing units and marketing at scale.

- 6. *Fasal Bima Yojana* and other similar schemes can also help in reducing losses in case of crop failure and other losses during harvest and transportation.
- 7. There is a need for state policy support to promote local varieties which are resilient, and in demand by producers and customers

considering market mechanism pushing for hybrid G-9 variety which is highly susceptible to fungal diseases especially in humid regions like this and also not preferred by people at large in the state. Conservation and development of local varieties also preserves local natural and cultural heritage, as mandated in various existing policies such as National Biodiversit

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