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Phokele Maponya[1,2]✉

[1] Agricultural Research Council-Vegetable, Industrial, Medicinal Plant, Pretoria, South Africa
[2] Durban University of Technology, South Africa

Socioeconomic and Perceptions Statuses: A Case Study of the Agri-Silviculture Community Growers in KwaZulu Natal Province, South Africa

Abstract. Agroforestry holds significant importance in South Africa as a sustainable land-use approach that tackles essential environmental and economic issues, such as climate change adaptation, food security, and the enhancement of rural livelihoods. By combining trees with crops and livestock, it improves soil health, boosts biodiversity, and offers varied income sources, including timber, fruit, and nuts, alongside agricultural products. However, the uptake of agroforestry in South Africa is progressing slowly due to such challenges as limited land availability, water scarcity, and insufficient technical knowledge, as well as misinformation and negative attitudes, particularly among smallholder farmers. Numerous authors have also pointed out that most of the agroforestry research has been conducted from a biophysical standpoint, yet socioeconomic factors related to farmers' perceptions require greater focus. Therefore, there exists a strong willingness among rural households to embrace these practices if provided with adequate support, highlighting the necessity for more effective integration into national policy. The current study aimed to assess the status of agri-silviculture practices concerning socioeconomic factors and community perceptions. The primary objectives included: (1) Identifying and describing the socioeconomic characteristics of selected agri-silviculture community growers, and (2) Evaluating the perception status of these growers. Therefore, this study contributes to the promotion of agroforestry, as it presents the opportunity to boost production and subsequently elevate community income. Identifying and addressing socioeconomic and perceptual factors related to agroforestry practices is crucial for the adoption of agroforestry, which encompasses both economic and sociological aspects. A purposive sampling method was employed to select 90 community growers involved in agri-silviculture (specifically Groundnuts and Eucalyptus Trees). The research employed both qualitative and quantitative methods concurrently and they were applied with the aim on establishing the limitations, balance, and strength of the data. Furthermore, the methods included participatory action research as the community growers and stakeholders benefitted while the research was ongoing. Data collection methods included site observations, past research, and web and governmental reports. The study involved a closed and open-ended questionnaire with the following sections: socioeconomics, food security, sustainability, perceptions, market information, and observations. The results indicated that most of the communities concurred and held a favourable view regarding the competitiveness of agroforestry practices in fulfilling their fundamental requirements for fuel wood, fruits, fodder, timber, vegetables, and more. They also recognised that the adoption of agri-silviculture practices was essential for the community, thereby enhancing its economic, social, and environmental welfare. It is thus recommended that the agri-silviculture practice be intensified throughout South Africa, as it contributes significantly to food security, market access, and sustainable livelihoods.

Keywords: agri-silviculture community growers, agroforestry, groundnuts and eucalyptus trees, rural economic development, sustainable development and income generation

JEL Classification: Q00, Q15

[1] Agricultural Research Council-Vegetable, Industrial, Medicinal Plant, Pretoria, South Africa
[2] Faculty of Management Sciences, Durban University of Technology, e:mail: maponyap@arc.agric.za; https://orcid.org/0000-0003-4883-2474; Corresponding Author

Introduction

Agroforestry is a land use system that incorporates the combination of woody perennial plants, agricultural crops, and livestock to foster beneficial ecological and economic interactions for the production of food, fibre, and livestock. Furthermore, agroforestry is defined by the direct integration of trees and crops on the same land, either spatially or temporally, as outlined by Nair (1985). In contrast, an alternative method involves a "coarse-level mixing" of trees and crops across separate parcels (Price, 1995) or within designated "compartments" (Odum, 1969) on a farm, which is referred to as a "farm mosaic" or mixed farming. A well-managed agroforestry system offers numerous advantages and enhances livelihoods and income generation. In addition, agroforestry systems are tailored to specific areas and climates; therefore, it is essential to develop agroforestry systems that are relevant to local conditions and take into account the biophysical and socioeconomic contexts on an individual basis.

Furthermore, agroforestry significantly contributes to improving food security by providing a diverse range of products and benefits to farmers. These benefits include food, fodder, and shade for livestock, in addition to timber and renewable wood energy (Paul et al. 2017). It boosts agricultural productivity by fostering soil conservation, enhancing soil water retention, increasing soil organic matter, improving soil fertility, and delivering various ecosystem services (Aynekulu et al. 2019). This land use strategy holds substantial potential for mitigating climate change through carbon sequestration. Agroforestry, which involves the cultivation of trees alongside crops, is advocated as a suitable and sustainable alternative to conventional agriculture, as it fulfils the needs of landholders for food, income, and timber products. Agroforestry systems should also comply with the 4 I's (Integration, Intention, Interconnected & Intensive) and the 4 F's (Firewood, Fertiliser, Food & Fodder) (Paul et al. 2017).

Agroforestry offers a sustainable, on-farm solution to the collection of firewood from natural forests, thereby mitigating deforestation while enhancing household income and energy security. Integrating trees into agricultural land – through methods such as alley cropping, live fences, and woodlots – can fulfil up to 65% of a household's firewood requirements. As noted by Sibelet et al. (2019), wood fuel is essential for energy supply in sub-Saharan Africa (SSA) and is expected to continue being a major component of the energy mix for the population in the future. The researchers also highlighted that the improved agroforestry system accounted for 65% of the firewood, in contrast to just 7% from traditional cropping systems.

A research study carried out in the Limpopo and Mpumalanga Provinces of South Africa by Maponya et al. (2020) examined the indicators of the food security index: (1) Availability (Sufficient) (2) Accessibility (Physical, Social & Economic Access) (3) Utilisation (Dietary Needs, Safe & Nutritious) (4) Stability (Short Term) (5) Sustainability (Environmental, Social & Economic) (6) Agency (People & Food Preferences). The study employed standardised questions to inquire about participants' food security status (percentage food secure/insecure) and levels (Severe, Mild & Moderate). It was determined that the food security status of respondents prior to the interventions, which included land allocation, provision of production inputs, and stipend payments, revealed a food insecurity percentage of over 65%. Following the intervention, which occurred after the growers had harvested groundnuts, Bambara nuts, maize, and vegetables (integrated with Moringa in the Vhembe District of Limpopo), it was observed that the majority of growers utilised their harvest for household consumption, while some were able to sell their produce in informal markets such as tollgates, pension pay points, and areas outside towns within their villages. According to Maponya et al. (2020), the incorporation of crop production played a significant role in reducing the food insecurity curve and enhancing the livelihoods of the community, as the final food insecurity percentage decreased to 20%, with most community growers categorised as mild and moderate.

Moreover, one of the benefits of specific agroforestry systems is the sustained production of high-value timber products, while also achieving immediate economic benefits from the livestock and forage components. In addition, grass-fed livestock generally fetch higher prices in the marketplace compared to their grain-fed equivalents. This scenario will be beneficial for the communities whose livestock graze within the plantations, providing a significant source of income. Agroforestry can also serve as an ecological substitute for chemical fertilisers by utilising "fertiliser trees" – nitrogen-fixing species (such as Gliricidia and Faidherbia) that enhance soil fertility, increase organic matter, and improve crop yields. Smallholder farmers gain from elevated and more stable yields without incurring the high expenses associated with chemical fertilisers.

In addition, agri-silviculture represents a system that integrates both crops and trees within the same landscape. As noted by Bentrup et al. (2019) and Maponya et al. (2022), the primary benefits of the agri-silviculture system include: (1) The production of various products such as food, vegetables, fruits, fodder, and forage essential for livestock, as well as fuel wood, timber, and leaf litter for organic manure production. (2) The enhancement and sustainability of crop productivity, which subsequently increases farmers' income levels. (3) The improvement of the nutritional value of animal feed through the provision of green fodder. (4) The practice serves as an effective method for soil nutrient recycling, thereby reducing the need for chemical fertilisers. (5) The enhancement of farm site ecology by mitigating surface runoff, soil erosion, nutrient loss, gully formation, and landslides. (6) The improvement of the local micro-climate, which boosts the productive capacity of the farm. (7) The alleviation of pressure on community forests and other natural forests for fodder, fuel wood, and timber. (8) The contribution to the beautification of surrounding areas.

South Africa is acknowledged as a semi-arid country that faces challenges related to water scarcity, particularly drought. As noted by Zerihun et al. (2014), Maponya et al. (2018), and Maponya et al. (2019), agroforestry practices are not significantly developed in South Africa. Zerihun et al. (2014) also highlighted those Southern African nations, including Malawi, Namibia, Tanzania, Zambia, and Zimbabwe, that reaped benefits from the Southern African Development Community (SADC) – International Centre for Research in Agroforestry (ICRAF) Zambezi Basin Agroforestry Project since the mid-1990s. In contrast, South Africa has not engaged in such institutional collaborations or national initiatives aimed at advancing agroforestry within smallholder farming systems. Nevertheless, in the tree-abundant savannah regions of South Africa, including areas of the Eastern Cape, Northern Natal, the Lowveld and Bushveld in the Northern Province, and the Kalahari where livestock farming occurs, trees are preserved to provide additional fodder during drought seasons, serve as fencing material and firewood, stabilise soil, offer shade, and contribute to overall environmental conservation (Zerihun et al. 2014).

Nevertheless, the adoption of agroforestry in South Africa is advancing at a sluggish pace due to obstacles such as restricted land availability, water shortages, and a lack of technical expertise, in addition to misinformation and negative perceptions, especially among smallholder farmers. Numerous researchers have noted that the majority of agroforestry studies have been approached from a biophysical perspective; however, there is a pressing need to address the socioeconomic aspects related to farmers' perceptions. Consequently, there is a significant willingness among rural households to adopt these practices if they receive sufficient support, underscoring the importance of more effective incorporation into national policy.

Hence, the primary socioeconomic premise of agroforestry hypothesis that the incorporation of trees into agricultural systems enhances the livelihoods, economic resilience, and food security of rural families more efficiently than traditional monoculture, especially in areas that are degraded or susceptible to climate change. Furthermore, agroforestry systems are believed to boost overall farm productivity per unit area by utilising resources in a complementary manner and promoting diversification, thereby reducing financial risk and offering both immediate (crops) and prolonged (timber/fruit) income sources.

This research reiterates that farmer and community perceptions are defined as the subjective preferences of farmers, which are essential traits that can influence decision-making processes (Adesina and Baidu-Forson, 1995). These perceptions are shaped by a range of previous behaviours, experiences, and observations, along with future aspirations. Additionally, they are affected by various external factors, such as individual and household characteristics, institutions, socioeconomic conditions, and environmental factors (Jha, Kaechele and Sieber, 2019). Over time, farmers' and community perceptions may evolve as new information emerges and previous perceptions are adjusted (Meijer, Catacutan, Ajayi, Sileshi, and Nieuwenhuis, 2019). It is important to note that farmer/community impressions may not necessarily align with the reality. Consequently, to prevent biased outcomes, the study considers all farmer/community impressions, regardless of whether they accurately reflect reality or not.

In the present study, research was conducted with the overall aim to determine the status of the agri-silviculture practice in terms of socioeconomics, perceptions and food security. The major objectives were: (1) To identify and describe the socioeconomic characteristics of the selected agri-silviculture community growers. (2) To determine the perception status of the agri-silviculture community growers.

Methodology

Study Area

According to ARC (2017), the KwaZulu-Natal Province enjoys a reliable and consistent rainfall pattern, coupled with fertile soils, which have made its agricultural sector notably productive and esteemed for its specialised skills across diverse farming types. KwaZulu-Natal has a total of 6.5 million hectares allocated for agricultural purposes, with 82% of this area being ideal for extensive livestock farming, while the remaining 18% is classified as arable land (KZNDARD, 2020). At the heart of these innovative initiatives, there is the advancement of agriculture and a commitment to promoting the integrated development of sustainable rural enterprises that can further bolster the province's agricultural sector. The forestry industry in KwaZulu-Natal covers around 740,000 hectares, representing 8.2% of the province's overall area. Out of this, 560,000 hectares have been planted, while an additional 190,000 hectares of land, owned by forestry companies, remain unplanted.

A sampled 90 agri-silviculture community growers participated in the study and were spread as follows: The agri-silviculture community growers were spread on the Mondi Group plantation as indicated in Figure 1.

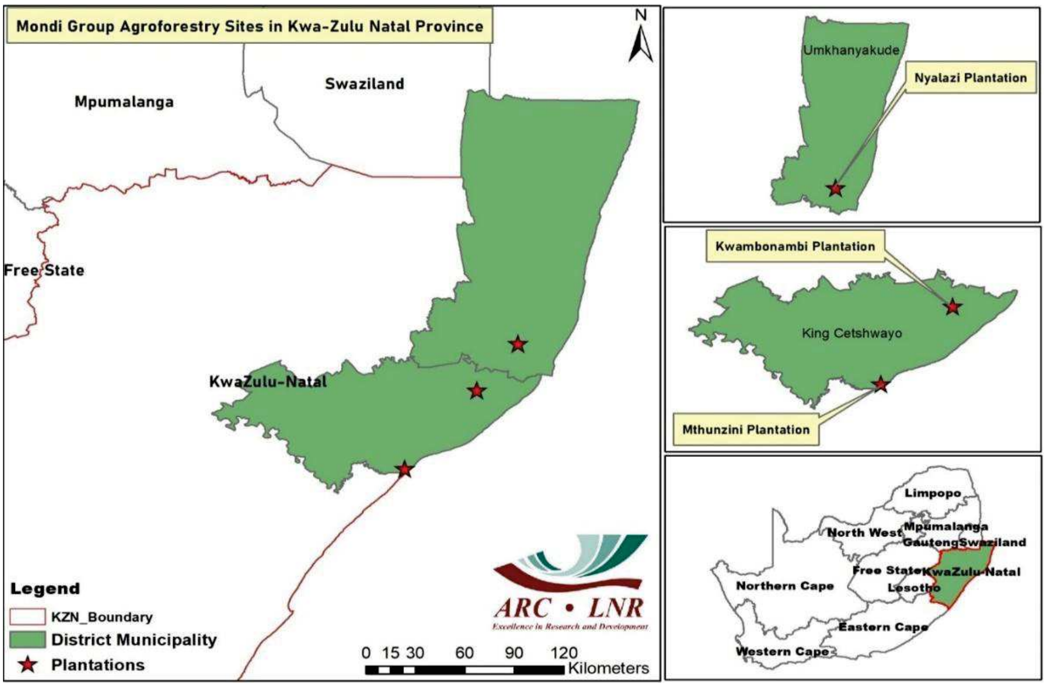

Fig. 1. Mondi Group Agroforestry Sites in KwaZulu Natal, South Africa

Source: ARC – NRE, 2024.

Study Design

The research employed both qualitative and quantitative methods concurrently and they were applied with the aim on establishing the limitations, balance, and strength of the data. Furthermore, the methods included participatory action research as the community growers and stakeholders benefitted while the research was ongoing. Data collection methods included site observations, past research, web and governmental reports. The study involved a closed and open-ended questionnaire with the following sections: socioeconomics, food security, sustainability, perceptions, market information, and observations. The closed-ended questions provided a question immediately, asked participants to choose from a list of possible responses, and were quantitative in nature, allowing the researcher to gather numerical data for statistical analysis. It took maximum 20 minutes to interview each community grower. On the other hand, the open-ended questions provided the participants with an allowance to construct their own response about the subject matter. The latter also included focus group discussions and field observations. The Mondi Group team conducted face-to-face interviews with the same 100 community growers who were interviewed in their native language for better understanding. The Mondi Group team were presented and trained on the PAR (Participatory Action Research) approach and data collection and analysis.

Sampling Procedure and Analytical Technique

A purposive sampling technique was used on selected 90 agri-silviculture community growers out of estimated 500 community growers. A rule of thumb was applied: the minimum selection of 10% of the population (estimated 500 agri-silviculture community growers), which is considered as a good sample size. These agri-silviculture community growers were spread on the 300 ha Mondi Group land and each agri-silviculture community grower was allocated an area of land, and the sample size was agreed with the stakeholder. The eucalyptus trees were then integrated with Groundnuts.

Data was captured and analysed using the software package for social sciences (SPSS version 20). Descriptive Analysis was used to describe data, while Univariate Regression Analysis was conducted to demonstrate the relationship and association of variables. Furthermore, Univariate Linear Regression is generally considered a simple linear regression when it refers to a model with one dependent variable and one independent variable. Hence, Univariate Regression Analyses were used to test the association of one explanatory variable at a time with the outcome without worrying about other variables or confounders (unconditional association). This is essential to shortlist variables for multivariable analysis, especially if there are a large number of explanatory variables. It also excluded the variables from further analysis that do not show any significant association with the outcome. Results of univariate logistic regression analyses included Wald, likelihood ratio, chi-square test statistics and P-values, parameter estimates and standard errors, and odds ratios and their confidence limits. For logistic regression, values of parameter estimates are not very intuitive as they are calculated on a log scale.

Therefore, odds ratios are examined, which are calculated after exponentiating parameter estimates. An odds ratio of <1 indicated negative association, whereas values >1 indicated positive association of the tested variable with the outcome.

The following econometric model was used to determine association of variables (Greene, 2003):

$$Wi = B0 + B1*Xi + Ei \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Wi is the dependent variable value for person i;
Xi is the independent variable value for person i;
B0 and B1 are parameter values;
Ei is the random error term;
The parameter B0 is called the intercept or the value of W when X = 0;
The parameter B1 is called the slope or the change in W when X increases by one.

The assessment tool variables predicted a 90% (R-squared = 0.90) variation in the dependent variable was explained by the independent variables. Prediction accuracies were assessed based on the coefficient of determination (R-squared). The coefficient of determination R-squared was used to explain the total proportion of variance in the dependent variable explained by the independent variable (Table 1). The R-squared removes the influence of the independent variable not accounted for in the constructs. R-squared is always between 0 and 100%. In general, the higher the R-squared, the better the model fits the data.

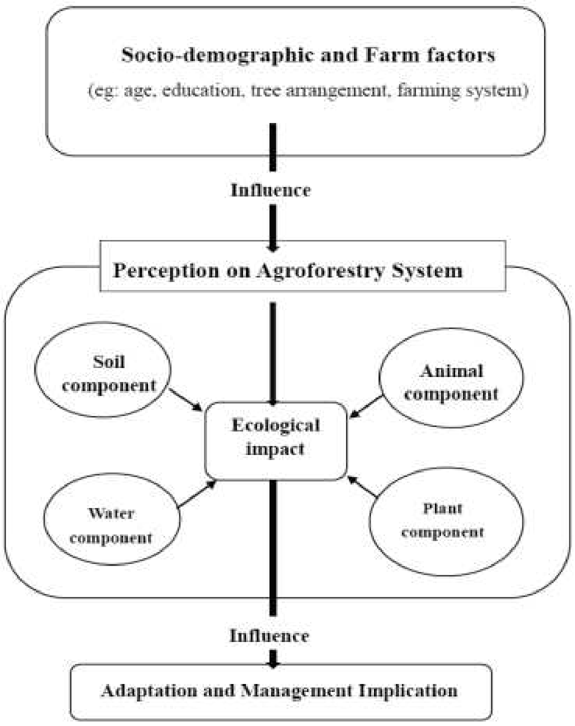

Fig. 2. Communities/ Farmers Perception Conceptual framework

Source: Ahmad et al. 2021.

In the current study, the social and economic factors play a crucial role in determining access to resources, as they fundamentally influence daily life and opportunities. These factors are inherently and significantly linked to outcomes such as community perceptions, among others. Additionally, socioeconomic factors are intrinsically connected and often encompass the collective impact of multiple variables at once, thereby enhancing the predictive power.

Table 1. Socioeconomic Factors Affecting Communities Perceptions

Variable	Coding system	Category	Signs
	Dependant variable		
Community Perceptions	1 If causing decrease, 0 no decrease	Dummy	
	Independent variable		
GEND	0 If male, 1 Female	Dummy	+
AGE	Age of the community member in years	Continuous	+
EDL	0 If have primary, 1 Otherwise	Dummy	-
FAR	Farming experience of the community member	Continuous	+
TRA	0 If Yes, 1 If No	Dummy	-

Source: Author's own work.

A detailed framework is required to illustrate the interaction of various factors in perception. In our research, we employed an analytical framework that includes both sociodemographic and agricultural factors influencing perceptions regarding the ecological effects of agroforestry (Fig. 2). This framework was developed to demonstrate that farmers' perceptions of the ecological impacts of agroforestry, categorised under four themes (soil, water, plant, and animal), arise from individual mental processes and are influenced by sociodemographic and agricultural factors. Numerous studies conducted globally have shown that sociodemographic and agricultural factors significantly impact respondents' perceptions (Sileshi et al. 2008; Sharmin and Rabbi, 2016; Fleming et al. 2019). Consequently, sociodemographic factors such as age, education level, and farming experience, along with agricultural factors like the origin of tree species, the type of agroforestry system, and the arrangement of tree planting, were integrated into the framework.

In addition, the respondents were asked on their perceptions on seven factors, namely: (1) Production (2) Demand (3) Related & Supporting Industries (4) Government Support (5) Organisational Strategy, Structure & Rivalry (6) Market, and (7) Chance. A 5-point Likert-type scale was used to assess the respondents' attitudes toward various agroforestry practices. The respondents were expected to select one of the options available for each statement/item. The responses of the sample households were then analysed using percentages because the Likert scale was measured on a scale of 1 to 5 (1 = strongly disagree, 5 = strongly agree, and 3 = not sure).

Research Results

Agri-silviculture Community Growers Selected Socioeconomic Characteristics

As shown in Table 2, the community growers originated from various districts, local municipalities, plantations, and villages throughout the KwaZulu Natal Province. The majority of the agri-silviculture community growers interviewed were female. According to Table 2, 92% of the interviewees were women, while only 8% were men. Regarding educational qualifications (Table 2), 96% of the growers had education below grade 7, whereas 4% had completed matric. A small percentage (14%) of community growers reported having received training in various aspects of agriculture and forestry, which has led some to engage in vegetable gardening. Furthermore, the community growers stated that they primarily relied on their indigenous knowledge system (IKS) for agroforestry practices. The findings on land acquisition (Table 2) revealed that the growers were provided land by Mondi Group for agricultural production. The age distribution among the growers indicated that most were over 56 years old (49%). As noted in Table 2, youth involvement is at 2%, with those aged 36-45 making up 14% and those aged 46-55 accounting for 35%. The farming experience of the agri-silviculture community growers is distributed as follows: 1-5 years (30%), 6-10 years (29%), 11-20 years (21%), and over 21 years (20%).

Table 2. Agri-silviculture Community Growers Selected Socioeconomic Characteristics

Variables	Community Growers	Structure, %	Variables	Community Growers	Structure, %
Province			**Marital Status**		
KwaZulu-Natal	90	100	Single	70	78
Districts			Married	20	22
uMkhanyakude	42	47	**Age Categories**		
King Cetshwayo	36	40	18-35	2	2
iLembe	12	13	36-45	13	14
Local Municipalities			46-55	31	35
Mandeni	12	13	>55	44	49
Umfolozi	36	40	**Level of Education**		
Mtubatuba	42	47	Less Grade 7	86	96
Plantations			Matric	4	4
Kwa Mbonambi	36	40	**Land Acquisition**		
Mthunzin	12	13	Mondi Group Land	90	100
Nyalazi	42	47	**Agroforestry Experience**		
Villages			1-5	27	30
Slovo	36	40	6-10	26	29
Mbizimbelwe	12	13	11-20	19	21
Shikishela	42	47	>20	18	20
Gender			**Training Provided**		
Female	83	92	Yes	14	16
Male	7	8	No	76	84

Source: Author's own work.

Agri-silviculture Community Growers Perceptions

Perceptions were asked on seven factors namely: (1) Production (2) Demand (3) Related & Supporting Industries (4) Government Support (5) Organisational Strategy, Structure & Rivalry (6) Market and (7) Chance. A 5-point Likert-type scale was used to assess respondents' attitudes toward various agroforestry practices. Respondents were expected to select one of the options available for each statement/item. The responses of the sample households were then analysed using percentages because the Likert scale was measured on a scale of 1 to 5 (1 = strongly disagree, 5 = strongly agree, and 3 not sure).

The results indicated that the following 2/12 production factors (Table 3) do cause the most decrease in agri-silviculture system competitiveness: cost of production and labour, while the following 2/12 do not cause the most decrease in agri-silviculture system competitiveness: lack of knowledge and insufficient source of water. This is true as the community growers indicated that for agroforestry practice, they relied mostly on their indigenous knowledge system (IKS) that was passed from one generation to another. And insufficient water is not a challenge as the plantation area's high rainfall (+750mm per annum) hence the community growers indicated that they had moved to the plantation area due to its good climate.

Table 3. Production factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following production factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Cost of production	37	8	8	7	40	100
Labour	11	4	37	37	11	100
Cost of unskilled labour	20	27	31	12	10	100
Quality of unskilled labour	20	30	24	17	9	100
Availability of unskilled labour	12	30	35	14	9	100
Cost of skilled labour	9	29	28	25	9	100
Availability of skilled labour	14	32	38	15	1	100
Administration cost associated with labour matters	21	23	31	15	10	100
Insufficient source of water	8	43	15	19	15	100
Infrastructure	11	32	20	21	16	100
Lack of knowledge	11	56	12	11	10	100
Lack of technology	10	28	25	23	13	100

Source: Author's own work.

The results indicated that most of the demand factors (Table 4) did cause a decrease in agri-silviculture system competitiveness: The five most influential demand factors included:

Distance to market (79%), Market information (64%), Cost to the market (65%) and quality of product (50%). However, 69 % of the community growers disagreed that market for agroforestry do cause decrease in agri-silviculture system competitiveness.

Table 4. Demand factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following demand factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Distance to market	6	7	8	29	50	100
Market information	11	15	10	29	35	100
Cost to the market	7	17	11	54	11	100
Quality of products	6	35	9	44	6	100
Market for agroforestry	32	37	9	11	11	100

Source: Author's own work.

The results indicated that the electricity suppliers (58%) (Table 5) did not cause decrease in agri-silviculture system while the financial institutions (53%) caused the most decrease in agri-silviculture system competitiveness. The lack of funding/support from financial institutions to purchase production inputs like seeds remains a huge challenge for the community growers. These findings are in line with Kerr et al. (2019), who concluded that there was more research needed on perceptions so that California's Central Valley became renowned not only for its agricultural output, but also for its diverse and sustainable perennial cropping systems. This also includes the role of financial institutions in supporting agroforestry practice.

Table 5. Related and supporting industries causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following related and supporting factors causing decrease/no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Financial institutions	11	17	19	46	7	100
Research institutions	19	28	20	22	11	100
Suppliers	26	15	26	21	12	100
Electricity suppliers	29	29	28	7	7	100

Source: Author's own work.

The results indicated that poor interaction and support between government (59%) and indirect support (52%) (Table 6) did not cause a decrease in agri-silviculture system competitiveness. Furthermore, among the six government factors, Land reform policy (87%) was perceived as the most important factor causing a decrease in agri-silviculture system competitiveness. This is not surprising as the community growers indicated that they were constrained by the unavailability of land in their villages hence the plantations offered more land for production.

Table 6. Government support causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following government support causing decrease / no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Poor interaction and support between Government	30	29	3	12	26	100
Indirect support	41	11	7	11	30	100
Trade policy	1	30	36	22	11	100
Land reform policy	6	3	1	67	23	100
Labour policy	9	12	43	26	10	100
Fiscal policy	9	12	39	27	13	100

Source: Author's own work.

The results indicated that the pricing strategy (53%) (Table 7) did not cause decrease in agri-silviculture system while most of the communities were not sure. This is consistent with the researchers' observations because community growers determine their own prices at the informal market. Therefore, they have the freedom to use their own pricing strategies without any interference from the agents etc. These findings hold significant importance as one of the motivations for conducting agroforestry research in South Africa's inland and coastal regions stems from the variations in the socioeconomic and cultural challenges faced by different communities. While certain communities favour the integration of trees with groundnuts or beans, others opt for the integration of trees with grass, trees with bees, or trees with mushrooms.

Table 7. Organisational strategy, structure, and rivalry causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following organisational strategy, structure and rivalry causing decrease / no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Adaptability	6	26	49	8	11	100
Culture	23	12	46	9	10	100
Structure	14	13	26	20	27	100
Flexibility	11	24	22	13	30	100
Pricing strategy	14	39	22	20	5	100

Source: Author's own work.

The results indicated that the following market factors (Table 8) did cause a decrease in agri-silviculture system: Market power of suppliers (69%) and Market power of buyers (69%). Community growers who had some market power over some have created a lot of uncertainties in some agroforestry sites in South Africa. According to Maponya et al. (2022), some community growers tried to use bargaining marketing approach which only benefitted a few. In addition, the power of buyers sometimes resulted in low prices for their groundnuts.

Table 8. Market factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following market factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Market power of suppliers	2	14	15	52	17	100
Market power of buyers	15	9	7	54	15	100
Threat of substitutes	10	22	35	22	11	100
Threat of new substitutes	26	20	31	20	3	100

Source: Author's own work.

The results indicated that out of 9 chance factors (Table 9), crime (51%) caused a decrease in agri-silviculture system. Other chance factors like AIDS (44%) and Drought (47%) do also cause significant decrease in agri-silviculture system. In addition, Maponya et al. (2022) emphasised that crime, e.g. poaching, was a challenge as the result of lack of fencing and again community growers moved to the plantation area due to its good rainfall as compared to their villages, which are dry.

Table 9. Chance factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness

Views The following chance factors causing decrease / no decrease in agri-silviculture system community growers' competitiveness	Responses (90 Agri-silviculture system permit holders)					
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	%
Economic stability	7	28	38	19	8	100
AIDS	7	22	27	34	10	100
Political stability	9	17	45	16	13	100
Price stability	11	18	48	19	4	100
Crime	7	27	15	40	11	100
Drought	10	32	11	32	15	100
Floods	11	36	16	28	9	100
Fires	13	33	19	27	8	100
Frost	9	12	51	15	13	100

Source: Author's own work.

The results (Tables 3–9) highlighted that most community members perceived production factors, demand conditions, related and supporting industries, government support, and chance as causes for a decrease in agroforestry competitiveness. Furthermore, most community members indicated that firm strategy, structure, and rivalry were not causing a decrease in agroforestry competitiveness as many community members strongly disagreed and disagreed or not sure. The identified community growers' perceptions are in line with some of the researchers' field observations. Identifying and addressing the primary perceptions and elements that influence the competitiveness of farmers in agroforestry practices is crucial for the adoption of agroforestry, which encompasses both economic and sociological aspects.

The Socioeconomic Factors Affecting Perceptions of Agri-Silviculture Community Growers

As shown in Table 10, there is a positive significant level among the following variables: age, gender, farming experience, and community perceptions. The estimated values support this observation, as they exceed 1 within the 95% confidence interval. Age did have a significant impact on the community's grower's knowledge and perceptions. The agroforestry practice is dominated by older community growers. This situation is concerning and highlights the urgent need to attract the younger generation to agroforestry as a critical priority. However, observations from various provinces in South Africa indicate that youth are more involved in the marketing phase of agroforestry practices rather than in soil preparation and production. A similar trend of youth participation was noted in the Limpopo, Mpumalanga, Eastern Cape, and Western Cape Provinces (Maponya et al. 2022). Recent research carried out in the Indus River Basin of Pakistan and Bangladesh has indicated that younger farmers exhibit a greater interest in adopting agroforestry practices compared to their older counterparts. This trend is attributed to their enhanced understanding of the advantages associated with the implementation of advanced agricultural technologies in agroforestry practices (Mahmood and Zubair, 2020). The agri-silviculture system in KwaZulu Natal is also dominated by women as most men have migrated to the cities in search of work.

Table 10. Univariate Analysis Determining Socio Economic Factors Affecting Communities Perceptions

Variable	Odds Ratio	Intervals
Age	1.399	[0.32 – 40.1]
Education Levels	0.79	[0.2 – 66.9]
Gender	1.22	[0.06 – 0.68]
Farming Experience	1.25	[0.20 – 2.79]
Training Provided	0.58	[0.15 – 10.7]

OR= Odds Ratio; 95%CI = 95% Confidence Intervals; 1< = No Association; 1> = Association

Source: Author's own work.

Furthermore, while both men and women participate in the management of trees cultivated on farms, existing literature indicates that women predominantly carry out most of the work, particularly during the initial phases of tree establishment. Research conducted by Epahra (2001) in Tanzania and by Gerhardt and Nemarundwe (2006) in Zimbabwe revealed that more than 60% of women in Tanzania are tasked with the management of tree species planted on farms. It is also not surprising that there is a positive significant level between farming experience and community perceptions. The communities expressed that it is through prolonged experience that they can effectively manage their designated plots. Consequently, they predominantly depended on their indigenous knowledge system (IKS) for agroforestry practices rather than formal training. As noted by Jose (2009) and Rao et al. (1997), the years of experience within the communities show a significant and positive correlation in perception studies. Thus, farmers with greater experience have noted improvements in these variables compared to those with less experience.

The above findings emphasised that the age of individuals significantly influenced the knowledge and perceptions of growers within the community. Older growers predominantly dominate the agroforestry practice. This scenario raises concerns and underscores the pressing necessity to engage the younger generation in agroforestry as a vital priority. Nevertheless, observations from different provinces in South Africa reveal that young people are more engaged in the marketing aspect of agroforestry practices rather than in soil preparation and production. A comparable trend of youth involvement was observed in the Limpopo, Mpumalanga, Eastern Cape, and Western Cape Provinces (Maponya et al. 2022).

Conclusions and Recommendations

Agroforestry, which involves the deliberate incorporation of trees and shrubs into agricultural and livestock farming systems, serves as a sustainable land-use approach that connects agriculture with forestry. This practice is being increasingly embraced to tackle issues such as climate change, food insecurity, and the decline of biodiversity. The advantages of agroforestry encompass the following:

Environmental Sustainability

- Soil Health & Conservation: Trees play a crucial role in minimising soil erosion, preventing landslides on inclines, enhancing water retention, and boosting fertility through the process of nutrient cycling.
- Climate Change Mitigation/Adaptation: Agroforestry systems can sequester a substantial amount of carbon (33%–73% more than traditional systems) within soil and biomass. Additionally, they serve as windbreaks and alter microclimates, resulting in a temperature reduction of 2–5°C, which alleviates heat stress on crops.
- Biodiversity Enhancement: These systems foster habitats for a variety of flora and fauna, including pollinators and beneficial insects that contribute to natural pest management.

Economic & Social Benefits

- Diversified Income: Offers various sources of revenue (such as fruits, timber, fodder, and medicinal products), ensuring stability in the face of market volatility.
- Improved Food Security: Strengthens nutrition and livelihoods for smallholder farmers, particularly in developing areas.
- Reduced Inputs: Leguminous trees have the ability to fix nitrogen, which can decrease the reliance on synthetic fertilisers by as much as 75%.

However, agroforestry has also some weaknesses/challenges which includes:

- Economic Barriers: The substantial initial investment costs and the prolonged, often delayed returns on investment are due to the time required for trees to mature.
- Technical Complexity: There is a necessity for specialised expertise to choose compatible species, manage intercropping effectively, and address potential competition for light, water, and nutrients.
- Operational Constraints:
  - Reduced Flexibility: The establishment of perennials entails a long-term commitment, which can hinder farmers' ability to swiftly adjust to evolving market conditions.
  - Land Tenure Issues: Ambiguities surrounding land and tree tenure rights frequently discourage long-term investments in trees.
  - Crop Competition: Trees that are not managed properly may excessively shade crops or compete for water, which could lead to a decrease in yields.

Hence, recognising and tackling main perceptions and factors that determine the competitiveness of the communities in agri-silviculture practices is relevant to the agroforestry adoption. The respondents were asked about their perceptions on seven factors, namely: (1) Production (2) Demand (3) Related & Supporting Industries (4) Government

Support (5) Organisational Strategy, Structure & Rivalry (6) Market and (7) Chance. A 5-point Likert-type scale was used to assess the respondents' attitudes and perception toward various agri-silviculture practice. Most of the communities accepted and had a positive perception of agroforestry practices in terms competitiveness to meet their basic needs regarding fuel wood, fruits, fodder, timber, vegetables, and so on, as well as accepted that agri-silviculture practice was critical for the community to adopt, thus benefiting the economic, social, and environmental well-being of the community. In conclusion, the identified community perceptions are in line with some of the researcher field observations and it is thus recommended that stakeholders should take note of the perceptions identified by the communities and the positive significant levels among the following variables: age, gender, farming experience, and community perceptions to increase agri-silviculture system competitiveness in South Africa.

The following areas for further research are recommended:

- Site-Specific Modelling: Creating models aimed at optimising tree-crop combinations tailored to local soil, slope, and climatic conditions.
- Economic Valuation & Policy: Engaging in further research to assess the value of non-market ecosystem services (such as carbon and biodiversity) and formulating financial incentives for their adoption, including payments for ecosystem services (PES).
- Long-Term Impact Studies: Implementing extensive soil sampling and longitudinal studies to gain a deeper understanding of carbon sequestration potential, as short-term studies may obscure variability.
- Technological Integration: Employing precision agriculture and remote sensing technologies to enhance the management and monitoring of agroforestry systems.
- Social and Gender Dimensions: Investigating the contributions of women, youth and smallholders in management, along with the sociocultural factors that facilitate or impede adoption.

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