

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

CASE STUDY OF CUSTARD APPLE IN THE VILLAGE: PARINCHE IN PURANDAR BLOCK, DIST. PUNE, MAHARASHTRA



ABOUT US

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INTRODUCTION

The custard apple (Annona squamosa) is a member of the family Annonaceae and a species of the genus Annona known predominantly for its edible fruits. It is a perishable fruit with a short shelf life of 3 days. Significant post-harvest losses of harvested custard apples occur due to a fall in price and inadequate storage facilities, which means a major loss of income for farmers. India is the world's second-largest custard apple producer after China but processes only 0.7 per cent of its production. This impacts farmers by way of high post-harvest losses and low returns during periods of excess supply in the market.

APPROACH

- 1. The GHG emissions for agriculture inputs and outputs, supply chain inventories, and primary processing (sorting, grading, storing) were calculated using Cool Farm Tool (CFT). The data required for the Cool Farm Tool was collected using the GHG emission data collection tool.
- 2. To study the value chain of custard apples, 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.

STUDY AREA

Parinche village is situated on the banks of the river Rudraganga in Purandar taluka, Pune district. Three hamlets – Pilanwadi, Kambalwadi, and Rautwadi – are also part of the village. The total population is 3,364 of which males are 1,952 and females are 1,412. The village falls in a rainshadow region and has been experiencing erratic rainfall. Around 10 years ago, there was a severe drought but in the past two years, the region has received double the average rainfall.

Farmers grow fruit crops including custard apples, figs, and other crops such as onions and soybean and sell them in Jejuri, Pune and Mumbai markets. This region is a major centre of custard apple production. The area under various crops and total production in Parinche village is as follows:

Crop	Area (Acre)	Total Production (MT)
Custard Apple	98.8	600
Soyabean	1482	1500
Onion	1235	25000
Bajari	666.9	594
Anjeer	3	12

Various Crops, Area and Production in Parinche

COUNTRY SCENARIO

1. The area under cultivation of custard apples in India has increased by 152.9 per cent in the past ten years and the production of custard apples has increased by 219.9 per cent (CMIE, 2022).



Sr No	State	Area ('000 hectares)	Production ('000 tonnes)	Yield (MT/ha)
1	Maharashtra	16.1	130.8	8.7
2	Madhya Pradesh	8.2	103.7	12.6
3	Gujarat	7.3	73.5	10
4	Andhra Pradesh	1.8	17.5	10
5	Telangana	0.7	9	13.1
6	Karnataka	0.9	7.1	8
7	Rajasthan	0.5	5.1	9.3
8	Tamil Nadu	0.2	1.3	6.2

State-wise area, production and yield of custard apples

Source: CMIE, 2022

- 2. Maharashtra, Madhya Pradesh, Gujarat and Andhra Pradesh have the highest production of custard apples. Telangana state has the highest yield of 13.1 MT/ha (CMIE, 2022).
- 3. Maharashtra produced 1,30,800 MT of custard apple in 2020-21, with 16,100 ha of land under

custard apple cultivation, mainly in Pune, Beed, Aurangabad, Parbhani and Solapur districts. Though Maharashtra has the highest production and largest area under custard apple cultivation, the yield of Maharashtra is relatively lower, at 8.7 MT/ha(Directorate of Economics Statistics, 2021).

A) Study area-specific findings

- The fruiting of custard apples starts in three years after the planting of saplings. Annually, fruiting usually starts in June and lasts till October. There a consistent demand for custard apples in the nearby markets of Pune, Mumbai, and Jejuri. For the initial three years, farmers take other intercrops such as soybean, bajari and onion.
- 2. Of the sample size of 34 custard apple farmers in Parinche village, 15.6 per cent are small farmers who have land up to 2 ha, 31.3 per cent are semi-medium farmers who have land up to 4 ha, 43.8 per cent are medium farmers who have land up to 10 ha and 9.4 per cent are large farmers who have land of more than 10 ha. In Parinche village, overall 45 per cent of farmers have land up to 3 acres, 16 per cent have 3 to 5 acres of land and 39 per cent have more than 5 acres of land.
- 3. The total land under custard apple cultivation in Parinche village is 98.8 acres which is 3 per cent of the total cultivable land and the total production is around 600 MT. Around 41.2 per cent of farmers have up to 150 plants and 47.1 per cent of farmers have 150-300 plants on their farms. Nine of the surveyed farmers have recently planted custard apple saplings, which have not begun to produce custard apples yet. The remaining 27 farmers have 23.85 acres of

land under custard apple cultivation and produce 144.8 MT of custard apples.

4. The *Phule Purandar* is the most popular variety of custard apple in the cluster. Around 97.6 per cent use this variety while only 2.9 per cent of farmers use the *Golden* variety. As per farmers, the *Phule-Purandar* variety has big-sized, sweet-tasting fruit and is suitable to be grown in local climatic conditions.



Custard apple of Phule Purandhar variety

5. The average cost of setting up a custard apple orchard is Rs. 49,550 per acre while the average cost of production during fruiting is Rs. 37,272. The yearly cost of production of a custard apple farm is Rs. 82,522 The major expenses are drip irrigation which accounts for 43.6 per cent, manure and fertilizers for 22 per cent, pruning for 17.5 per cent and electricity bills for 16.4 per cent.

Input cost particulars	Average input cost before fruiting (Rs/acre)	Per cent contribution	Average input cost during fruiting (Rs/acre)	Percent contribution
Seeds	4300	8.7	NA	NA
Human labour/tillage	4560	9.2	5430	15.8
Pruning	NA	NA	6012	17.5
Manure and fertilizers	5970	12.0	7560	22.0
Pesticides	1810	3.7	2320	6.7
Weedicides	1190	2.4	1760	5.1
Water bill	2000	4.0	1640	4.8
Drip irrigation	21580	43.6	NA	NA
Spray pump	2870	5.8	2870	NA
Electricity bill	5270	10.6	5630	16.4
Plastic crate	NA	NA	4050	11.8
Total	49550	100	34402	100

Cost of production of custard apple per acre in Parinche

- 6. None of the 34 farmers had conducted soil tests of the farmland. 41.2 per cent of farmers use only organic fertilizers and 62.8 per cent of farmers use a mix of inorganic/synthetic and organic fertilizers. The nearest soil testing lab is 75 km away at Krishi Vigyan Kendra (KVK), Baramati. The cost of testing one soil sample is Rs. 200. Farmers tend to avoid this expense of testing, and apply fertilizers by their own judgment of the soil.
- 7. Rainwater is the main source of water for irrigation in June, July and August. Groundwater is used in the other months. 72.7 per cent of farmers use well water and 27.2 per cent use borewells for irrigation. The village had a traditional *Shivkalin* (17th century) gravity-based irrigation system (*Paat Paddhat*) which has been largely degraded and abandoned over time due to multiple factors. The *Shivkalin* system includes two check dams on the local river Rudraganga, named *Thorali Chirebandi*

and *Dhakati Chirebandi*. The gravity canal system existed on the east bank which runs 4 km long, providing irrigation as well as recharge of nearby wells. The *Thorali Chirebandi* has been damaged at present and water is leaking from its east bank, thus failing in its sole purpose to hold and store water and increase its percolation. Consequently, the groundwater level in the region is decreasing rapidly and now the average groundwater level is 51 m. The average water level has gone down to around 40 ft in open wells.

8. The custard apple farmers spent an average of Rs. 15,646 on energy usage in the field and out of total expenses, the major expenses are electricity bills of water pumps and the fuel consumption of four-wheelers. The total emissions from in-field energy use is equivalent to 39.01 MT CO₂e from custard apple farms in Parinche village.

	No. of farmers (%)	Avg. fuel consumption	Avg expenses (Rs)	Per cent of total energy expenses
Water pump	32 (94.1)	Not applicable (Electricity)	6198	39.6
Tractor	31 (91.2)	27.6	2622	16.8
Four-wheeler	6 (17.6)	34.5	3623	23.2
Two-wheeler	23 (67.6)	30.3	3203	20.5
	Total		15646	100

Energy consumption and costs

- 9. As per collected data from the field in 2020-21, a total of 144.8 MT of custard apples were produced in Parinche village. There is a recent trend of farmers shifting to custard apple plantations mainly due to the potential for profit and the scarcity of water. Custard apple farms require less water compared to other crops in this cluster including fig orchards. The maximum custard apple production starts when plants are more than four years old. In a sample of farmers interviewed, seven farmers have had custard apple farms for less than four years. The average productivity of the remaining 27 custard apple orchards is 6.07 MT/acre. Two farmers have exceptional custard apple productivity of 6.5 MT/acre.
- 10. The average custard apple productivity of Maharashtra is 3.5 MT/acre which means the average productivity of Parinche village is higher than that of Maharashtra. When compared to the state average, all the farmers have productivity higher than the state average.
- The custard apples are usually graded into three grades based on their size. Around 33.7 per cent of produce is of grade-1, 37.5 is of grade-2 and the remaining 12.1 per cent is of grade-3. Grade-1 fruit fetches an average market price of Rs. 67 per kg, grade-2 of Rs. 43 per kg and grade-3 of Rs. 21 per kg.

Custard apple	Average Production in MT (%)	Grade-wise average price (Rs)
Grade-1	48.8 (33.7)	67
Grade-2	54.3 (37.5)	43
Grade-3	41.8 (28.9)	21

Grade wise production in Parinche

- 12. Mealybugs and white and black fungi are common diseases and pests of custard apple fruit and plants. Farmers are experiencing climate change-related extreme events and changes in rainfall patterns. Delays in the monsoon, an increase in average rainfall and the number of cloudy days, and a decrease in the number of rainfall days have created favourable conditions for pests and diseases. These reasons such as pest attacks, untimely rain and a fall in market price, result in the loss of custard apples. The untimely rain and pest attacks are major causes of the loss of custard apple produce.
- The nearest APMC markets for the sale of custard apples are Pune, Saswad and Mumbai.
 Of 34 farmers, nine sold their produce in the Pune market, thirteen at Saswad and three at the Vashi APMC market in Mumbai.

Reason for spoilage	No. of farmers (%)	Quantity spoiled in kg (%)
Pest attack	8 (29.6)	2295 (33.1)
Untimely rain	12 (44.4)	4100 (59.1)
Sorting and packing	0 (0.0)	0 (0.0)
Fall in market price	4 (14.8)	540 (7.8)
	Total	6935 (4.8% of total production)

APMC Market	No. of farmers	Quantity sold in kg (%)
Saswad	19	88183 (60.9)
Pune	9	15059 (10.4)
Mumbai	3	41558 (28.7)

14. As per the price data received from farmers, based on the average price of custard apples across months and of different grades of custard apples in the year 2020-21 in the Saswad, Pune and Mumbai (Vashi) APMC markets, the profit percentages the Saswad, Pune and Mumbai markets were 115 per cent, 130 per cent and 147 per cent respectively.

Farmer's Net Income	Saswad	Pune	Mumbai
Average cost of production ¹ (Rs/acre)	85,522	85,522	85,522
Average yield (q/acre)	60.7	60.7	60.7
Average cost of production at farmgate (Rs/q)	1409	1409	1409
Cost of transportation (Rs/q)	120	180	240
APMC market expenses (Rs/q)	160	160	160
Total expenses (Rs/q)	1689	1749	1809
Average price received in the market (Rs/q)	3623	4026	4474
Net profit (Rs/q)	1934	2277	2665
Profit percentage	115	130	147

15. The total emissions from various gases due to various activities at the pre-production, production and post-production levels of custard apple farming in Parinche village in the form of carbon dioxide equivalent is as follows.

GHG emissions from custard apple farming in Parinche

Total	Emission	Average emission
Emission	per acre	per kg
39304 kg CO ₂ e	1683 kg CO ₂ e	0.275 kg CO ₂ e

16. The marginal farmers who own land up to 2 acres have minimum emission per acre and average emission per kilogram of custard apple produced. The emission per acre of farmers who have 2-5 acres, 5-8 acres of land and more than 8 acres of land is higher than that of marginal farmers. The data relating to average emission per kilogram of custard apples is skewed as seven orchards are less than four years old.

GHG emission from custard apple farming as per land holding in Parinche

Sr. No.	Landholding (acre)	Total Emission (MT CO2e)	Emission per acre (kg CO2e)	Average emission per kg of custard apple (kg CO ₂ e)
1	Up to 2	73.95	15.89	0.275
2	2-5	161.96	17.42	0.280
3	5 – 8	187.71	16.41	0.270
4	More than 8	5.17	17.24	0.270

GHG emissions from various activities from custard apple farming in Parinche

Sr.	Sources	Up to	2 acre	2 - 5	acre	5-8	acre	More the	an 8 acre
No.		Per acre							
		of custard							
		apple							
1	Residue management	0.42	0.0001	0.453	0.0001	0.58	0.0001	0.66	0.0001
2	Fertilizer production	3.12	0.0005	3.24	0.0005	3.23	0.0005	3.21	0.0005
3	Fertilizer application	204.45	0.034	213.1	0.035	227.25	0.038	281.9	0.036
4	Crop protection	1.91	0.0003	1.88	0.0003	2.03	0.0003	2.84	0.0003
5	Carbon stock	-11.70	-0.004	-6.28	-0.003	-0.6.83	-0.003	-6.73	-0.001
6	Energy use (Field)	1313.18	0.2268	1357.8	0.235	1340.6	0.221	1368.1	0.225
7	Off-farm transport	73.91	0.017	73.57	0.012	75.42	0.012	74.18	0.012

17. The data about greenhouse gas emissions from various activities related to custard apple farming shows that energy use in the field such as electricity consumption for water pumps and fertilizer application produces the highest amount of greenhouse gases. The emission per acre from various activities for marginal farms is lesser than that of small, medium and large farms.



Total Emissions (kg CO₂e) for custard apple production in Parinche

- 18. The overall value chain of custard apples mainly comprises agriculture input suppliers, producers/farmers, commission agents, traders, wholesalers, retailers, exporters, processors and consumers. The only value additions done by farmers individually at the farmgate level are cleaning, sorting and grading.
- 19. The net profit for various supply chain intermediaries is calculated using the cost of production/value addition, net selling price, and losses at each stage. The expenses are highest at the farmer's level (Rs. 1,749 per quintal) while the APMC trader and retailer incurred the lowest expenses. The farmers receive the lowest net profit of Rs. 1,934 per quintal while the APMC trader receives the highest net profit from the sale of custard apples.

Supply chain intermediaries	Cost of production and marketing-related expenses in Pune APMC (Rs/q)	Selling price (Rs/q)	Net profit (Rs/q)
Farmer	1749	4026	1934
Commission Agent /APMC Trader	132	8986	4828
Retailer	1252	11252	2141

Percentage share of stakeholders of the supply chain in net profit in the sale of custard apples



Farmer Commission Agent/ Trader Retailer

RECOMMENDATIONS

1. Promotion of sustainable agriculture practices

- The farmers in Parinche village are aware of the benefits of organic farming. They claim that custard apples produced using organic fertilizer have a good shelf life but production is less. Therefore, most farmers use a mix of synthetic/inorganic and organic fertilizers. Increasing access to soil testing can encourage more farmers to test the soil and adopt the scientific application of fertilizers. This will reduce the expenditure on fertilizers by avoiding excessive application of fertilizers. In turn, this will reduce GHG emissions from fertilizer production and fertilizer application which is 86.8 kg CO₂e and 6,215.2 kg CO₂e respectively.
- Organic farming can be promoted through initiatives such as the distribution of vermicompost beds, and the sale of vermicompost, vermiwash, and other organic fertilizers.
- Groundwater assessment, identifying recharge and discharge zones, and progressive adoption of watershed development work through Farmer Producer Company (FPCs) can help in the improvement of groundwater levels. This will reduce GHG emissions from field energy use which is 39.01 MT CO₂ eq.
- It is required to organize the farmers in the village to perform watershed development-related work in

the village to improve to improve groundwater levels.

• The *Paat Paddhat*, traditional water irrigation and recharge system in the village, can be rejuvenated. The damage to the ancient check dams can be repaired and the 4 km long gravity canal system can be desilted. This will increase water percolation in the soil and improve the situation of groundwater.

2 Integrated Pack House and Processing Unit

In India, presently around 40 lakh tonnes of fruits and vegetables are produced. Of this, around 30-40 per cent of the produce is lost resulting in an economic loss of around Rs. 92,000 crore (Kumar, 2016)(Report of the Committee for Doubling Farmers' Income-Post-Production Agri-Logistics: Maximising Gains for Farmers, 2017). Small integrated units of packhouse and processing can help avoid post-harvest losses and improve price realization. Apart from a collection centre, this unit would provide facilities such as cleaning, washing, sorting, packaging, cold storage, and marketing. The pulping unit can process grade-2 and grade-3 custard apples and also market surplus custard apples which will help farmers obtain a better price for their produce. The custard apple harvesting season is from June to October. The demand for custard apple pulp is higher in the months of October

Grade	Productivity (Kg/acre)	Gross income through the sale of raw custard apples (Rs/acre)	Quantity of pulp produced (Kg/acre)	Gross income through the sale of processed custard apples
Grade-1	2046	137082	909	181800
Grade-2	2272	97696	757	151400
Grade-3	1752	36792	584	116800
Total	6070	271570	2250	450000

Comparison of potential income from processing of different grades



Deseeding machine Source: Bluecold cited in Knitcon, 2022



Layout of processing unit

to May due to the festive and wedding seasons. As the shelf life of custard apples is hardly 2-3 days, storing them in pulp form to fetch more profit during periods of high demand is a good value-addition strategy for farmers. If custard apples are sold in raw form, the gross profit of the farmer will be Rs. 2,71,570 per acre. If the raw custard apples are processed, the gross income per acre will be Rs. 4,50,000 per acre. The expenses on the processing unit include the cost of raw materials, labour, land, processing equipment, electricity, etc. The processing into pulp will add a total value of Rs. 4.45 crore for custard apples produced on 98.8 acres in the village. This is exclusively for custard apples without consideration of processing of other fruits (jamun, mango, fig, strawberry, chikoo, guava etc). During field studies, it was also observed that the cost of electricity is a major expense for such processing units.

3. Weather advisories

 Western Maharashtra is experiencing extreme weather events. The monsoon delay, increase in average rainfall and the number of cloudy days, and decrease in the number of rainfall days has created favourable conditions for pests and diseases. Field studies show that at present, the advisories provided through local weather stations are not being effectively communicated to the farmers. Therefore, the utilization of this information is very less. It is recommended that cluster-specific regional real-time advisories should be developed and properly communicated to alert the farmers about extreme weather events and about the mitigation and adaptation measures to be taken. Citizen science and other approaches that are effective in engaging farmers may be used for locally-relevant weather and crop advisories.

4. Market price information

 As market price-related information is not easily accessible to farmers, farmers tend to sell their produce to traders in contact with them. They do not explore distant markets for a better price and end up selling produce to nearby markets at a cheaper price. Therefore, farmer-accessible and user-friendly technologies which could provide real-time market information to farmers need to be developed and disseminated.

5. Promotion of Farmers Producer Company

Small and medium farmers do not have enough quantity of products and therefore they cannot sell products directly to processors or to retail chains which demand custard apples in large quantities. If these farmers come together to form an FPC, then they would be able to collectively sell the produce to the retail chain and processing industry at a higher price. It will also reduce the cost of transport and other costs and increase the total price realization by individual farmers. The FPC can also function as an inputs shop, as a primary and secondary processing of agricultural products and promoting sustainable agriculture practices. The farmer's collectivization can be an effective strategy to reduce the cost of inputs, increase productivity, reduce GHG emissions and sequester carbon emissions, and increase the profit of small and medium farmers.

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