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Adity Isha Prachi Tirkey
Silviculture and Forest Management Division, ICFRE – Institute of Forest Productivity, Ranchi, Jharkhand, India

Rikesh Kumar
Silviculture and Forest Management Division, ICFRE – Institute of Forest Productivity, Ranchi, Jharkhand, India

Alok Kumar Singh
Rajiv Gandhi South Campus, Banaras Hindu University, Mirzapur, Uttar Pradesh, India

Robin Kumar Ram
Faculty of Forestry, Birsa agricultural university Ranchi, Jharkhand, India

Nandan Kumar Mishra
Faculty of Forestry, Birsa agricultural university Ranchi, Jharkhand, India

Ravi Shankar Prasad
Silviculture and Forest Management Division, ICFRE – Institute of Forest Productivity, Ranchi, Jharkhand, India

Corresponding Author:
Alok Kumar Singh
Rajiv Gandhi South Campus, Banaras Hindu University, Mirzapur, Uttar Pradesh, India

Agroforestry for rural economic empowerment and food security: A review

Adity Isha Prachi Tirkey, Rikesh Kumar, Alok Kumar Singh, Robin Kumar Ram, Nandan Kumar Mishra and Ravi Shankar Prasad

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Abstract
Agroforestry systems promote multiple crops, enhancing food availability and nutritional diversity. They also improve soil fertility and support local economies, contributing to community welfare. Agroforestry trees can improve food security for farmers experiencing wildlife crop raiding, as 56% of participants reported that agroforestry can provide both income and food. Tree density positively correlated with food security, with a small fraction of farmers relying on tree income as a "safety net." Research on agroforestry practices should be disseminated to rural farmers, and government policies and research institutes should encourage farmers to adopt these strategies for food security and zero hunger. Agroforestry has been a significant contributor to rural economic upliftment, particularly in areas like Kenya, Sumatra-Indonesia, Northern Ethiopia, and homegarden agroforestry. These systems have shown positive impacts on rural farmers' livelihoods, with studies showing a 30% monthly income increase from selling agroforestry products. Challenges such as inadequate access to resources, environmental factors while inadequate markets and lack of market infrastructure limit farmers' ability to sell their produce. Issues such as wildlife destruction, pests, diseases, and crop failure also pose significant threats to agroforestry systems, leading to reduced productivity. Despite these challenges, agroforestry can provide socio-economic benefits such as tree products and income, bolstering the rural economy and promoting sustainable livelihoods.

Keywords: Agroforestry system, nutritional diversity, food security, rural economy, sustainable livelihood

Introduction

In the era of climate change and catastrophes, leading a question mark on food security and a havoc on the economic empowerment especially on the rural economy. The agroforestry system plays a vital role in assuming the leadership to address the problem of the eleventh-hour emergency. The agroforestry system not only provides the biodiversity and ecosystem services but also has some materialistic money benefit. The 2030 Agenda for Sustainable Development, adopted by all United Nations members in 2015, created 17 world Sustainable Development Goals (SDGs). Out of these 17 goals, no poverty (SDG 1), Zero hunger (SDG 2) and Decent work and economic growth (SDG 8) deals with the food security and economic empowerment. The adoption of different agroforestry system can lead a sustainable pathway to sustainable food security and rural gross domestic product (G.D.P).

The integration of various components of the agroforestry like trees, crops, livestock, fisheries and others, not only improve the agricultural productivity but also contribute to the environmental stability. This multifaceted land use pattern addresses food availability, access, and utilization, while also providing economic benefits through diversified income sources. The objective of this review is to evaluate the present services and benefits provided by the agroforestry system. Below are key aspects of agroforestry's impact on food security and livelihood management.

Role of agroforestry in achieving food security

Agroforestry plays a noteworthy role in boosting food security by combining agricultural practices with forestry, fisheries and livestock management. This multifaceted approach not only increases the diversity of food sources but also enhances soil health and resilience against climate change, thereby ensuring sustainable food production and attainment of united nation's S.D.G. With respect to diversification of food resources, agroforestry systems promote a variety of multiple crops, which enhances food availability as well as nutritional diversity promoting overall nutritional status of human race [1]. The system enhances food security by providing diverse and sustainable yields, improving soil fertility, and supporting local economies, thereby contributing to the overall welfare of communities [2]. The system fulfills food security by improving soil health, increasing agricultural productivity, and providing high-quality nutritious fodder for livestock, thereby addressing interconnected challenges of energy and food insecurity [3]. Human-wildlife conflicts are a threat to livelihoods throughout Africa, including Kenya. A major source of human-wildlife conflict is crop raiding, which can seriously impact livelihoods and household food security through crop destruction and income loss. This novel research study explores the role of agroforestry trees as one strategy that may improve food security for farmers experiencing wildlife crop raiding. This study draws on household surveys and interviews conducted in 2014-2015 from the communities of Burat and Kinna in Isiolo County, Kenya. From the results, 56% of research participants reported that agroforestry can provide both income and food in cases of wildlife crop raiding [1]. A survey of 399 farmers categorized them into low practitioners (LAP), medium practitioners (MAP), and high practitioners (HAP) based on tree number. The study found that HAP households had more access to food and resources, with higher food security probability for households with more resources. Smaller farms had more on-farm trees, while larger farms had fewer trees per household. Tree density positively correlated with food security, with a small fraction of farmers relying on tree income as a "safety net" [2]. Food production is crucial for social and economic justice for any country. Nigeria faces a persistent food crisis due to insufficient resources. Agroforestry, a system that combines tree growth with crop production, can combat food insecurity and reduce crop failure during adverse conditions. This approach improves soil fertility, health, and rural income [3]. Research on agroforestry practices should be disseminated to rural farmers, and government policies and research institutes should work to encourage farmers to adopt and apply these strategies for the achievement of food security and zero hunger.

Contribution of agroforestry to rural economic upliftment

During the medieval period of history of mankind, be it the case of feudalism or zamindari system or any different form of system, rural or village economy has been independent and sustainable. Due to industrial revolution in 15th century and then the ongoing globalization has resulted the rural economy fragile and dependent. This dependence has put the village population into stress due to various like climate change, government policies or the COVID-19. In this time of emergency agroforestry system can come to rescue. Agroforestry technologies in Vihiga County, Kenya, have been found to positively impact rural farmers' livelihoods. A study conducted in four major villages found that income and land size were the main socioeconomic factors influencing the adoption of these technologies. The study found that 85% of respondents reported a 30% monthly income increase from selling agroforestry products, such as firewood, timber, fruits, and charcoal. The findings suggest the need for strengthening extension service delivery, diversifying agroforestry production, and harmonizing market structure [2]. A study explores the impact of coffee agroforestry systems and sustainability certification on Sumatra-Indonesia farmers' livelihoods. Interviews with 408 coffee farm-households reveal positive economic and environmental benefits, suggesting future policy should provide better land-use alternatives for better livelihoods [3]. A study in Northern Ethiopia has revealed that indigenous agroforestry practices play a vital role in adapting to climate change and bolstering livelihood resilience. Farmers are actively altering their crop varieties, types of livestock, and tree species to enhance their adaptive capacity. Indigenous agroforestry ranks as the third most favoured option for climate change adaptation, after livestock and off-farm activities. Trees on farms are recognized as the third most important livelihood asset, improving crop productivity, household income, and overall capabilities for adapting to climate change as well as underscores the critical need to expand indigenous agroforestry practices to achieve long-term resilience [4].

The high species diversity, multi-strata structures and complexity of structure are found in home garden agroforestry. The presence diverse woody species of home gardens that act different to fulfil a diversity of social, economic, cultural need, while providing several ecosystem services/ environmental services and play a great role of biodiversity conservation. These could contribute to the sustainability of agricultural system. Home garden agroforestry practice is highly recommended and acceptable than mono-cropping consequently it provides a socio-economic benefits like tree products (Timber, firewood, construction materials and fruit for food) and income [5]. The sustainable independent livelihood can bolster the rural economy and spur the ongoing living standard of the population.

Challenges and consideration

Though agroforestry presents a promising approach to enhancing food security and livelihood management and economic uplift, yet it faces several challenges that hinders its effectiveness. These challenges include inadequate access to resources, market limitations, and environmental factors, which collectively impact the adoption and success of agroforestry practices on a global level. Smallholder farmers often struggle with poor or inadequate access to credit and extension services, which are crucial for implementing agroforestry systems effectively [6, 7]. Inadequate markets as well as lack of market infrastructure for agroforestry products limit farmers' ability to sell their produce, affecting their income and food security [8, 9]. Issues such as wildlife destruction, pests, diseases, and crop failure pose significant threats to agroforestry systems, leading to reduced productivity [10, 11]. A significant portion of households practicing agroforestry report varying levels of food insecurity, with many relying on external sources to supplement their food needs [12, 13]. While agroforestry can enhance income through diversified products, the benefits are not uniformly experienced, leading to disparities among farmers due to various accessibility of technology [14].

Unawareness, lack of education, technical skills, capital, and extension services hinder agroforestry adoption, impacting food security and livelihood management for smallholder farmers [14]. Despite these challenges, agroforestry remains a vital strategy for improving food security and livelihoods, particularly in resource-poor settings. However, addressing the barriers to its adoption is essential for realizing its full potential and attaining of the respective SDGs of united nation.

Futuristic aspect of agroforestry in achieving food security and economic upliftment: Agroforestry presents a special land use pattern to achieve food security and economic upliftment, particularly in developing regions facing environmental and socio-economic challenges in the era of post covid scenario. By integrating trees, crops, and livestock, agroforestry systems enhance biodiversity, improve soil health, and create resilient agricultural landscapes. This multifaceted strategy not only addresses food production needs but also contributes to sustainable development goals. Agroforestry allows farmers to generate multiple income streams from crops, timber, and non-timber forest products, reducing economic vulnerability [16]. The establishment of value chains for wood products has positively impacted farmers' incomes, promoting agroforestry as a viable economic model [17]. Agroforestry systems improve crop yields and resilience against climate variability, crucial for food security in regions reliant on monsoon patterns [18]. These systems promote organic matter accumulation and nutrient cycling, sustaining agricultural productivity over time. Agroforestry contributes to ecosystem conservation by enhancing carbon sequestration and reducing soil erosion [19, 20]. Agroforestry enhances food security and economic upliftment by diversifying agricultural systems, improving soil fertility, and providing year-round produce, thus reducing vulnerability to climate change and market fluctuations [21, 22]. While agroforestry offers significant benefits, challenge and issues mentioned above must be addressed to fully realize its potential in enhancing food security and economic upliftment of the rural economy.

Conclusion

The sad plight of the food security and rural economy scenario due the commotion of climate change, hostile government policies, economic recession [23]. The agroforestry system has a viable and practically adoptable strategy to address the problem. Though it has various ground level constraint or faulty government policies. The agroforestry provides a silver lining in achieving the objective of food security and rural economic development. Agroforestry can enhance food security and economic upliftment by integrating sustainable practices that improve productivity, reduce poverty, and support ecosystem conservation.

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