An Economic Analysis of Impact of Land Use on Productivity of Arecanut in Karnataka: With Special Reference to Shivamogga District

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ABSTRACT:

Arecanut cultivation plays a pivotal role in the agrarian economy of Shivamogga district, Karnataka, contributing over 70 percent of the district's agricultural income and providing substantial rural employment. The district's favourable agro-climatic conditions, fertile soils, and efficient land-use practices have positioned it as a major hub of arecanut production in India. This study aims to analyze the impact of land use patterns on the productivity of arecanut in Shivamogga district. The findings highlight that efficient land management and optimal fertilizer application are critical to improving arecanut productivity in Shivamogga. The study underscores the importance of adopting sustainable land use practices and scientific resource management to ensure long-term growth and economic stability in the arecanut sector.

KEYWORDS:

Arecanut cultivation, Land Use, Productivity.

Introduction

Arecanut (Areca catechu L.) is one of the most important commercial plantation crops of India, providing livelihood and employment to millions of small and marginal farmers. Karnataka stands as the leading producer of arecanut, contributing more than half of the national output, with major growing regions concentrated in the districts of Uttara Kannada, Shivamogga, Chikkamagaluru, Davanagere, and Dakshina Kannada. The crop holds a significant place in the rural economy of the state, serving as a major source of cash income and supporting various allied industries such as processing and trade.

Arecanut production is the backbone of Shivamogga's economy, contributing over 70% of the district's income and providing significant employment. The district's large cultivation area, favorable agro-climatic conditions, and efficient land management practices have positioned it as a leading arecanut-producing region in Karnataka. With continued focus on sustainability, technological adoption, and land optimization, Shivamogga's arecanut sector holds strong potential for future growth. Land use patterns play a crucial role in determining the productivity and sustainability of arecanut cultivation. The way land resources are managed-through crop combinations, irrigation practices, soil management, and conservation techniques-directly influences yield levels and long-term farm profitability.

Land use patterns play a crucial role in determining the productivity and sustainability of arecanut cultivation. The way land resources are managed-through crop combinations, irrigation practices, soil management, and conservation techniques-directly influences yield levels and long-term farm profitability. In recent years, changing land use due to population pressure, urban expansion, and diversification into intercrops has altered the traditional arecanut farming landscape in Karnataka. Consequently, understanding how different land use types and management practices affect productivity has become vital for ensuring sustainable agricultural growth.

An economic analysis of the impact of land use on arecanut productivity helps to identify the most efficient and profitable land management strategies. Such an evaluation not only aids in optimizing resource use but also provides policy insights for improving farm income, maintaining soil fertility, and supporting sustainable land management. This study, therefore, aims to analyze the relationship between land use practices and the productivity of arecanut in Karnataka, using empirical data and statistical methods to assess the economic significance of land use decisions on farmers' output and income.

Research Gap

Although several studies have examined the trends in area, production, and productivity of arecanut, limited research has focused on the economic impact of different land-use systems on arecanut productivity. Most existing studies emphasize general agronomic factors, soil charac-

teristics, or climatic conditions, while overlooking the comparative economic efficiency and sustainability of various land–use practices such as monocropping, intercropping, and agroforestry. Furthermore, there is a lack of region–specific analysis, particularly for major arecanut–growing regions like Shivamogga district in Karnataka, where diverse land–use systems coexist. The available literature also provides insufficient insights into how land–use management influences input use efficiency, cost of cultivation, and returns per hectare. Hence, there is a clear need for a comprehensive economic analysis that integrates land–use patterns with productivity outcomes to identify the most sustainable and profitable land–use practices for arecanut cultivation. Present study make attempt to explore factors affecting areca–nut productivity in Karnataka. And also explain Impact of land use different land use patterns practiced (land size, soil quality, irrigation, drainage, and slope) on Productivity of Arecanut and productivity in study area.

Objectives of the Study

1. To study factors affecting Productivity of Arecanut in Karnataka
2. To analyse the Impact of land use different land use patterns practiced (land use type, land size, irrigation, drainage, and fertilizer dose) on Productivity of Arecanut and productivity in study area.

Methodology

This study employs a descriptive and analytical research design to Analysis of Impact of Land Use on Productivity of Arecanut. it is purely based on primary and secondary data. Primary data were collected using a structured questionnaire and personal interviews from 60 Arecanut cultivators. Respondents were selected using purposive sampling, ensuring representation from different land use types (sole cropping, intercropping, agroforestry) and farm sizes. The study is conducted in Shivamogga district, Karnataka. Secondary data regarding arecanut cultivation and sectoral trends were obtained from Government of India reports, National Sample Surveys, and Department of Horticulture publications. Data were analyzed using descriptive statistics to summarize trends and patterns, and multiple regression analysis to identify the relative influence of different land use patterns practice on arecanut productivity. Regression coefficients were used to determine the magnitude and significance of each factor.

Variables and Measurement

Sl. No	Variable	Type	Measurement
1.	Y: Arecanut Yield	Dependent	Fresh (Raw) Arecanut (Hasi Adike) kg per Acre
2.	X1: Land Use Type	Independent	Categorical (0=Sole, 1=Agroforestry, 2=Intercrop)
3.	X2: Land Size	Independent	In Acre
4.	X3: Irrigation	Independent	Binary (0 = rainfed, 1 = irrigated)
5.	X4: Drainage	Independent	Ordinal (1 = poor, 2 = moderate, 3 = good)
6.	X5: Fertilizer Dose	Independent	kg per hectare

Arecanut Cultivation in Shivamogga

Arecanut cultivation in Shivamogga is a cornerstone of the district's agrarian economy. High productivity, extensive cultivation area, mixed cropping practices, and strong market infrastructure collectively make Shivamogga a leading arecanut production center in India. With continued government support and improved farming techniques, the region holds significant potential for sustainable growth in the sector. Arecanut production is the backbone of Shivamogga's economy, contributing over 70% of the district's income and providing significant employment. It drives the local economy through cultivation, processing, and associated businesses, supporting banking, transport, and educational institutions, but its dominance also makes the economy vulnerable to price fluctuations and production issues. Arecanut processing creates jobs, particularly for women and minors, while cooperative societies like MAMCOS facilitate marketing, loans, and support for entrepreneurs.

Table 1: Fresh Arecanut Production in Shivamogga District from 2015 to 2022–23

Year	Area (Hectare)	Production (Tonnes)	Yield (Tonne/Hectare)
2015 –16	52,550.00	5,05,418.00	9.62
2016 – 17	55,256.00	6,29,637.00	11.39
2017 – 18	58,855.00	6,45,592.00	10.97
2018 – 19	92,241.00	8,46,523.00	9.18
2019 – 20	93,584.00	9,21,386.00	9.85
2020 – 21	1,00,486.00	11,84,730.00	11.79
2021 – 22	1,11,758.00	11,88,549.00	10.64
2022 – 23	1,18,836.00	7,60,549.00	6.4

Source: https://data.desagri.gov.in/website/crops–apy–report–web

The data reveals a steady expansion in arecanut cultivation area in

Shivamogga district from 52,550 hectares in 2015–16 to 1,18,836 hectares in 2022–23, indicating farmers' growing preference for arecanut as a major plantation crop. Production also increased overall, peaking at 11,88,549 tonnes in 2021–22, before a sharp decline to 7,60,549 tonnes in 2022–23. The yield trend (tonne/hectare) fluctuated over the period, with the highest yield (11.79 t/ha) recorded in 2020–21, showing favorable climatic and management conditions. However, the yield dropped drastically to 6.40 t/ha in 2022–23, possibly due to climatic stress, pest infestation, or disease outbreak (e.g., yellow leaf disease) affecting productivity.

Overall, the area under arecanut cultivation in Shivamogga has more than doubled in eight years, highlighting its growing economic importance. Production trends show substantial progress with intermittent fluctuations in yield. Despite increased area, productivity declined in 2022–23, indicating the need for improved disease and climate resilience. Continuous monitoring and adoption of scientific practices are essential for sustainable production growth.

Factors Affecting Areca–Nut Productivity in Karnataka

Many factors affect areca nut productivity, ranging from climatic conditions to farming practices and market influences. Areca nut palms are sensitive to environmental changes, and farmers' decisions on managing the crop can significantly impact yield and quality.

Climate: rainfall pattern, temperature, humidity, sunshine: Arecanut is highly sensitive to rainfall distribution, temperature and relative humidity. Well–distributed rainfall and warm, humid conditions (Malnad/ Western Ghats) favour growth, but excess rains during sensitive stages (flowering/nut development) and heatwaves both reduce yield or cause quality loss. Recent climate–suitability studies and district analyses for Karnataka show climate variables can explain a very large share of yield variability.

Size of Land use: Land use significantly influences arecanut productivity in Karnataka. Agroforestry and intercropping systems yield higher than sole cropping. Land size positively affects output, as larger plots allow better resource use and management. Factors like irrigation, soil fertility, and drainage further enhance yield. Sustainable land management and diversification strategies are essential to improve productivity, farm income, and long–term arecanut cultivation viability.

Water management: irrigation method, drainage, timing: Irrigation frequency and method matter: drip fertigation and adequate irrigation during dry spells increase yield and water–use efficiency; conversely, poor drainage and waterlogging (excess monsoon) lead to fruit–rot outbreaks and yield loss. Several studies from India demonstrate large positive effects of irrigation frequency and drip systems.

Soil fertility & **nutrient management:** Soil N, P, K and organic matter strongly influence productivity. Proper fertilizer rates, placement, and timing (and balanced nutrition) are repeatedly identified in ICAR/CPCRI extension manuals as key for high yields. Soil amendments (lime/gypsum) when needed and periodic soil–testing improve outcomes.

Pests & **diseases (especially fruit–rot / "Kole" / fungal diseases):** Fruit–rot and other fungal diseases cause severe losses when rainfall is excessive and humidity stays high; recent news from Karnataka (Dakshina Kannada, Udupi, Chikkamagaluru) report large–scale crop damage from rot after heavy monsoons, underlining disease risk as a major productivity driver. Effective disease surveillance, timely fungicide sprays, and drainage are critical.

Orchard age, planting material and variety: Yield varies with age of orchard (young vs mature vs senescent) and the cultivar/variety planted. Seedling quality, recommended spacing, and use of improved varieties (from CPCRI/Regional stations) influence long–term productivity. Older orchards may show yield decline unless rejuvenated.

Agronomic practices & **intercropping:** Spacing, shade management (shade trees), mulching, weeding, and intercropping systems (e.g., black pepper, banana) affect plant health and net returns. Good agricultural practices published by research institutions list these as yield determinants.

Socio–economic factors: labour, price incentives, input access: Labour availability and cost, market prices, availability of quality inputs (fertilizers, improved seedlings), and credit/support influence farmers' ability to adopt yield–enhancing practices; economic incentives drive area expansion in Karnataka (documented trends).

SURVEY BASED ANALISIS ANA DATA INTERPRETATION

The study was conducted in Shivamogga district of Karnataka, one of the major arecanut–producing regions in the state. The district was

purposively selected due to its favorable climatic conditions, extensive area under arecanut cultivation, and diversity in land–use patterns such as Size of land use, monocropping, intercropping, and agroforestry systems.

Table 2: Distribution of Factor Influenced to 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	05	8.33	04
	30 to 35	08	13.33	03
	35 to 40	17	28.33	02
	40 and above	30	50.00	01
Qualification	Illiterate	02	3.33	04
	Primary and Higher Primary	14	23.33	03
	PUC and above	24	40.00	01
	Degree and above	20	33.33	02
Occupation	Agriculture	40	66.67	01
	Agriculture and Service Business	15	25.00	02
	Agriculture and Service	05	8.33	03
Land Holding	0.5 Acre	10	16.67	03
	1 Acre	16	26.67	02
	2 Acres	27	45.00	01
	2.5 Acres	01	1.67	05
	3 Acres	06	10.00	04
Years of experience in Arecanut cultivation	Up to 10 years	15	25.00	03
	10 to 15 years	25	41.67	01
	15 to 20 years	20	33.33	02
Distribution of Household Income	Less than 2.5 lakhs	04	6.67	04
	2.5 to 5 lakhs	24	40.00	01
	5 to 7.5 lakhs	22	36.67	02
	7.5 to 10 lakhs	08	13.33	03
	10 and above	02	3.33	05
Share of Income from Arecanut cultivation	Less than 2.5 lakhs	14	23.33	02
	2.5 to 5 lakhs	26	43.33	01
	5 to 7.5 lakhs	12	20.00	03
	7.5 to 10 lakhs and above	08	13.33	04

Source: field survey

Distribution of Gender: The data reveal that arecanut cultivation is male–dominated, with 83.33% of respondents being male and only 16.67% female. This indicates that men play a major role in arecanut pro–duction, while women's participation is relatively low.

Distribution of Age: Age–wise distribution shows that 50% of farmers belong to the 40 years and above category, followed by 28.33% in the 35–40 years group, 13.33% in 30–35 years, and 8.33% in 25–30 years. This suggests that arecanut farming is largely practiced by middle–aged and senior farmers with considerable experience.

Qualification: Educational status indicates that 40% of the respondents have completed PUC and above, 33.33% possess a degree or higher, 23.33% have primary and higher primary education, and only 3.33% are illiterate. This shows that arecanut farmers are generally well-educated, which may contribute to better adoption of improved cultivation practices.

Occupation: Occupational distribution reveals that 66.67% of respondents depend solely on agriculture, while 25% are engaged in agriculture and business, and 8.33% combine agriculture and service. This demonstrates that agriculture, particularly arecanut farming, is the primary livelihood source for most respondents.

Land Holding: Landholding size shows that 45% of farmers possess 2 acres, followed by 26.67% with 1 acre, 16.67% with 0.5 acre, 10% with 3 acres, and 1.67% with 2.5 acres. This indicates that medium-sized farms dominate arecanut cultivation in the study area.

Years of Experience in Arecanut Cultivation: Experience levels indicate that 41.67% of farmers have 10–15 years of experience, 33.33% have 15–20 years, and 25% have up to 10 years. This highlights that most cultivators are well-experienced, contributing to higher efficiency and knowledge in arecanut farming.

Distribution of Household Income: Income distribution shows that 40% of households earn between ₹2.5–5 lakhs, 36.67% earn ₹5–7.5 lakhs, 13.33% earn ₹7.5–10 lakhs, 6.67% earn less than ₹2.5 lakhs, and 3.33% earn ₹10 lakhs and above. This suggests that most farmers fall within the middle-income group.

Share of Income from Arecanut Cultivation: Regarding income share from arecanut, 43.33% of respondents earn ₹2.5–5 lakhs, 23.33% earn less than ₹2.5 lakhs, 20% earn ₹5–7.5 lakhs, and 13.33% earn ₹7.5–10 lakhs and above. This confirms that arecanut cultivation is a major contributor to household income.

The analysis reveals that arecanut cultivation is primarily managed by middle-aged, educated male farmers with moderate landholdings of about two acres. Most respondents rely mainly on agriculture for their livelihood and possess significant farming experience. Income analysis shows that arecanut contributes substantially to household earnings. Overall, socio-economic factors strongly influence farmers' involvement in arecanut cultivation.

Hypothesis Testing

Hypothesis of the Study

- There is a significant difference in arecanut productivity across different land use patterns practice (sole cropping, intercropping, and agroforestry) in study area.

Regression Model Summary

- Dependent Variable: Transformation Level
- R-squared: $R^2 = 0.875$, meaning 87.5% of yield variation is explained by these variables – very strong explanatory power.
- Adjusted R-squared: 0.864, Adjusted for number of predictors; still high, confirms model reliability.
- F-statistic: 75.81, Overall model is highly significant.
- Prob (F-statistic): 3.61×10^{-23}, $p < 0.001$ (overall model is statistically significant)

Coefficients and Significance

Variable	Coefficient	Significance	Interpretation
Intercept	-1884.52	Not significant	When all other variables are zero, the model predicts a negative yield (not practically meaningful, just a baseline).
Land Use Type	-525.88	Not significant	Different land use types slightly reduce yield, but the effect is not statistically significant.
Land Size	5820.77	(p < 0.001)	Each additional acre of land increases yield by ~5821 kg/acre. This is highly significant.
Irrigation	282.54	Not significant	Irrigation slightly increases yield (~283 kg/acre), but the effect is not statistically significant.
Drainage	592.62	Not significant	Better drainage improves yield by ~593 kg/acre, but the effect is not significant.
Fertilizer Dose_ kg per_ Acre	10.54	(p = 0.001)	Each kg of fertilizer increases yield by ~10.5 kg/ acre. This is significant.

Source: Primary data

Multiple Linear Regression Model

$$Y = b0 + b1X1 + b2X2 + b3X3 + ... + bpXp + \varepsilon$$

Yield kg per Acre = −1884.52 − 525.88 (**Land Use Type**) + 5820.77 (**Land Size**) + 282.54 (**Irrigation**) + 592.62 (**Drainage**) + 10.54 (**fertilizer Dose kg per Acre**) + ε

The multiple linear regression analysis of arecanut yield (n = 60) reveals that Land Size and Fertilizer Dose_kg_per_Acre are the most

significant factors. Land Size has a coefficient of 5820.77 ($p < 0.001$), indicating that each additional acre increases yield by ~5821 kg/acre. Fertilizer Dose shows a positive effect of 10.54 ($p = 0.001$) per kg of fertilizer. Other factors, including Land Use Type (−525.88), Irrigation (282.54), and Drainage (592.62), are not statistically significant. The model explains 87.5% of yield variation ($R^2 = 0.875$) and is highly significant overall ($F = 75.81$, $p < 0.001$), highlighting key areas to enhance productivity.

Conclusion

Arecanut cultivation plays a pivotal role in the agrarian economy of Shivamogga district, Karnataka, contributing over 70 percent of the district's agricultural income and providing substantial rural employment. The district's favorable agro-climatic conditions, fertile soils, and efficient land use practices have positioned it as a major hub of arecanut production in India. This study evidence that the area under arecanut cultivation in Shivamogga has more than doubled in eight years, highlighting its growing economic importance. Production trends show substantial progress with intermittent fluctuations in yield. Results of primary data revealed that land size and fertilizer dosage are the most significant factors influencing productivity. Land size showed a strong positive relationship with yield (coefficient = 5820.77, $p < 0.001$), while fertilizer dose also had a positive impact (coefficient = 10.54, $p = 0.001$). Other variables such as land use type, irrigation, and drainage, though positively related, were not statistically significant. The regression model explained 87.5% of the variation in yield ($R^2 = 0.875$) and was significant at 1% level ($F = 75.81$, $p < 0.001$). The findings suggest that land size expansion and optimal fertilizer management are the primary drivers of higher arecanut yield in Shivamogga. While irrigation and drainage remain important, their effects are secondary compared to the structural and input-related factors. The study emphasizes the need for balanced fertilizer use, efficient land utilization, and sustainable cropping systems to enhance the productivity and profitability of arecanut cultivation in the region.

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