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Coconut Cultivation in South Konkan Region of Maharashtra: A Study of Economic Well-being

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study on economic well-being was conducted in the South Konkan region with 144 sample coconut growers. The objective behind this study was to estimate cost, returns, profitability and financial feasibility of coconut production. The study was conducted by means of adoption index, standard cost concept and financial feasibility measures. Numerous technologies have been suggested by the Regional Coconut Research Station, Bhatye, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, to enhance the quality of coconut production after extensive research in the field. The extent up to which the technologies were adopted was 45.51 per cent overall. This suggested a wide scope for raising the adoption rate. The economic analysis of coconut production in the

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research area showed that growing coconuts through the use of recommended technology was profitable. It was observed that farmers are saving more on each expense due to the high adoption rate. In coconut cultivation, the net present value was positive (Rs. 230665). The B: C ratio is greater than one (1.41) and the internal rate of return (IRR) is higher than the going interest rate (23.01%). This demonstrated the economic viability of coconut production. The policy should be made to spread the recommendations to the farmers and training should be provided to farmers on larger scale for more profitable production.

Keywords: Coconut; technology adoption; net present value; internal rate of return; B:C ratio; payback period; saving in cost.

1. INTRODUCTION

Coconut scientifically known as *Cocos nucifera*, is a versatile plant with a multiple use. On the global scale, coconuts are cultivated in tropical and subtropical regions, becoming an important agricultural commodity. Coconut was grown in more than 93 countries of the world with total production of 62.41 mt nuts globally. Most of the production was in Indonesia, Philippines and India which, collectively accounting for over 73 per cent of total world production [1]. Whereas, India covers about 21.34 per cent of coconut production globally [2].

Coconuts play a significant role in the economies of many countries, including India. They serve as a source of income for farmers and are the foundation in various industries, such as agriculture, food and beverage, cosmetics and pharmaceuticals [3]. India is one of the world's largest producers of coconuts. As per the 2022-23 statistics given by the Coconut Development Board (CBD), the major coconut-producing states include Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra [4,5]. Maharashtra is one of the leading coconut-producing states in India. The state has a significant coconut cultivation area and its production contributes to the overall national output. Coastal regions of Maharashtra, particularly the Konkan region, are known for extensive coconut cultivation. Other regions in the state with suitable agro-climatic conditions also contribute to coconut farming [6-10]. The South Konkan region of Maharashtra, being productive to tropical crops, holds particular importance for coconut cultivation. Coconut farming in the South Konkan region of Maharashtra has a broad scope and utility, ranging from improving farmers' incomes and livelihoods to developing policies, enhancing competitiveness and contributing to sustainable agricultural practices [11-14].

This study is much useful to the farmer's community particularly Coconut growers. It would be useful to understand the economic well-being of coconut growers and will give useful insights to the farmers. This study is useful as it will give an idea on the importance of technology adoption for improving the productivity to coconut growers [15,16]. Among these different technologies for adoption, the various technologies studied were choice of high yielding varieties, spacing, manure application, pest management, fertilizer application, intercropping in coconut plantations, disease management, fertilizer application through drip irrigation, micronutrient application, power operated coconut de-husker, Foldable coconut de-husker, tractor mounted hydraulic elevator etc. While adopting the suggested technologies, a significant scope to raise the level of adoption was observed. This study of economic well-being aims to provide a comprehensive evaluation by analyzing key economic factors, trends in production and also the study seeks to reveal the relationship between technology adoption and the overall economic well-being of coconut growers in the South Konkan region of Maharashtra.

2. DATA SOURCE AND METHODOLOGY

Data were collected on costs, returns, profitability and financial feasibility of coconut cultivation from coconut growers with the aid of pre structured and pretested interview schedule. Coconut is traditionally grown in the Konkan region due to the suitable climate. The South Konkan region consisted of two districts such as Ratnagiri and Sindhudurg was purposively selected. The area of coconut under Sindhudurg district was 17929 ha and Ratnagiri district was 5556 ha [17]. which was highest in the Konkan area. For the purpose of the study, three tahsils from each district with the largest area under coconut cultivation were chosen. Two randomly chosen villages were chosen from each tahsil. A

random selection of 12 farmers was made from each village. Making it a sample of 144 farmers.

2.1 Tabular Analysis

The data was organized into appropriate tables and basic statistical methods were applied for the analysis, including averages, ratios and percentages in addition to standard cost concepts and discounted and undiscounted measures.

2.2 Technology Adoption

The actual level of adoption of each item of technology on each of the farmers' fields was estimated.

Technology Adoption Index: The Technology Adoption Index of each farmer was estimated by using the following formula [18].

$$TAI = 1 / n \{(\mathbf{AX1/RX1}) + (\mathbf{AX2/RX2}) (AXn/RXn)\}X\ 100$$

Where,

N = No. of technologies
AXn= Actual use of selected technology
RXn= Recommended use of selected technology

The following formulas were used to calculate the adoption index for those particular inputs used on sample farms in excess quantity more than the recommended level [19].

A) Excess use up to 200 percent

For calculating the adoption index for excess input use up to 200 percent more than the recommended input level for individual input (technology) following formula was used.

Single Technology Adoption Index (STAI)

$$STAI = 2 - (AXi/ RXi) X\ 100$$

Where, 2 = constant

B) Excess use up to 300 percent

Single Technology Adoption Index (STAI)

$$STAI = [3 – (AXi/ RXi)] / 2 X\ 100$$

Where, 3 = constant (a) and 2 = constant (b)

There was no any farmer found in the present study who has applied any form of the input excess or more than 300 per cent than the recommended level.

The sample farmers were grouped into three categories of adoption level, by calculating the total adoption index for inputs for each farmer.

The classification was carried out with the help of mean and standard deviation criteria, such as

1. Group I (Low adopters) = Less than (AM – SD)
2. Group II (Medium adopters) = (AM-SD) to (AM+SD)
3. Group III (High adopters) = Greater than (AM+SD)

Where,

AM - Arithmetic mean of Technology Adoption Index
SD - Standard Deviation of Technology Adoption Index

2.3 Cost Concept

The standard cost concept was used in farm management studies for the estimation of production cost, returns and profit of farmers who adopted the recommended technologies of Coconut.

Cost A: Cost 'A' includes expenses incurred on all the purchased inputs, hired labour and imputed value of farm produced inputs. The items considered in Cost A –

i. Hired human labour
ii. Manures (owned & purchased)
iii. Fertilizers and bio-fertilizers
iv. Plant protection chemicals and growth regulators
v. Depreciation of implements and machinery
vi. Land revenue
vii. Interest on working capital, etc.

Cost B: Cost B includes Cost A + interest on fixed capital and rental value of owned land.

Cost C: Cost C includes Cost B + imputed value of family labour and supervision charges.

2.4 Financial Feasibility of Coconut Production

2.4.1 Discounted measures

Net Present Value (NPV): It is a discounted measure and NPV is the difference between the discounted benefit minus discounted costs for a project period.

$$\boldsymbol{NPV} = \sum_{t}^{n} \frac{B_t - C_t}{(1+r)^t}$$

Where,

B_t = Benefit in period 't'
C_t = Costs in period 't'
r = Discount rate
t = Life of orchard
For the viability of investment, NPV should be positive at the prevailing rate of interest.

Benefit-Cost ratio:

It indicates the relationship between the benefit of the project and the cost of the project.

It is computed as,

$$\mathbf{BCR} = \frac{\sum_{t=1}^{n} \boldsymbol{Bt}(1+r)^{-1}}{\sum_{t=1}^{n} \boldsymbol{Ct}(1+r)^{-1}}$$

Where,

Bt = Benefits or returns from the project
Ct = Costs involved in the project
r = Discount rate
n = life of the project

If BCR is greater than one, the investment is considered economically feasible.

Internal Rate of Return:

It is the discount rate at which the NPV of all cash flows is equal to zero.

IRR = (LDR) + (HDR-LDR) ×

$$\frac{\text{NPV at lower rate of return}}{(\text{NPV at lower rate of return} - \text{NPV at higher rate of return})}$$

Where,

LDR = Lower discount rate
HDR = Higher discount rate
When IRR is greater than the prevailing rate of interest then investment is feasible.

2.4.2 Undiscounted measure

Pay Back Period:

It is the number of years required to recover cost from return.
It is computed as,

$$P = \frac{\boldsymbol{I}}{\boldsymbol{E}}$$

Where,

P = Payback period in years,
I = Investment in rupees,
E = Annual net cash revenue in rupees.

The value of P should be minimum, then the investment in production is feasible.

3. RESULTS AND DISCUSSION

3.1 General Information of Sample Cultivators

The general information of the selected coconut growers regarding age, size of family, education and persons working on the farm is given in Table 1.

3.1.1 Age

Age has a significant impact on the extent to which suggested Coconut technologies are adopted. Table 1 shows that, on average, the farmers had an age of 50.90 years. This indicates that the farmers are of medium age and they can implement the new technologies. The marginal, small, and medium groups of the chosen farmers had an average age of 51.35, 49.69, and 51.65 years, respectively.

3.1.2 Education

Education also plays an important role in the adoption of Coconut technologies. It is revealed from Table 1 that, the average educational score at the overall level was 9.51. The academic score for marginal farmers was 9.06, while the scores for small and medium farmers were 9.67 and 9.79, respectively. The study found that the sample respondents' educational status was good.

3.1.3 Size of the family

The family size has a major effect on the availability of farm labour, which ultimately

affects the income generation ability of the farmer's family. It is indicated from Table 1 that; the average size of the family was 5.97 family members at the overall level. Out of these, 49.08 per cent were female family members and 50.92 per cent were male family members. Marginal farmers had an average family size of 5.50, while small and medium farmers had average family sizes of 5.58 and 6.80, respectively. The study's findings given that the average size of farm families in the study area was medium.

3.1.4 Persons working on the farm

It was observed from the Table 1 that at overall level on an average 2.19 people were working on farms. Out of which, 45.21 per cent were female members and 54.79 per cent were male members. It was determined that the farm family makes up the human labour force (2.19 members) that is actively involved in farming. The number of people employed on farms by marginal farmers, small farmers, and medium farmers was 2.13, 1.95, and 2.48, respectively. Out of total members in a family at overall level 36.68 per cent family members were working on farm.

3.2 Cropping Pattern

The information about the cropping pattern of sample farms is presented in Table 2.

Table 2 shows that the overall gross cropped area is 1.27 ha, of which 0.27 ha (21.26%) were planted with perennial crops, 0.07 ha (5.51%) with *Kharif* crops and 0.93 ha (73.23%) with *Rabi* crops. Crops like rice (*Oryza sativa*) and nagli (*Eleusine coracana*) were grown during the *Kharif* season. On the contrary, horsegram (*Macrotyloma uniflorum*) and wal (*Lablab purpureus*) were grown during the *Rabi* season.

At the overall level, 0.21 ha (16.54%) and 0.05 ha (3.94%) of the planted area was for rice and nagli, respectively. At the overall level, the area covered by wal and horsegram was 0.03 ha (2.36 %) and 0.04 ha (3.15%), respectively. In terms of perennial crops, 37.01 percent (0.47 ha) of the gross cropped area was planted with coconut, 19.69 percent (0.25 ha) with mango (*Mangifera indica*), 9.45 percent (0.12 ha) with arecanut (*Areca catechu* L.) and only 7.09 percent (0.09 ha) with other perennial crops.

Table 1. General information of selected coconut cultivators

Sr. No.	Particulars	Marginal (N=48)	Small (N=48)	Medium (N=48)	Overall (N=144)
1	Average age (years)	51.35	49.69	51.65	50.90
2	Average educational score	9.06	9.67	9.79	9.51
3	Family size				
	a) Below 14 years				
	1)Male	0.96 (17.45)	1.08 (19.35)	1.40 (20.59)	1.15 (19.26)
	2)Female	0.96 (17.45)	1.10 (19.71)	1.19 (17.50)	1.08 (18.09)
	b) 14 years and above				
1) Male	1.83 (33.27)	1.73 (31.00)	2.06 (30.29)	1.89 (31.55)	1) Male
	2) Female	1.75 (31.82)	1.67 (29.93)	2.15 (31.62)	1.85 (30.99)
	Total	5.50 (100.00)	5.58 (100.00)	6.80 (100.00)	5.97 (100.00)
4	Persons working on the farm				
	1)Male	1.23 (57.75)	1.10 (56.41)	1.27 (51.21)	1.20 (54.79)
	2) Female	0.90 (42.25)	0.85 (43.59)	1.21 (48.79)	0.99 (45.21)
	Total	2.13 (100.00)	1.95 (100.00)	2.48 (100.00)	2.19 (100.00)

(Figures in parentheses are percentage to total)

Table 2. Cropping pattern of selected coconut cultivators (Figures in ha)

Sr. No	Particular	Marginal (N=48)	Small (N=48)	Medium (N=48)	Overall (144)
A	***Kharif* season**				
	a) Rice	0.12 (20.69)	0.18 (12.95)	0.34 (18.78)	0.21 (16.54)
	b) Nagli	0.02 (3.45)	0.05 (3.60)	0.08 (4.42)	0.05 (3.94)
	c) other	-	0.01 (1.66)	-	0.01 (0.59)
	Subtotal (A)	0.14 (24.14)	0.24 (17.27)	0.42 (23.20)	0.27 (21.26)
B	***Rabi* / Summer season**				
	a) Horse gram	0.02 (3.45)	0.04 (2.88)	0.09 (4.97)	0.04 (3.15)
	b) Wal	0.01 (1.72)	0.03 (2.16)	0.05 (2.76)	0.03 (2.36)
	Subtotal (B)	0.03 (5.17)	0.07 (5.04)	0.14 (7.73)	0.07 (5.51)
C	**Perennial crop**				
	a) Coconut	0.31 (53.45)	0.58 (41.73)	0.82 (45.30)	0.47 (37.01)
	b) Mango	-	0.24 (17.27)	0.28 (15.47)	0.25 (19.69)
	c) Arecanut	0.10 (17.24)	0.17 (12.23)	0.15 (8.29)	0.12 (9.45)
	d) other	-	0.09 (6.47)	-	0.09 (7.09)
	Subtotal (C)	0.41 (70.69)	1.08 (77.70)	1.25 (69.06)	0.93 (73.23)
D	**Gross Cropped Area** (A+B+C)	0.58 (100.00)	1.39 (100.00)	1.81 (100.00)	1.27 (100.00)
E	**Net cropped area**	0.54	1.27	1.63	1.15
F	**Cropping intensity (%)**	107.41	109.45	111.04	110.43

(Figures in parentheses are percentages of Gross cropped area)

Table 3. Distribution of sample farmers as per level of adoption

Sr. No.	Category of technology adoption	Technology adoption index	Range of technology adoption index (%)	No. of sample farmers	Percentage
1	Low	0 to 0.31	0 to 30.63	24	16.67
2	Medium	0.32 to 0.60	30.64 to 60.39	91	63.19
3	High	above 0.60	above 60.39	29	20.14
Overall technology adoption score for all technologies (%) = 45.51 (Standard Deviation = 14.88)					

The land owned by marginal, small and medium farmers was covered with perennial crops on 0.41 ha (70.69%), 1.08 ha (77.70%) and 1.25 ha (69.06%), respectively. Furthermore, it was discovered that the area under coconut for small, medium and marginal farmers was 0.82 ha (45.30%), 0.58 ha (41.73%) and 0.31 ha (53.45%), respectively. Perennial crops, which make up 73.23% of the area, are the most common cropping pattern in the study area. Out of them, about 37.01 percent were coconut, followed by 19.69 percent mango and 9.45 percent arecanut.

At the overall level, 1.15 ha was the average net cropped area. Overall, cropping intensity was

determined to be 110.43 per cent, for marginal farmers it was 107.41 per cent, for small farmers it was 109.45 per cent and for medium farmers it was 111.04 per cent.

3.3 Distribution of Sample Farmers as per Level of Adoption

The selected farmers for Coconut cultivation were classified into three groups as per the adoption level and represented in Table 3.

Based on the range of the technology adoption index, the sample farmers were divided into three groups: a) low adopters (0 to 30.63%), b) medium adopters (30.64 to 60.39%) and c) high adopters (above 60.39%). Out of total respondents, the proportion of adopters group in sample respondents was a) Low adopters (16.67%), b) medium adopters (63.19%), c) high adopters (20.14%). With an overall technology adoption index score of 45.51 percent in the study area, there is clearly space to increase adoption significantly. When it came to adoption levels, the majority of farmers (63.19%) belonged to the medium adoption group, with high adoption (20.14%) and low adoption (16.67%) following. The results are in conformity with Mhatugade S A. [20] while conducting a study on the Economic assessment of technology adoption in Cashew in Ratnagiri district of Maharashtra.

3.4 Per Hectare Cost of Cultivation of Coconut Plantation

The data about the per hectare cost associated with coconut cultivation for low, medium, high, and overall adopters' groups was calculated and is displayed in Table 4.

3.4.1 Per hectare cost of cultivation of low adopters

It is seen from Table 4 that with low adopters, the total cost of production (Cost-C) per hectare was Rs. 186020, of which 38.37 per cent (Rs. 71380) came from Cost-A and 82.18 per cent (Rs. 152872) from Cost-B.

Manures, fertilizer, chemicals for plant protection, irrigation, and other inputs accounted for just 6.49 per cent, 0.44 per cent, 1.50 per cent, and 1.51 per cent of the total cost, respectively. The depreciation on machinery and implements was Rs. 4139 (2.23%). There was Rs. 111 in land revenue and other ceases for low adopters. Interest on working capital came to a total of Rs. 4983 (2.68%). The interest on fixed capital amounted to Rs. 1247, while the rental value of the owned land came to Rs. 37988 (20.42%). The amortization cost came to a total of Rs. 42257 (22.72%). Family labour accounted for 13.98 per cent of the total cost. A portion of the total cost, or 3.84 per cent, went toward supervision fees.

3.4.2 Per hectare cost of cultivation of medium adopters

Table 4 illustrates that the total cost of production (Cost-C) per hectare for medium adopters was Rs. 181538, with Cost-A accounting for 33.83 per cent (Rs. 61419) and Cost-B accounting for 81.81 per cent (Rs. 148519).

The inputs such as Manures, fertilizer, plant protection chemicals and irrigation shared 5.74 per cent, 0.37 per cent, 0.62 per cent and 0.80 per cent of the total cost, respectively. The depreciation on machinery and implements was Rs. 2897 (1.60%). For medium adopters, land revenue and other ceases were worth Rs. 100. Interest on working capital was Rs. 3233 (1.78%). The amount of interest on fixed capital was Rs. 1115, and the rental value of the owned land came to Rs. 43728 (24.09%). At Rs. 42257, the amortization cost accounted for 23.28 per cent of the total cost. Family labour contributed to 14.80 per cent of the total cost. Supervision fees accounted for 3.38 per cent of the overall expenditure.

3.4.3 Per hectare cost of cultivation of high adopters

As Table 4 displays, the total cost of production (Cost-C) per hectare for high adopters was Rs. 171252, out of which Cost-A contributed 28.14 per cent (Rs. 48191) and Cost-B for 80.34 per cent (Rs. 137582).

A total of 5.30 per cent, 0.34 per cent, 0.32 per cent, and 0.60 per cent of the cost was attributed to inputs like manures, fertilizer, irrigation, and plant protection chemicals. The depreciation on machinery and implements was Rs. 2545 (1.49%). For high adopters, land revenue and other ceases were Rs. 109. The working capital interest rate emerged to be Rs. 2103 (1.23%). The interest paid on fixed capital was Rs. 1088, while the rental value of the owned land came to Rs. 46046 (26.89%). At Rs. 42257, the amortization cost accounted for 24.68 per cent of the total expenses. Family labour contributed 16.85 per cent of the total cost. Supervision fees comprised 2.81 per cent of the overall

expenditure. At Rs. 276929, the gross returns exceeded the total cost by 61.71 per cent. Thus, the net returns came to an amount of Rs. 105677.

The Table 4 showed that, overall, gross returns were Rs. 258950 and total cost (cost 'C') was Rs. 179602. Net returns therefore came to Rs. 79348.

The cost of labour was the highest of all the items, coming in at Rs. 66383 (36.96%), then the land's rental value at Rs. 42587 (23.71%), and manures at Rs. 10527 (5.86%). The expenditure on fertilizers, plant protection chemicals and irrigation were Rs. 671 (0.37%), Rs. 1487 (0.83%) and Rs. 1767 (0.98%), respectively. Cost "A" was Rs. 60329 and cost "B" was Rs. 146323 at the overall level.

Table 4. Per hectare cost of cultivation of Coconut plantation (Figures in Rs.)

Sr No	Items	Low adopters (N=27)	Medium adopters (N=92)	High adopters (N=25)	Overall adopters (N=144)
1	Hired labour				
	a) Male	37313 (20.06)	36295 (19.99)	29070 (16.98)	34225 (19.06)
	b) Female	6375 (3.43)	5228 (2.88)	3132 (1.83)	4911 (2.73)
	Total	**43688 (23.49)**	**41523 (22.87)**	**32202 (18.80)**	**39136 (21.79)**
2	Manures	12080 (6.49)	10420 (5.74)	9080 (5.30)	10527 (5.86)
3	Fertilizers				
	N	198 (0.11)	128 (0.07)	162 (0.09)	163 (0.09)
	P	131 (0.07)	116 (0.06)	68 (0.04)	105 (0.06)
	K	444 (0.24)	420 (0.23)	346 (0.20)	403 (0.22)
	Total	**773 (0.42)**	**664 (0.37)**	**576 (0.34)**	**671 (0.37)**
4	Plant protection	2794 (1.50)	1122 (0.62)	546 (0.32)	1487 (0.83)
5	Irrigation	2812 (1.51)	1460 (0.80)	1030 (0.60)	1767 (0.98)
6	Interest on working capital (6% for 12 months)	4983 (2.68)	3233 (1.78)	2103 (1.23)	3440 (1.92)
7	Land revenue	111 (0.06)	100 (0.05)	109 (0.06)	107 (0.06)
8	Depreciation on irrigation structure and implements	4139 (2.23)	2897 (1.60)	2545 (1.49)	3194 (1.78)
	Cost A	**71380 (38.37)**	**61419 (33.83)**	**48191 (28.14)**	**60329 (33.59)**
9	Rental value of land (1/6th of gross produce-land revenue)	37988 (20.42)	43728 (24.09)	46046 (26.89)	42587 (23.71)
10	Interest on fixed capital (10% on fixed capital)	1247 (0.67)	1115 (0.61)	1088 (0.64)	1150 (0.64)
11	Amortization cost	42257 (22.72)	42257 (23.28)	42257 (24.68)	42257 (23.53)
	Cost B	**152872 (82.18)**	**148519 (81.81)**	**137582 (80.34)**	**146323 (81.47)**
12	Family labour				
	a) Male	20625 (11.09)	21975 (12.10)	23048 (13.46)	21883 (12.18)
	b) Female	5385 (2.89)	4902 (2.70)	5803.5 (3.39)	5364 (2.99)
13	Supervision charges @ 10% of Cost A	7138 (3.84)	6142 (3.38)	4819 (2.81)	6033 (3.36)
	Cost C	**186020 (100.00)**	**181538 (100.00)**	**171252 (100.00)**	**179602 (100.00)**
	Gross Returns	**228591**	**262966**	**276929**	**258950**
	Net Returns	**42571**	**81428**	**105677**	**79348**

[Figures in the parentheses indicate percentage to total cost (cost C)]

Table 5. Per hectare yield and returns from coconut

Sr No	Item of returns	Low adopters (N=24)		Medium adopters (N=91)		High adopters (N=29)		Overall adopters (N=144)	
		Qty	value (Rs)	Qty	value (Rs)	Qty	value (Rs)	Qty	value (Rs)
A	Main product								
	1) Mature nuts (No.)	11051 (98.51)	218632 (95.64)	11835 (97.31)	249715 (94.96)	12566 (97.55)	265196 (95.76)	11876 (95.56)	246575 (95.22)
	2) Tender nuts (No.)	167 (1.49)	2531 (1.11)	327 (2.69)	6215 (2.36)	315 (2.45)	5636 (2.04)	297 (2.44)	5424 (2.09)
	Total Nuts (No.) (A)	**11218 (100.00)**	**221163 (96.75)**	**12162 (100.00)**	**255930 (97.32)**	**12881 (100.00)**	**270832 (97.80)**	**12173 (100.00)**	**251999 (97.31)**
	By product								
B	1) Coconut leaves *(Zaps)*(No)	563	1705.56 (0.75)	553	1729.28 (0.66)	482	1405.20 (0.51)	543	1668.57 (0.64)
	2) Broom (No.)	30	1263.16 (0.55)	37	1478.38 (0.56)	24	1550 (0.56)	33	1456.52 (0.56)
	3) husks (No.)	4524	4235.19 (1.85)	4086	3544.24 (1.35)	4751	3040.40 (1.10)	4267	3586.32 (1.38)
	4) trunks (No.)	582	223.85 (0.10)	549	283.6 (0.11)	635	101.60 (0.04)	560	240.00 (0.09)
	Total (B)		**7428 (3.25)**		**7036 (2.68)**		**6097 (2.20)**		**6951 (2.67)**
	Total (A+B)		**228591 (100.00)**		**262966 (100.00)**		**276929 (100.00)**		**258950 (100.00)**
6	**Nuts/ tree**	**60**		**86**		**100**		**82**	

(Figures in parentheses indicate percentage to total)

It was concluded that, as the technology adoption is improved the net returns also found to be increased. Similar results are also observed by Dusang P. [21] while studying the Economic feasibility of coconut cultivation in Sindhudurg District of Maharashtra.

3.5 Yield and Returns from Coconut Cultivation

For each adopter group of orchards, the gross return was calculated based on the production of coconut and its byproduct per hectare. The value of the mature and tender nuts as well as the value of the byproducts like husks, coconut leaves (*zaps*), brooms and trunks were included in the gross returns. Table 5 presents the results of the analysis findings.

It was observed from Table 5, the gross returns earned overall amounted to Rs 2,58,950, of which 2.09 per cent came from tender nuts and 95.22 per cent from mature nuts. It can also be observed that only main produce accounted for 97.31 per cent of returns. The remaining percentages of returns came from husks (1.38%), trunk (0.09%), broom (0.57%), and Coconut leaves (*zaps*) (0.64%). So, it showed that by-product only contributes about 2.67 per cent of returns. In terms of the overall gross returns, the highest returns such as Rs 2,76,929 were attained by high adopters, followed by medium adopters, Rs 2,62,966, and low adopters, Rs 2,28,591. This revealed that yield and returns increase with an increase in the degree of technology adoption.

The number of nuts per tree at the overall level was 82 nuts. Whereas, it was lowest such as 60 nuts in the case of low adopters followed by 86 nuts and 100 nuts per tree for medium and high adopters.

The yield of main produce also showed an increasing trend as the level of technology adoption increased from the low adopters to the high adopters. Among the various by-products, the contribution of husks was the highest in all three groups and 1.38 per cent at overall level.

Table 6. Per hectare economics of Coconut plantation on sample farmers

Sr. No.	Particulars	Low adopters (N=24)	Medium adopters (N=91)	High adopters (N=29)	Overall adopters (N=144)
1	Gross returns (Rs)	2,28,591	2,62,966	2,76,929	2,58,950
2	Costs (Rs)				
	Cost A	71,380	61,419	48,191	60,329
	Cost B	1,52,872	1,48,519	1,37,582	1,46,323
	Cost C	1,86,020	1,81,538	1,71,252	1,79,602
3	Profit at (Rs)				
	Cost A	1,57,211	2,01,547	2,28,738	1,98,621
	Cost B	75,719	1,14,447	1,39,347	1,12,627
	Cost C	42,571	81,428	1,05,677	79,348
4	Saving in Cost (Rs)				
	Cost A	-	9,961	23,189	-
	Cost B	-	4,353	15,290	-
	Cost C	-	4,482	14,768	-
5	Per nut total cost of production	13.83	11.54	10.98	12.09
6	Per nut sale price	20.80	22.63	23.23	22.41
7	Per nut profit	6.97	11.09	12.25	10.32

Table 7. Financial Feasibility of investment in Coconut plantation

Sr. No.	Particulars	Low adopters (N=27)	Medium adopters (N=92)	High adopters (N=25)	Overall adopters (N=144)
A	Discounted measures				
	Net Present Value (Rs.)	137931	240775	266233	230665
	Internal Rate of Returns (%)	19.61	23.40	24.58	23.01
	Cost Benefit Ratio	1.25	1.44	1.51	1.41
B	Undiscounted measure				
	Payback period (Years)	16	11	9	12

3.6 Profitability of Coconut Orchard

The profitability of coconut cultivation was calculated for various farmer adoption category groups, and the results are shown in Table 6. Based on the amount of coconut produced per hectare, it's by product, and the price paid to the growers, the gross returns were calculated.

It is observed from Table 6 that the per hectare profit of the coconut orchard at Cost C was, Rs 1,05,677, Rs 81,428, and Rs 42,571. This suggested that the profit was highest for high adopters and lowest for low adopters at various cost points. This resulted from lower yield levels for low adopters than for high adopters. Saving in cost for medium adopters was Rs 9,961 at Cost A, Rs 4,353 at Cost B and Rs 4,482 at Cost C. Savings was found to be increased for high adopters such as Rs 23,189 at Cost A, Rs 15,290 at Cost B and Rs 14,768 at Cost C. This shows that with the high level of adoption, the farmer has seen to be saving more on each cost. The production cost per nut for high adopters was Rs 10.98, while the costs for medium and low adopters were Rs 11.54 and Rs 13.83, respectively. The production cost per nut was reported to be Rs 12.09 overall. Farmers sell the coconut at Rs 20.80, Rs 22.63, Rs 23.23 and Rs 22.41 per nut for low, medium, high and overall adopters. Hence, the profit per nut was Rs 6.97, Rs 11.09, Rs 12.25 and Rs 10.32 for low, medium, high and overall adopters respectively. This shows that the high level of technology adoption leads to high rates of profits.

3.7 Financial Feasibility of Investment in Coconut Plantation

A substantial amount of capital is required for coconut orchard investments, and the income is distributed over a long period. After resources are invested in starting a coconut orchard, there is no way to get them back. Therefore, it is essential to assess the value of such a significant investment.

A series of cash outflows (costs) was also prepared, taking into account the annual cost of establishment for the orchard's first seven years and the maintenance costs after that point. Similar to this, a series of cash inflows was prepared, taking into account the returns received per hectare. The economic viability of investing in a coconut plantation was assessed using this series of flows and the economic parameters like i) Pay-back period, ii) Net Present Value, iii) Benefit-Cost ratio, and iv) Internal rate of return by the steps described in the methodology chapter. Table 7 displays the estimated values for these parameters.

It was observed from Table 7 that, for the low adopter category group, the Net Present Value was Rs. 1,37,931, and that it was trending upward as the adoption index increased. Overall, the Net Present Value was Rs. 2,30,665. Since the net present value of each adoption category group is positive, the investment in each was considered to be economically feasible. It does, however, suggest that investment in the low-adoption category is less viable in the study area compared to the medium and high-adoption category groups.

The internal rate of return (IRR) in low adopter group was 19.61 per cent which shows that investing in coconut production is feasible. likewise, IRRs in the medium and high adoption categories were 23.40 per cent and 24.58 per cent, respectively. This suggests that investing in coconut plantations is both financially feasible and that IRR rises following an increase in technology adoption.

In comparison to groups in the medium and high adoption categories, the low adoption category

had a lower economically feasible cost-benefit ratio of 1.25. For medium adopters, the cost-benefit ratio was 1.44, whereas for high adopters, it was roughly 1.51. Overall, it came out to 1.41, proving that the investment is economically feasible.

The payback period for medium and high adopters was 11 years and 9 years, respectively, while it was 16 years for low adopters. The payback period is projected to be 12 years at the overall level. Thus, the payback period decreases as technology adoption rises.

All financial viability parameters, including net present value, internal rate of return, benefit-cost ratio, and payback period, were found to be satisfactory. It shows that every adoption category is financially feasible. Similar results are also obtained by Longanathan et. al. [22] while studying the cost, returns and economic viability of Coconut plantations in Tamil Nadu.

4. CONCLUSION

Konkan being the paradise of Maharashtra has a variety of crops and coconut is the prominent crop in its cropping system. The study analyzed the economic well-being of coconut cultivation in the South Konkan region of Maharashtra focusing on sample coconut growers. The average age of the farmers was 50.90 years, indicating that younger generations should be involved in farming. The average educational score of the respondents was 9.51, indicating a relatively good educational status. About 38.68% of the family members were involved in farming, and farming was the main occupation for 93.75% of farmers. The per hectare cost of cultivation ranged from Rs 1,86,020 for low adopters to Rs 1,71,252 for high adopters, and Rs 1,81,538 for medium adopters. Gross returns from total nuts produced were Rs 2,51,999, accounting for 97.32 per cent of total per hectare returns from coconut orchards. Profit at Cost C can be observed to be Rs 79,348 at the overall level while profit is maximum for high adopters i.e. Rs 1,05,677 followed by medium and low adopters i.e. Rs 81,428 and Rs 42,571 respectively. The per nut total cost of production was Rs 12.09, and per nut sale price was Rs 22.41, giving a per nut profit of Rs 10.32. The net present value (NPV) was about Rs. 230665, and the internal rate of returns (IRR) was 23.01%. The Benefit-Cost ratio was 1.41, indicating that the investment in coconut orchards is feasible. The payback period was projected to be 12 years.

It can be concluded from the present study that although the economics of coconut production was found to be profitable; focus should be given on adoption of recommended technologies of the university to enhance the yield, quality of nuts and area under coconut.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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