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PROFITABILITY ANALYSIS OF ARECANUT-BASED INTERCROPPING SYSTEMS: A CASE STUDY IN SHIVAMOGGA DISTRICT IN KARNATAKA

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ABSTRACT

Arecanut, commonly known as betel nut, is one of the most important commercial plantation crops in India, with Karnataka being the leading producer. Within the state, Shivamogga district holds prominence due to its favorable climate, extensive cultivation, and the prevalence of intercrop systems such as banana, pepper, cocoa, and turmeric. As arecanut is a perennial crop with wide spacing, it provides considerable scope for intercropping, which enhances resource use efficiency and secures additional income for farmers. In this present research experiment was conducted in the Shivamogga District in Karnataka using four different cropping models. Model I consisted of areca nut as a monocrop. Model II included areca nut intercropped with banana, vegetables, and pulses. Model III comprised areca nut intercropped with ginger, maize, pulses, and brinjal. Model IV involved areca nut intercropped with tomato, pulses, and a tomato–chilli–pulses combination. These cropping systems were established during 2014–15 on an experimental site with ten-year-old areca nut palms. The cost and income analysis of arecanut-based cropping systems clearly shows how intercropping improves overall profitability compared to sole arecanut cultivation. In Model-I (sole arecanut), the total cost of cultivation is ₹10,91,000 with an income of ₹11,25,000, giving only marginal returns. However, when intercrops are introduced, the economic performance improves significantly. Model-II (arecanut + banana + vegetables + pulses) requires an additional cost of ₹1,90,000, raising the total cost to ₹12,81,000, but generates an intercrop income of ₹5,00,000, increasing overall income to ₹16,25,000, where intercrops contribute about 39.03% of net profit. Similarly, Model-III (arecanut + ginger + maize + pulses + brinjal) shows the highest profitability, with an additional cost of ₹2,95,000 and overall cost of ₹13,86,000, yielding ₹8,00,000 from intercrops. This boosts the total income to ₹19,25,000, with intercrops contributing a significant 57.72% share in net profit, proving it to be the most economically viable model. Model-IV (arecanut + tomato + chilli + pulses) also performs well, with an additional cost of ₹2,50,000 and total cost of ₹13,41,000, generating ₹6,00,000 from intercrops and achieving an overall income of ₹17,25,000, with intercrops contributing 44.74% of net profit. Thus, the study indicates that intercropping not only increases total farm income but also reduces the economic risk associated with sole arecanut cultivation, with Model-III standing out as the most profitable and sustainable option.

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INTRODUCTION

Arecanut commonly known as betel nut, is one of the most important commercial plantation crops in India, playing a vital role in the social, cultural, and economic life of millions of people. India is the largest producer and consumer of arecanut in the world, with Karnataka contributing the highest share to national production. Within Karnataka, Shivamogga district occupies a prominent place due to its favorable agro-climatic conditions, extensive arecanut cultivation, and the prevalence of diverse intercrop systems such as banana, pepper, cocoa, and turmeric. Arecanut, being a long-duration and perennial crop with wide spacing, offers considerable scope for intercropping, which not only enhances resource use efficiency but also provides additional sources of income to farmers.

Intercropping in arecanut plantations is increasingly promoted as a strategy to improve land productivity, diversify farm income, reduce economic risks, and ensure year-round cash flow. It also helps in maintaining soil fertility, utilizing family labor efficiently, and providing food, fodder, or marketable produce alongside arecanut. Despite these advantages, the profitability of arecanut-based intercropping systems varies significantly depending on the choice of intercrop, management practices, and market conditions. While some intercrops are known to provide quick returns, others contribute to long-term sustainability. However, systematic economic evaluations comparing different intercrop systems in arecanut plantations are limited, especially in specific regions like Shivamogga.

Given the growing importance of income diversification and risk management in plantation agriculture, it becomes essential to analyze the profitability of arecanut-based intercropping systems. A case study in Shivamogga district will not only generate location-specific evidence but also help identify the most economically viable crop combinations for farmers. Such an analysis is expected to provide useful insights for policy makers, extension agencies, and farmers, thereby contributing to the promotion of sustainable and profitable arecanut cultivation.

REVIEW OF LITERATURE

K. P. Vishwajith and others (2015) "Exploring the feasibility of arecanut based farming systems in augmenting farm economy- a case study in Karnataka, India" This study analysis of primary data from 48 arecanut growers indicates that arecanut-based cropping systems can be grouped into sole arecanut, arecanut–banana, arecanut–coco, and arecanut–spices. Among these, the arecanut–spices system showed the highest monetary advantage, with arecanut–pepper being the most profitable combination. Discriminant analysis highlighted key factors such as area, labour cost, and fertilizer cost as major contributors differentiating farmers among these groups, with a probability of correct classification as high as 0.85. The study also found that including poultry enterprise increased the benefit-cost ratio from 2.20 (sole arecanut) to 2.72. Overall, the findings suggest that an integrated system like arecanut–pepper–poultry is a promising option to enhance farm income and economic sustainability for arecanut growers.

G. Chandrashekhar and others (2018) "Economics of Different Horticultural Crops under Arecanut Based Multistoreyed Cropping System in West Bengal Condition" This study explained that Multi-storey cropping in arecanut plantations involves growing two or more crops in the interspaces during the main crop season, including both intercropping and mixed cropping. Such systems have been shown to enhance the growth and yield of arecanut, as indicated by increased frond numbers and higher yield per palm compared to sole cropping. In trials across seven models, maximum mean arecanut yield was recorded in var. Mohitnagar

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(1.590 kg/plant), while minimum was in var. Mangala (1.348 kg/plant). Economically, Model-III (Arecanut + Banana + Turmeric) was the most profitable, yielding ₹36,919.95 per hectare with a B:C ratio of 3.68:1, whereas Model-I and Model-VI recorded the lowest income and B:C ratio, respectively. The study indicates that multi-storey cropping not only improves arecanut yield and income but also enhances land-use efficiency, making Model-III a suitable and remunerative system for adoption by farmers in the region.

Nagappa Desai and others (2023) "Effect of Intercropping System of Vegetables on Yield and Economics of Arecanut Plantation" This study was carried out during 2015–16 and 2016–17 in Tiptur taluk of Tumkur district, Karnataka, to evaluate the role of vegetable intercropping in arecanut plantations. Three systems were compared: T1 – arecanut monocropping (farmers' practice), T2 – arecanut + cowpea, and T3 – arecanut + french bean. The trials were conducted in 26-year-old Gubbi local variety arecanut plantations at seven farmers' fields. Results revealed that intercropping improved arecanut yield compared to monocropping. The maximum chali yield was recorded in arecanut + french bean (12.53 q/ha/year), followed closely by arecanut + cowpea (12.25 q/ha/year), while monocropping gave the lowest yield. Economically, the french bean intercrop system performed best, recording the highest net annual income (₹2,56,832/ha) and benefit-cost ratio (2.85). The cowpea intercrop also showed good returns (₹2,29,083/ha; B:C 2.72), whereas monocropping was least profitable (₹1,45,290/ha; B:C 2.29). Soil fertility analysis showed that both cowpea and french bean intercrops improved nitrogen, phosphorus, and potassium availability due to incorporation of legume biomass. Soil pH remained neutral to slightly alkaline with improved organic matter status. Overall, the study highlights that vegetable intercropping, especially with french bean, enhances arecanut yield, increases farm income, and sustains soil fertility. Such systems provide a profitable and ecologically sound alternative to monocropping for farmers in Karnataka.

RESEARCH GAP

The literature survey revealed some of the study was related to issues like Role of Arecanut Cultivation in Enhancing Farmer's Income. Some studies are also related to economics of Arecanut Cultivation there are only few studies focused on Arecanut-Based Intercropping Systems, Production and marketing of Arecanut. Thus, the review of literature clearly shows that there is dearth of studies relating to Profitability Analysis of Arecanut-Based Intercropping Systems. There is limited evidence on the cost of cultivation, profitability, and returns in Arecanut-Based Intercropping Systems. Therefore, there exists a clear research gap in conducting a systematic profitability analysis of arecanut-based intercropping systems, comparing different intercrop combinations and integrating both economic indicators and farmers' socio-economic conditions. This study develops evidence-based recommendations on Arecanut-Based Intercropping Systems that can enhance farm income, ensure resource sustainability, and guide policy support for arecanut farmers.

OBJECTIVES OF THE STUDY

1. To study the role of intercropping systems in Arecanut cultivation.
2. To evaluate how intercrop systems affect agronomic performance, and farm-level economics of arecanut cultivation.

HYPOTHESIS OF THE STUDY

- There is a Statistical difference in Cost of Cultivation and Income in Arecanut-Based Intercropping Systems in Study area.

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METHODOLOGY

The study follows a descriptive-cum-analytical research design using a case study approach in Shivamogga district, Karnataka, a major arecanut-growing region with diverse intercrops. A multi-stage sampling method will be adopted, selecting major taluks, villages, and finally 60 arecanut farmers practicing intercropping. Primary data will be collected through structured interviews using a pre-tested questionnaire on socio-economic profile, cropping pattern, costs, returns, and perceptions, while secondary data will be sourced from government reports, research institutions, and cooperatives. Cost and return analysis will be used to estimate gross returns, net returns, and benefit-cost ratios for different systems, comparing intercropping with sole arecanut. The ANOVA will be employed to test Statistical difference in Cost of Cultivation and Income in Arecanut-Based Intercropping Systems and identify profitability determinants. The study is expected to highlight the most viable intercrop combinations and provide evidence-based insights for enhancing income and sustainability of arecanut farmers in Shivamogga.

ROLE OF INTERCROPPING SYSTEMS IN ARECANUT CULTIVATION

Arecanut is a perennial plantation crop grown widely in Karnataka, Kerala, and parts of other southern states. Since arecanut palms are spaced widely and take several years to reach full bearing, the interspaces between palms remain underutilized if left vacant. Intercropping serves as an effective strategy to optimize land use, enhance resource efficiency, and improve the overall sustainability of arecanut plantations.

1. **Efficient Land Utilization**: Arecanut plantations have wide spacing, and the interspaces can be effectively used by growing intercrops. Prevents land from remaining idle, especially during the early non-bearing years of arecanut.
2. **Income diversification**: By growing compatible intercrops such as banana, black pepper, cocoa, turmeric, ginger, or vegetables alongside arecanut, farmers are able to generate additional income while waiting for the palms to attain peak yield. This reduces financial dependence on a single crop and helps in stabilizing farm income against market fluctuations or crop failures.
3. **Resource use efficiency**: Different intercrops utilize sunlight, soil nutrients, and moisture at various levels, thereby improving productivity per unit area. For example, legumes add nitrogen to the soil, enhancing fertility, while shade-tolerant crops like cocoa or turmeric thrive under the arecanut canopy.
4. **Soil Fertility and Health Improvement**: Addition of organic matter from intercrops improves soil structure and microbial activity.In addition, minimizes weed growth, and helps in reducing soil erosion, especially in high-rainfall areas.
5. **Risk management and resilience**: Arecanut is vulnerable to pests, diseases, and climate-related stresses such as drought or heavy rainfall. Intercrops act as an insurance mechanism, providing alternative sources of food and income during adverse conditions. Provides a safety net against market fluctuations, pest attacks, and climatic uncertainties. Ensures income even if arecanut yield is affected by diseases like Yellow Leaf Disease. Furthermore, crops like black pepper and banana complement arecanut economically and biologically, creating a more resilient farming system.
6. **Labor Utilization and Employment**: Intercropping ensures continuous agricultural operations throughout the year. Provides better use of family labor and reduces idle time. the cultivation and harvesting of different crops are spread across seasons, thereby

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providing continuous employment and reducing idle labor time. In addition, diversified cropping patterns improve dietary diversity and household food security for farming families.

7. **Food and Nutritional Security:** Farmers can grow food crops like vegetables, fruits, and spices along with arecanut. It improves household consumption and dietary diversity.
8. **Economic Viability:** Increases gross returns, net returns, and benefit-cost ratio compared to sole arecanut. Makes arecanut farming more profitable and sustainable.
9. **Biodiversity and Ecological Balance:** Mixed cropping systems enhance biodiversity within plantations. It supports beneficial insects, natural predators, and improves overall ecosystem services.
10. **Sustainability of Farming System:** Creates a multi-storied cropping system that is more productive and resilient. It supports long-term ecological and economic sustainability of arecanut cultivation.

Overall, intercropping in arecanut cultivation enhances economic viability, ecological sustainability, and livelihood security. It transforms monocropping plantations into integrated farming systems that are more productive, profitable, and resilient. Hence, promoting suitable intercrop combinations tailored to local conditions can significantly improve the long-term sustainability of arecanut farming.

SURVEY BASED ANALISIS ANA DATA INTERPRETATION

A survey of thirty villages of Shivamoga district of Karnataka state has been conducted 60 of Arecanut Cultivators have been interviewed through questionnaire. In this sample 15 respondents are practice areca nut as a monocrop. 15 of respondents included areca nut intercropped with banana, vegetables, and pulses. 15 of respondents comprised areca nut intercropped with ginger, maize, pulses, and brinjal and finally 15 of respondents involved areca nut intercropped with tomato, pulses, and a tomato–chilli–pulses combination. The research findings are as follows,

Table 1: Distribution of Gender, Age and qualification of respondents and factor influenced involved in Arecanut Cultivation

Characteristics		Respondents	Percentage	Rank
Distribution of Gender	Male	50	83.33	01
	Female	10	16.67	02
Distribution of Age	25 to 30	08	13.33	04
	30 to 35	12	20.00	03
	35 to 40	15	25.00	02
	40 and above	25	41.67	01
Qualification	Illiterate	01	1.67	4
	Primary and Higher Primary	12	20.00	3
	PUC and above	22	36.67	2
	Degree and above	25	41.67	1
Occupation	Agriculture	33	55.00	01
	Agriculture and Service Business	15	25.00	02
	Agriculture and Service	12	20.00	03
Land Holding	Below 2.5 Acre	08	13.33	04

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	2.5 to 5 acres	27	45.00	01
	5 to 7.5 acres	15	25.00	02
	7.5 to 10 acres	10	16.67	03
Years of Experience in Arecanut Cultivation	Up to 10 years	10	16.67	03
	10 to 15 years	18	30.00	02
	15 to 20 years	32	53.33	01
Distribution of House hold Income	Less than 2.5 lakhs	01	1.67	05
	2.5 to 5 lakhs	10	16.67	04
	5 to 7.5 lakhs	15	25.00	03
	7.5 to 10 lakhs	18	30.00	01
	10 and above	16	26.67	02
Share of Income from Arecanut Cultivation	Less than 2.5 lakhs	12	20.00	04
	2.5 to 5 lakhs	14	23.33	03
	5 to 7.5 lakhs	16	26.67	02
	7.5 to 10 lakhs and above	18	30.00	01

Source: Field Survey

The socio-economic profile of respondents involved in arecanut cultivation provides valuable insights into the demographic composition, resource base, and economic dependency of farm households. Gender-wise distribution reveals that men dominate the sector, with 83.33% of respondents being male, compared to only 16.67% female. This reflects the traditional pattern of male dominance in plantation crop decision-making, though women's involvement in labor activities is often significant but less formally recognized.

The age distribution indicates that arecanut farming is primarily practiced by mature and experienced individuals. A majority (41.67%) of respondents were above 40 years, followed by 25% in the 35–40 age group, and 20% in the 30–35 group. Only 13.33% fell in the 25–30 age category, suggesting limited participation of youth in plantation farming. This points to generational continuity but also raises concerns about declining youth interest in agriculture.

Educational qualifications of the farmers reveal encouraging trends, with 41.67% possessing a degree or higher qualification, and 36.67% having completed PUC or higher secondary. Around 20% had only primary or higher primary education, while illiteracy was negligible (1.67%). This indicates that arecanut cultivation is managed largely by educated farmers, which may facilitate adoption of improved technologies, scientific practices, and better financial management.

Occupation-wise, agriculture remained the backbone of livelihood, with 55% of respondents depending solely on farming. Another 25% combined agriculture with service business, while 20% engaged in agriculture alongside service jobs, reflecting diversification of income sources to manage risk and enhance household stability.

Landholding patterns show that medium farmers dominate arecanut cultivation. Nearly 45% of respondents owned 2.5–5 acres, followed by 25% with 5–7.5 acres and 16.67% with 7.5–10 acres. Only 13.33% were marginal farmers with less than 2.5 acres. This distribution suggests that arecanut cultivation is more viable and commonly adopted by medium to large holders, as it requires higher investment and long-term commitment.

Experience in farming highlights a strong base of skilled cultivators. More than half (53.33%) of respondents had 15–20 years of experience, followed by 30% with 10–15 years. Only 16.67% were relatively new, with less than 10 years of experience. This reflects the inherited

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nature of arecanut cultivation, where knowledge and practices are often passed through generations.

Household income distribution reveals a relatively prosperous group, with 30% earning ₹7.5–10 lakhs annually, and 26.67% earning above ₹10 lakhs. Only a small fraction (1.67%) earned less than ₹2.5 lakhs. When income share specifically from arecanut was analyzed, 30% of respondents reported earnings above ₹7.5 lakhs, and 26.67% between ₹5–7.5 lakhs, confirming that arecanut remains the principal contributor to household income.

Overall, the analysis indicates that arecanut cultivation in Shivamogga is dominated by educated, middle-aged to older male farmers with medium-sized holdings and long-term experience. The crop is the backbone of household income, though some farmers diversify through services and businesses. While profitability is high, declining youth participation suggests the need for strategies to attract younger generations into plantation farming.

Table.1 Details of various Model of Arecanut-Based Intercropping Systems in 1 acre in study area.

	Main Crop	**Intercrops in First 3 years**		
Models		**1st Year**	**2nd Year**	**3rd Year**
Model - I	Arecanut			
Model - II	Arecanut	Banana	Banana	Vegetables + Pulses
Model - III	Arecanut	Ginger	Maize+ Pulses	Brinjal + Pulses
Model - IV	Arecanut	Turmeric	Tomato + Pulses	Chilli + Pulses

Areca nut is a perennial crop that requires approximately six years from planting to the first harvest capable of generating income. This long gestation period increases the initial cost of cultivation, as farmers must wait several years without any returns. Intercropping offers a practical alternative to mitigate this financial burden. By introducing intercrops during the early stages of areca nut cultivation, typically within the first one to three years, farmers can generate additional income and make better use of available land. This study focuses on analyzing four different types of areca nut-based intercropping systems to evaluate their economic viability and potential benefits for farmers. The experiment was conducted in the study area using four different cropping models (Table 1). Model I consisted of areca nut as a monocrop. Model II included areca nut intercropped with banana, vegetables, and pulses. Model III comprised areca nut intercropped with ginger, maize, pulses, and brinjal. Model IV involved areca nut intercropped with tomato, pulses, and a tomato–chilli–pulses combination. These cropping systems were established during 2014–15 on an experimental site with ten-year-old areca nut palms.

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Table.2 Details of Average Cost of Cultivation and Net Profit and Income under different Arecanut-Based Intercropping Systems for initial 3 Years of Arecanut Cultivation in 1 acre in study area.

Models	Cost of Cultivation of Arecanut up to 3 Years	Cost of Cultivation for Intercrops (Per acre)										Impact of Arecanut-Based Intercropping Systems		
		Land Preparation	Seed material& Plantation	Argo chemicals & Fertilizers	Labour Cost	Harvesting and post-harvest operations	Other Cost	Gross Expenditure	Gross Return	Net Return/ Profit	B:C Ratio	Overall Cost of Cultivation For 3 Years old Arecanut	Percentage of Overall Cost of Cultivation Share Covered by Intercrops	Income Frome Arecanut-Based Intercropping Systems
Model - I	527000	-	-	-	-	-	-	-	-	-	-	527000	Nil	Nil
Model - II	527000	20000	70000	50000	25000	20000	5000	190000	500000	310000	1:2.63	717000	69.73%	500000
Model - III	527000	25000	120000	70000	50000	20000	10000	295000	800000	505000	1:2.71	822000	97.32	800000
Model - IV	527000	20000	100000	70000	30000	20000	10000	250000	600000	350000	1:2.4	777000	77.22%	600000

Source: Field Survey

Table 2 shows that cost–return analysis of arecanut-based intercropping systems clearly highlights the advantages of integrating compatible crops during the initial non-bearing phase of arecanut. In the monocrop system (Model I), farmers incur a high establishment cost of ₹5,27,000 up to three years without any interim income, making it financially unviable in the short run. On the other hand, intercropping models (II, III, and IV) substantially reduce the economic burden by generating early returns. Model II, with banana, vegetables, and pulses, involves an additional investment of ₹1,90,000 but yields a gross return of ₹5,00,000, resulting in a net profit of ₹3,10,000 and covering nearly 70% of the arecanut establishment cost. Model III, with ginger, maize, pulses, and brinjal, emerges as the most profitable option, where an investment of ₹2,95,000 generates the highest gross return of ₹8,00,000 and a net profit of ₹5,05,000. It also records the best B:C ratio (1:2.71) and covers almost the entire arecanut cultivation cost (97.32%), thereby making the crop establishment phase virtually cost-free. Model IV, integrating tomato, chilli, and pulses, also provides considerable benefits, with a gross return of ₹6,00,000 and a net profit of ₹3,50,000, covering over 77% of the establishment cost, though slightly less efficient than Models II and III. These findings reveal that intercropping not only enhances farm income during the initial years but also improves resource-use efficiency, spreads financial risk, and ensures quicker recovery of establishment costs. Among the tested systems, Model III is the most economically sustainable, followed by Model II and Model IV, whereas sole arecanut cultivation proves least viable due to its delayed returns.

HYPOTHESIS TESTING

Hypothesis of the study

- There is a Statistical difference in Cost of Cultivation and Income in Arecanut-Based Intercropping Systems in Study area.

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Table.3 Details of Average Cost of Cultivation and Net Profit and Income under different Arecanut-Based Intercropping Systems for 10 Years of Arecanut Cultivation in 1 acre in study area.

	Cost of Cultivation for Arecanut	Cost of Cultivation for Intercrop	Total Cost of Cultivation	Income from Intercrop	Income from Arecanut Cultivation	Overall Income (including Intercrop)	Percentage of share from Intercrop in Net Profit
Model - I	1091000	-	1091000	Nil	1125000	1125000	Nil
Model - II	1091000	190000	1281000	500000	1125000	1625000	39.03%
Model - III	1091000	295000	1386000	800000	1125000	1925000	57.72%
Model - IV	1091000	250000	1341000	600000	1125000	1725000	44.74%

Source: Field Survey

The cost and income analysis of arecanut-based cropping systems clearly shows how intercropping improves overall profitability compared to sole arecanut cultivation. In Model-I (sole arecanut), the total cost of cultivation is ₹10,91,000 with an income of ₹11,25,000, giving only marginal returns. However, when intercrops are introduced, the economic performance improves significantly. Model-II (arecanut + banana + vegetables + pulses) requires an additional cost of ₹1,90,000, raising the total cost to ₹12,81,000, but generates an intercrop income of ₹5,00,000, increasing overall income to ₹16,25,000, where intercrops contribute about 39.03% of net profit. Similarly, Model-III (arecanut + ginger + maize + pulses + brinjal) shows the highest profitability, with an additional cost of ₹2,95,000 and overall cost of ₹13,86,000, yielding ₹8,00,000 from intercrops. This boosts the total income to ₹19,25,000, with intercrops contributing a significant 57.72% share in net profit, proving it to be the most economically viable model. Model-IV (arecanut + tomato + chilli + pulses) also performs well, with an additional cost of ₹2,50,000 and total cost of ₹13,41,000, generating ₹6,00,000 from intercrops and achieving an overall income of ₹17,25,000, with intercrops contributing 44.74% of net profit. Thus, the study indicates that intercropping not only increases total farm income but also reduces the economic risk associated with sole arecanut cultivation, with Model-III standing out as the most profitable and sustainable option.

Data Table

Group	Model - I	Model - II	Model - III	Model - IV	Total
N	$n1=15$	$n2=15$	$n3=15$	$n4=15$	$n=60$
$\sum xi$	M1=$\sum x1$=16365000	M2=$\sum x2$=19215000	M3=$\sum x3$=20790000	M4=$\sum x4$=20115000	$\sum x$=76485000
$\sum x2i$	$\sum x21$=18321225000000	$\sum x22$=24912125000000	$\sum x23$=29068950000000	$\sum x24$=27191525000000	$\sum x2$=99493825000000
Mean $\bar{x}i$	$\bar{x}1$=1091000	$\bar{x}2$=1281000	$\bar{x}3$=1386000	$\bar{x}4$=1341000	Overall $\bar{x}$=1274750
Std Dev Si	$S1$=182641.3347	$S2$=145825.2379	$S3$=134698.0751	$S4$=124587.8921	

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ANOVA table

Source of Variation	Sum of Squares SS	df	Mean Squares MS	F	*p*-value
Between samples	*SSB*=758531250000	*k*-1=3	7585312500003=252843750000	11.4553	0
Within samples	*SSW*=1236040000000	*n*-*k*=56	123604000000056=22072142857.1429		
Total	*SST*=1994571250000	*n*-1=59			

- *H*0: There is no Statistical difference in Cost of Cultivation in Arecanut-Based Intercropping Systems in Study area.

*H*1: There is a Statistical difference in Cost of Cultivation in Arecanut-Based Intercropping Systems in Study area.

F(3,56) at 0.05 level of significance, =2.7694

As calculated *F*=11.4553>2.7694

So, *H*0 is rejected, Hence There is a Statistical difference in Cost of Cultivation in Arecanut-Based Intercropping Systems in Study area.

Data table

Group	Model - I	Model - II	Model - III	Model - IV	Total
N	*n*1=15	*n*2=15	*n*3=15	*n*4=15	*n*=60
∑*xi*	*M*1=∑*x*1=16875000	*M*2=∑*x*2=24375000	*M*3=∑*x*3=28875000	*M*4=∑*x*4=25875000	∑*x*=96000000
∑*x*2*i*	∑*x*21=19395925000000	∑*x*22=39890625000000	∑*x*23=55647725000000	∑*x*24=44788525000000	∑*x*2=159722800000000
Mean $\bar{x}i$	$\bar{x}$1=1125000	$\bar{x}$2=1625000	$\bar{x}$3=1925000	$\bar{x}$4=1725000	Overall $\bar{x}$=1600000
Std Dev *Si*	*S*1=171453.8672	*S*2=141736.6774	*S*3=67268.1202	*S*4=104931.9507	

ANOVA table

Source of Variation	Sum of Squares SS	df	Mean Squares MS	F	*p*-value
Between samples	*SSB*=5212500000000	*k*-1=3	52125000000003=1737500000000	106.8878	0
Within samples	*SSW*=910300000000	*n*-*k*=56	91030000000056=16255357142.8571		
Total	*SST*=6122800000000	*n*-1=59			

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- *H*0: There is no Statistical difference in Income in Arecanut-Based Intercropping Systems in Study area.

*H*1: There is Statistical difference in Income in Arecanut-Based Intercropping Systems in Study area.

F (3,56) at 0.05 level of significanc = 2.7694

As calculated *F*=106.8878>2.7694

So, *H*0 is rejected, hence There is Statistical difference in Income in Arecanut-Based Intercropping Systems in Study area.

CONCLUSION

Arecanut, commonly known as betel nut, is one of the most important commercial plantation crops in India, with Karnataka being the leading producer. Within the state, Shivamogga district holds prominence due to its favorable climate, extensive cultivation, and the prevalence of intercrop systems such as banana, pepper, cocoa, and turmeric. As arecanut is a perennial crop with wide spacing, it provides considerable scope for intercropping, which enhances resource use efficiency and secures additional income for farmers. A field experiment was conducted in Shivamogga during 2014–15 on ten-year-old arecanut plantations using four cropping models. Model I was sole arecanut, Model II included arecanut with banana, vegetables, and pulses, Model III involved arecanut with ginger, maize, pulses, and brinjal, while Model IV comprised arecanut with tomato, chilli, and pulses. Economic analysis revealed that sole arecanut (Model I) incurred a cost of ₹10,91,000 and generated only ₹11,25,000, offering marginal returns. By contrast, intercropping improved profitability. Model II required an additional cost of ₹1,90,000, raising the total to ₹12,81,000, but generated ₹5,00,000 from intercrops, increasing overall income to ₹16,25,000, with intercrops contributing 39.03% of net profit. Model III was the most profitable, with a cost of ₹13,86,000 and intercrop returns of ₹8,00,000, giving the highest income of ₹19,25,000, where intercrops contributed 57.72% of profit. Model IV also performed well, with a cost of ₹13,41,000, intercrop income of ₹6,00,000, and total earnings of ₹17,25,000, contributing 44.74% from intercrops. Overall, intercropping significantly enhances farm profitability and reduces risks compared to sole arecanut. Among the systems, Model III proved the most sustainable and economically viable.

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