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MIXED CROPPING SYSTEM ALONG WITH COCONUT

Prof. Vasanth Kumar
Department of Humanities and Social Science, Yenepoya Institute of Arts, Commerce & Science (YIASCM), Yenepoya (Deemed to be University), Mangalore
ORCID: 0009-0005-7363-448X

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ABSTRACT----------
Intercropping structure in coconut cultivation enables environmental resolution regarding enhancement in ecological sustainability and farm performance, specifically for small scale farmers. The paper explored how Intercropping structure enhances farm performance, carbon capture, enduring agricultural output and soil productivity. This study examines the capable harvests like black pepper, banana, legumes and pineapple along with coconut palm in order to utilize the terrain, intercropping enables the agriculturists to expand revenue streams and improve soil quality. It Examines the disputes of administering intercropping structure and requirement for high agriculturists knowledge and primary funding. The researches' objective is to discover how mixed cropping structure enhances resource effectiveness, aids towards eco friendly environment through biodiversity and carbon capture, this also focuses on reduction of dependence on artificial addictive. The study will highlight the enduring financial and environmental advantages of implementing intercropping in coconut cultivation, placing it as an important technique for eco-friendly farming.

KEY WORDS: *Mixed cropping, Coconut Cultivation, Intercropping, Sustainable Agriculture, Soil health, Carbon Capture, Smallholder Farmer, Biodiversity.----------*

1. INTRODUCTION

India is an agriculturist country, culturally structured by crop rotation, where two or more harvests are farmed on the same terrain. For small scale farmers who always focus on optimising limited land resources for higher income and efficiency can rely on this method. To expand agricultural output in the context of coconut farming a prominent position is acted by crop rotation which in return improves sustainability and increases economic benefits. In India, coconut is the prominent farm crop in warm climate region, which is grown by marginal and small farmers. Nonviable profits may arise in single crop coconut farming because of underuse of farm resources, limited output, and variable market rates. Research underscored that overhead cover space utilization is around 30% and coconut single crop cultivation system utilize is only 22% of terrain [9]. To enhance soil health and overall outputs the remaining parcel of land is utilized through mixed cropping [12], [5]. Additionally, to make enhanced coconut outputs intercropping with various harvests like banana, black pepper cocoa can improve retainment of moisture and productivity of soil [12]

For better output, intercropping structure provides countless advantages comprising of nutrient elements and water, higher application of sunlight. Incorporating suitable crops which includes black pepper, pineapple, bean plants together with coconut provides important efficiency in enhancing productivity of soil, boosting agricultural revenue which aids in long-lasting farming [6]. Improved carbon capture, decreased soil loss and biodiversity preservation are some of the ecological advantages of intercropping system. The expansion of shade resilient crops can be facilitated by coconut tree tops which enables adequate sunlight to flow through [2].

Small scale farmers can utilize coconut-based intercropping as it refines the usage of environmental assets, enhancing soil productivity, and expansion of income. The current research aims to examine the potential advantage of intercropping structure in coconut plantation, highlighting on their influence on crop productivity, carbon capture, soil quality and economic benefits. The objectives include

- To evaluate the influence of intercropping structure on coconut harvest and overall plantation output.
- To examine the impact of intercropping on soil quality along with nutrient cycling.
- To examine ecological advantages of intercropping framework on carbon capture and biodiversity improvement.

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2. LITERATURE REVIEW

For the current study various literatures are taken inclusive of diverse aspects of mixed cropping structure. Intercropping structure, specifically coconut-based systems, are widely implemented in equatorial agriculture to improve performance, asset use effectiveness and agricultural income. Research have exhibited that mixed cropping structure coconut with harvests like black pepper, banana, and legumes enhances soil quality, water usage, and carbon capture [2], [11]. Financially, these structures outperform single farming, offering increases benefit-cost ratios and decreases internal expenses through ecofriendly nutrient management [4], [6]. In spite the advantages, disputes remain in execution, such as high primary cost and higher management complexes (Datta & Tapas, 2020).

3.METHODOLOGY

From existing studies and research papers this study is established on secondary facts. To identify the strengths, weaknesses, opportunities and threats (SWOT) of combined cropping systems in coconut plantations a thorough literature review was conducted. From peer-reviewed journals, case studies and preceding agricultural research the information was referenced. Aiming on farm productivity and creativity, profit generation, soil health and carbon sequestration, Environmental, economic and agronomic results of different crop mixture was assessed. By symphonizing perceptions from various studies, this study offers a broad understanding of the difficulties and advantages of combined cropping systems in coconut plantations.

4. TRADITIONAL AND MODERN MIXED CROPPING SYSTEMS

In India intercropping is been practiced in warm climate regions, small scale farmers use it as an approach to utilize terrain and assets. To enhance efficiency along with adaptability over market variations. Coconut will be the main harvest in the coconut based harvesting system, simultaneously co cultured crops like black pepper, banana, medicinal plants, legumes and pineapple are cultivated in remaining space [7].

Study has been highlighted the advantageous of intercropping, mixed cropping system enhances the use of sunlight, water and soil quality which guides towards the high economic benefit and harvest. Integration of various crops such as coconut, banana and black pepper has enhanced earning of 45600/ha in West Bengal [4]. Expansion of diversified crops in spaces in between can be utilised as the rooting structure of coconut palms is confined within 25% of land [10].

5. ENVIRONMENTAL BENEFITS OF MIXED CROPPING SYSTEMS

There are several advantages of coconut integrated cropping system which adds to ecological sustainability. Soil quality via organic matter accumulation process and nutrient flow can be improved. Requirement for synthetic fertilizers can be reduced by combining bean like harvests with coconut as it enhances nitrogen levels in soil. Secondly, carbon captures can be enhanced [11].

Additionally stratified system belonging to harvests in intercropping system decreases soil degradation through decreasing water flow and increasing water penetration. Area with low rainfall can get benefit from coconut-based intercropping as it aids in better preservation of water and it averts soil deterioration [3].

6. ECONOMIC IMPACTS OF MIXED CROPPING

Coconut rooted intercropping harvesting structures have exhibited hopeful financial consequences as an outcome. Harvest like black pepper, pineapple, coconut banana have been specified extremely rewarding when it comes to numerous harvesting models. Research have examined that economic return ratio of intercropping with these harvests is more in comparison with coconut single crop farming [4]

Advancement of financial sustainability through intercropping structure by improving crop harvests without well-known extra expenses and this is possible only with the help of various combinations of soil fertility practices such as organic matter reuse and the use of organic fertilizers [6].

7. AGRONOMIC PRACTICES AND RESOURCE USE EFFICIENCY

For the achievement of intercropping structure in coconut yield, productive agronomic practices are essential. The important key position in guaranteeing that assets like water, nourishment and sunshine are utilised effectively is through arrangement, crop choice and water management. For instance, research on coconut Gliricidia structure identified that banana and other shade-adapted crops could prosper when coconut palms were positioned 7.5 meters separate since they enhanced sufficient light to enter [11].

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8. SOIL HEALTH AND NUTRIENT CYCLING IN MIXED CROPPING SYSTEMS

In coconut based mixed cropping structure, soil quality acts as an significant position in productivity of intercropping system, effective fertility management is pivotal for long term sustainable output. Only coconut plantation in in one particular terrain will have low fertility advancement because of minor and restricted root structure of the palm. Consequently, combining diverse harvests with long system of roots will lead into soil quality and nutrient cycling.

The capability along with improved nutrient availability in soil, particularly when legumes and alternative nitrogen fixing plants are inclusive in it are considered as an advantage of intercropping structure. Study has identified that implementing leguminous harvests in coconut rooted structure will notably improve nitrogen concentration in soil, enhancing the accessibility nutrient for the principal harvests and decreases the requirement for fertilizer compounds. Moreover, the usage of organic materials for example green manure, biomass reusing and vermicompost progressively improves water holding capacity and soil composition [11].

Effective usage of obtainable supplies can be achieved through soil nutrient flow which is assisted by the diverse harvests cultivated in intercropping system. Studies has exhibited coconut based intercropping system with the integration of the crops like black pepper and banana improves potassium levels and phosphorus nutrient, commonly restricting nutrients in single crop structure [6].

Research has highlighted mixed cropping system reduces the soil deterioration in comparison with monoculture structure, intercropping system can retain or enhances the physical and chemical characterises of soil with time. In inclined surfaces intercropping structure decreses nutrient loss and soil erosion, as the various cultivation can decrease the influence of surface runoff and rainfall [3].

To sum up coconut based intercropping structure can improve soil quality along with nutrient flow encourages ecofriendly agriculture which reduces the requirements of extrinsic resources it also facilitates the farmers in preventing nutrient exhaustion and erosion of soil.

9. WATER USE EFFICIENCY AND IRRIGATION IN COCONUT BASED MIXED CROPPING SYSTEM

In mixed cropping structure various harvests like banana, pineapple and black pepper, adds high effective application of water if not considered as waste as it goes through deep sublimation. Mixed cropping structure allows various harvests to absorb the water and retain it as water is spread across the terrain which results in water use effectiveness of the whole structure [6].

In trickle irrigation water is employed into the root sectors of both intercrops and coconut which is founded to be specifically efficient in intercropping structure. Study highlighted funding into trickle irrigation structure has substantially enhanced economic benefits in intercropping structure, in this case the water usage is effective resulting in reduction in comprehensive expense of watering. Sophisticated water supply tools like trickle water supplies integrated with intercropping system guarantees every harvest is been moistened [1].

The usage of soil protection in coconut cultivation, specifically with ecofriendly resources like coconut fibre has exhibited that it decreases drying and enhance the water penetration in terrain. For additional improvement of sustainability and output the combination of coconut cultivation and water efficient harvesting is must. Arid resistant harvests like Gliricidia sepium not only enables in water preservation as it supplies to maintenance of soil hydration, avoiding water wastages in arid period [11]

10. ECONOMIC VIABILITY OF MIXED CROPPING SYSTEM

Small scale farmers can be in advantageous state as intercropping can supply diverse source of income in a one piece of terrain, which decreases the financial uncertainties relating to changing prices of mono harvests similar to coconut. Financial factors are the main aspects for implementing intercropping structure, specifically for small scale farmers who maintain coconut as fundamental stream of income. Research has underscored integration of coconut with premium harvests like banana, pineapple and black pepper can enhance the total earnings by as high as 40% in combination with coconut single crop farming [4].

Reduction of maintenance for chemical fertilizers can be enhanced through bean crops co cultivated with coconut, for instance Gliricidia sepium, which aids to nitrogen assimilation. Beside increase in income, mixed cropping decreases the internal expenses. Moreover, in comparison with cultural conventional farming, combined with soil fertility management solutions which includes ecofriendly recycling like organic matter from coconut composting that helps in retainment of fertility of soil at a less expense [11].

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Enduring agricultural sustainability is an element of profitability as well. Farmers have a safety net thanks to intercropping structure, as risk of harvest collapse is spread among various crops. As a result, single cropping structures are less exposed to market changes, insect outbreaks and climatic shocks which regularly has a disproportionately negative impact [8].

11. CARBON SEQUESTRATION AND ENVIRONMENTAL SUSTAINABILITY

Position of various harvesting systems in ecofriendly environment and carbon capture on coconut harvesting is another significant aspect. Where coconut palms by itself may efficiently pitfalls carbon, when they are connected with other harvests, its capability is greatly increased. Intercropping coconut with fruit palms like jamun and mango enhances carbon inventories over and under the ground. Coconut based intercropping structure have been exhibited up to 40% higher carbon than coconut single farming, jamun-coconut structure shows up to 140t/ha of carbon [2].

In enhancing whole ecological structure resilience, intercropping Donates to ecosystem conservation via biomes for diverse varieties. Moreover, environmental advantages in intercropping structure expands above carbon capture. Research has emphasised on layered harvesting structure, where coconut-based structure guarantees within in which minimisation of soil erosion takes place, soil quality is retained progressively maintenance of water is done efficiently [3].

To sum up mixed cropping structure provides small scale farmers financial sustainability and ecofriendly environment as it includes enhanced water supply tools, water b effective harvests and sustainable soil management as a result it enhances performance.

12. CHALLENGES AND LIMITATIONS

Although there are many advantages of intercropping but there are some challenges in its execution. The primary funding in mixed cropping system is elevated, farmers lack awareness regarding ideal crop pairing. Disease exposures and insects are more in crowded cultivation systems, moreover operational intricacy rises with higher number of crops [8].

13. SWOT ANALYSIS

Below given are the SWOT analysis structure in order to examine the strengths, weaknesses, opportunities and threats of intercropping structure along with coconut cultivation.

13.1 Strength

Study conducted by [4] had underscored that combining harvests like pineapple, black pepper and banana can prominently enhance the profitability, For instance in mixed cropping structure with the combination of black pepper, coconut and pineapple structure generated a profitability of rupees 45600/ha. Another strength of intercropping structure can enhance soil quality. Bean crops for example Gliricidia enhanced levels of nitrogen with the help of microbial fixation [11].

13.2 Weaknesses

Firstly, Mixed cropping structure can be complex for small scale farmers, this structure needs additional protective management than single farming, main concern lies in the water supply management, control of insects and soil quality management. Apart from this agriculturist may require instruction regarding efficient adoption of these structures. [8] The primary funding is another concern. Since mixed cropping structure needs proper water supplies so initial investment required for the intercropping structure is higher in comparison with single farming.

13.3 Opportunities

Intercropping structures enables significant aptitude in favour of carbon capture, causing them alleviation efforts for climate crisis. For example, in comparison with coconut single farming, intercropping structure with coconut and jamun produced 140 t/ha. [2] Secondly, Organic farming decreases dependence on artificial fertilizers and enhances biodiversity along with enduring soil quality via organic waste recovery [3].

13.4 Threats

Market variable prices is the prominent threat when it comes to intercropping of various harvests. Fluctuating cost of crops like pineapple and banana probably impact agricultural income, specifically area in which these harvests are influenced by market situations. [8] Increased hazard may arise in intercropping structure because of multiple plants and closeness of diversified species.

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14. CONCLUSION

The varied cropping systems in coconut habitation provide environmental, substantial economic and agronomic benefits this is illustrated from the discovery of this study. By combining crops such as black pepper, banana and pineapple with coconut, directing to increased income and creativity the above systems permit the smallholder farmers to improve the use of restricted land resources. In addition, by decreasing the need for chemical fertilizers, combined cropping enhances soil health by developing nutrient cycling and or natural matter content which leads to the long-term soil fertility [11].

Moreover, combined cropping systems environmental well- being is significant. Where coconut is multi cropped with fruit trees such as mango and jamun, leading to climate change reduction the carbon sequestration rates are excessive in such systems. The multi-dimensional covering structure decreases soil erosion and enhances water holding, which makes these systems stronger to environmental stressors such as drought and heavy rainfall [2]. Regardless of these advantages, combined cropping systems execution presents difficulties. Including disease and pest control, crop spacing and irrigation management farmers need training to control the excessive difficulty of these systems. For smallholder farmers, starting investments in natural inputs and irrigation systems may also be a hurdle. Nevertheless, combined cropping systems offer sustainable benefits once implemented and decrease the need for outer inputs, directing to make them reasonably feasible in the long term [8].

In conclusion, combined cropping systems are a favourable solution for enhancing the profitability and sustainability of coconut- based farming. They improve resource use order, facilitate biodiversity, and put up to climate change reduction through carbon sequestration. Optimizing crop mergers for varied agro- climatic zones and offering farmers with the knowledge and tools needed to execute these systems successfully is what the future study should focus on. Smallholder farmers can proceed to prosper in a dynamic agricultural landscape that is made certain in this research.

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