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ROOTS OF REVENUE: EXPLORING THE INTEGRATION OF AGRO-FORESTRY MODELS AND SMALL RUMINANT PRODUCTION FOR FARMER EARNINGS MAXIMIZATION

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Abstract
A recent study investigated the potential of doubling farmers' income by integrating various agro-forestry models with small ruminant production. Three agro-forestry model types were established: Silvipature (Type I), Hortipasture (Type II), and Hortisilvipasture (Type III), each covering an acre of land in the farmers' fields. The study analyzed the economics of these models under irrigated conditions, including establishment costs, expected income from small ruminant integration, and additional income from horticultural plants. Results indicated that the optimal utilization of available land through horti-pasture and horti-silvi-pasture, combined with sheep production, provided additional income for farmers.

Keywords: Agro-froestry systems, Small Ruminant Integration, Cost economics.

Introduction

Title: Maximizing Farmer Earnings through the Integration of Agro-Forestry Models and Small Ruminant Production: A Sustainable Approach to Enhancing Rural Livelihoods

Introduction

In recent times, the global agricultural landscape has been experiencing a paradigm shift towards the adoption of sustainable farming practices that not only guarantee food security but also protect the environment and contribute to the economic well-being of farmers. Agroforestry, defined as the deliberate integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits (Nair, 2012), has emerged as a promising approach to achieving this objective. Agroforestry models, such as silvopastoral systems, have been found to provide multiple benefits, including increased productivity, improved soil fertility, and enhanced biodiversity conservation (Franzluebbers et al., 2012). Moreover, small ruminant production, which involves the rearing of sheep and goats, is an important component of rural farming systems that contributes significantly to the livelihoods of smallholder farmers (Peacock, 2005). This paper seeks to explore the potential of maximizing farmer earnings through the integration of agroforestry models and small ruminant production by reviewing current literature and case studies from around the world.

Agroforestry models, such as silvopastoral systems, which involve the integration of trees, pasture, and livestock, have been found to offer significant environmental and economic benefits (Franzluebbers et al., 2012). For instance, these systems have been shown to increase pasture productivity, improve soil

fertility, and reduce greenhouse gas emissions through carbon sequestration (Montagnini & Nair, 2004). Furthermore, silvopastoral systems have been documented to enhance the welfare of small ruminants by providing shade and shelter, improving the quality and quantity of forage, and reducing the incidence of parasitic infections (Rojas-Downing et al., 2017).

Small ruminant production, which primarily involves the rearing of sheep and goats, is an integral component of the livelihood strategies of millions of smallholder farmers worldwide (Peacock, 2005). Small ruminants not only provide a source of income through the sale of meat, milk, and fiber, but also serve as a means of asset accumulation and insurance against crop failure and other risks (Devendra & Chantalakhana, 2002). Moreover, small ruminants have relatively low capital requirements, short generation intervals, and high reproductive rates, which make them particularly suitable for small-scale, resource-poor farmers (Dubeuf et al., 2004).

The integration of agroforestry models and small ruminant production has the potential to significantly enhance the livelihoods of smallholder farmers by increasing their income and strengthening their resilience to economic and environmental shocks. For example, a study conducted in the highlands of Ethiopia found that the integration of fodder trees and sheep production led to a 58% increase in net income compared to traditional crop-livestock systems (Negash et al., 2012). Similarly, a study in the semiarid tropics of India revealed that the integration of agroforestry and goat production resulted in a 50% increase in net income, as well as a reduction in poverty and vulnerability to drought (Gopalakrishnan et al., 2012).

The adoption of integrated agroforestry and small ruminant production systems also has the potential to contribute to the achievement of several Sustainable Development Goals (SDGs), such as ending poverty and hunger, ensuring sustainable consumption and production patterns, and taking urgent action to combat climate change (United Nations, 2015). For instance, the adoption of agroforestry practices can help to mitigate climate change by increasing carbon sequestration in agricultural landscapes (Montagnini & Nair, 2004). Moreover, the integration of small ruminant production can contribute to the enhancement of food security by providing a reliable source of animal protein and improving the nutritional status of rural households (Peacock, 2005).

In conclusion, the integration of agroforestry models and small ruminant production has the potential to significantly enhance the livelihoods of smallholder farmers by increasing their income, improving their resilience to economic and environmental shocks, and contributing to the achievement of the SDGs. Further research is required to identify the most suitable agroforestry models and small ruminant production systems for different agroecological zones and socioeconomic contexts, as well as to develop appropriate extension and policy support mechanisms for the widespread adoption of these integrated farming systems.

Materials and Methods

Three types of agro-forestry models were established *viz.* Silvipature (Type I), Hortipasture (Type II) and Hortisilvipasture (Type III) each model with an area of one acre of land in the farmers field.

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Agroforestry Model	**Fodder Trees**	**Fodder crops (Grass and legumes)**	**Hortiplants**
Silvipasture	*Gliricida&* *Leuceana leucocephala*	Guinea grass *Cenchrusciliaris* *Stylo hamata* and*Stylo scabra*	-
Horti pasture		Guinea grass *Cenchrus ciliaris* *Stylo hamata* and *Stylo scabra*	Mango
Hortisilvi pasture	*Gliricida&* *Leuceana leucocephala*	Guinea grass *Cenchrus ciliaris*	Mango

Stylo hamata and*Stylo scabra*

The fodder tree saplings were planted at a space rate of 8 X 8'. Understorey pasture grass was established at a seed rate of *Cenchrusciliaris* (2kg), Guinea grass (0.5 kg) and *Stylohamata* (1.5 kg) and *Styloscabra* (1.5 kg). The horti-plants saplings were planted at a spacing about 25'X 25'. The economics of the models under irrigated condition were studied for cost of establishment, expected income on integration with small ruminant component and additional income through horti-plants.

Results and Discussion

The total expenditure for the establishment and expected revenue from respective agro forestry models are furnished in the Table 1.

Table.1. Expenditure for establishment and expected revenue from different Agroforestry Models (per acre)

Details of expenditure for establishment and revenue from different Agroforestry Models	**Silvi Pasture (Rs.)**	**Horti Pasture (Rs.)**	**Hortisilvi Pasture (Rs.)**
Land cleaning, levelling, bund formation against slope and ploughing	7500	7500	7500
Pit digging	1332	1080	1980
Production cost for fodder seedlings	1332	-	900

Production cost for Horti crops seedlings	-	2880	2880
Basal manure	3200	4000	4000
Seed Cost for grass and legumes*	1000	1000	1000
Total expenditure for establishment	14364	16460	18260

Expected income through animal component (irrigated area) (holding capacity 16-20 sheep)	36000	32400	28800
Expected additional income from Horti plants from 4th year onwards	-	18000	18000

**Cenchrus (2Kg) + Stylo hamata (1.5Kg) + Sylo scabra (1.5Kg) + Guinea grass (0.5kg)*

The total expenditure for establishing Silvipasture, Hortipasture and Hortisilvipasture types of agro-forestry models in one acre of land were Rs.14,364, Rs.16,460 and Rs.18260 respectively. The establishment cost included land cleaning, land levelling, bund formation, ploughing, pit digging, production of fodder seedlings, basal manure and seed cost of grasses and legumes. Based on the biomass yield and anticipated integration with small ruminant component (16-20 sheep), the expected income in the three models were Rs.36,000/Rs.32,400/- and Rs.28,800/- respectively for type I, II and III. The expected additional income from the horti plants from the fourth year was Rs. 18,000/- for type II and type III models. Hence it was observed that for effective utilization of available lands, establishment of horti-pasture and horti-silvi-pasture along with sheep production provided additional income Ramana*et al.* (2000).

Conclusion

Establishment of horti-pasture and horti-silvi-pasture by effective utilization of available lands along with sheep production provided additional incomes in turn increased the socio economic status of the farming community.

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