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Research Article

Smallholder Farmers' Perception of Agro-ecological Practices and its determinants: Insights from RIPAT Project in Ruangwa District, Tanzania

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Abstract: *It is recognized that using agro-ecological practices can guarantee sustained agricultural production, which satisfies the necessary amount of food demand. To persuade farmers to adopt agro-ecological practices, it is imperative first to understand their perception of agro-ecology approach. This study aimed to analyze farmers' perceptions of agro-ecological practices and their determinants, using data that were collected from 126 RIPAT and 126 non-RIPAT farmers who were randomly selected in Ruangwa District, Tanzania. Results revealed a significant difference in perception between RIPAT and non-RIPAT farmers. Most RIPAT farmers perceived agro-ecological practices more likely than their counterpart due to training that increased their awareness. The majority in both groups of farmers perceived the relative advantage of agro-ecological practices, particularly in environmental protection and human health and nutrition, but also considered its implementation as labor-intensive and time-consuming. Unlike non-RIPAT farmers, RIPAT farmers perceived agro-ecological practices as compatible with their social values, farming experience, and demands, and farmers can try to implement them to enhance agricultural production. The results of binary logistic regression showed that exposure to the RIPAT approach, access to information, income, and access to credit were significantly influencing farmers' perception of agro-ecological practices. Awareness of agro-ecological practices, which could be brought about by training, increases the likelihood of positive perception of the same. Therefore, the study recommends more agro-ecological training programs to enhance farmers' awareness and knowledge which in turn could influence their perception resulting in enhanced adoption of agro-ecological practices for sustainable food production.*

Keywords: Agro-ecological practices, perception, RIPAT approach, RIPAT farmers
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1. Introduction

The growing population of the world is projected to rise from 8 billion today to 9.8 billion in 2050 (UN, 2017), as a result, there is a need to increase food production to feed an additional 2 billion people. This situation has sparked anxiety around the world about the kind of agricultural systems that will be able to guarantee enough food production to satisfy the expanding demand in a sustainable way (Kremen and Miles, 2012). Conventional or modern agricultural methods, such as intensive tillage, monoculture, and the application of agrochemical fertilizers, pesticides, and herbicides, are currently criticized for prioritizing short-term productivity over long-term sustainability. This criticism stems from their negative effects, including the overuse and degradation of agricultural resources, alterations to global ecological processes crucial for supporting agriculture, negative impacts

on human health, and the weakening and dismantling of social conditions that facilitate resource conservation (Gliessman, 2015). According to FAO (2018), agricultural systems that intensively use resources and heavily rely on external inputs have contributed to significant deforestation, water scarcity, biodiversity decline, greenhouse gas emission and depletion of soil fertility.

As opposed to conventional agriculture, the agro-ecology approach receives great attention around the world as a win-win solution to address the aforementioned challenges posed by contemporary agricultural practices. This approach integrates ecological principles along with social and economic considerations in agricultural production (FAO, 2015). According to Silici (2014), these ecological principles include the following: improving biomass recycling to maximize nutrient availability; reducing the use of non-renewable and off-farm inputs; reducing energy, water, nutrient, and genetic resource losses by promoting the preservation and renewal of soil, water, and agro-biodiversity resources; increasing diversity of species and genetic resources within the agro-ecosystem over time and space; and promote important ecological processes and services by strengthening the positive biological interactions and synergies between the elements of agro-biodiversity. Crop and livestock diversification, natural control of pests and diseases, crop rotation, minimum tillage, and use of organic fertilizer are a few examples of agro-ecological practices based on these ecological principles (Wezel *et al*., 2014). These agro-ecological practices seek a better way of harnessing ecosystem functions as much as possible to create a positive biological interaction and synergies among the elements of the agro-ecosystem rather than relying on synthetic inputs (Gliessman, 2020). Numerous studies conducted have demonstrated the beneficial contribution of the agro-ecological farming approach on different aspects including income (D'Annolfo *et al.,* 2017); food and nutrition security (Lucantoni, 2020) and environment (Gliessman, 2015).

Understanding farmers' perception of agro-ecological practices is crucial since perception matters when it comes to adoption. As stated by Tatlidil *et al.* (2009), the lack of knowledge regarding farmers' perceptions may hinder the adoption of novel agricultural practices that are promoted to farmers. Perception, alongside other factors, significantly influences farmers' decisions regarding agricultural innovations (Darko, 2014; Makate *et al.,* 2017; Saha *et al.,* 2018). Despite its importance, there is a scarcity of empirical studies that comprehensively explore farmers' perceptions of these innovative practices. As a result, there is little knowledge regarding how farmers perceive the characteristics of promoted agro-ecological practices in comparison to conventional agricultural methods. Perception varies among farmers and is highly influenced by the socio-economic traits and information-seeking habits of the farmers (Tatlidil *et al.,* 2009). Farmers may develop either positive or negative perceptions. A poor understanding of novel agricultural practices may lead to a negative perception while an accurate understanding brings a positive perception (David and Abbyssinia, 2017). Rogers (2003) argues in his innovation-decision process model that farmers typically evaluate new ideas before deciding whether or not to implement them. Thus, before adopting the newly promoted agricultural practices, farmers must be convinced that the innovations are suitable for their specific circumstances and offer greater relevance compared to existing ones.

The Rural Initiatives for Participatory Agricultural Transformation (RIPAT) approach is an extension approach developed to bridge the agricultural technology gap through the dissemination of sustainable agricultural technologies and practices for the improvement of small-scale farmers' farming systems. Using a reflective and experiential learning method, the RIPAT approach trains farmers, who then select which introduced practices to adopt from a basket of options and mentor other community members who are not part of the group to follow suit (Vesterager *et al*., 2017). In Ruangwa District, the RIPAT approach has been implemented to promote the dissemination of various agro-ecological practices, including crop diversification, mulching, cover cropping, minimum soil tillage, intercropping, utilization of organic fertilizers, and agroforestry for improvement of smallholder farmers' farming system. Among others, the RIPAT approach was expected to influence farmers' perception of agro-ecology.

Therefore, based on the above background, the objectives of this study were to (1) analyze farmers' perception of the characteristics of agro-ecological practices, and (2) examine factors influencing farmers' perception of agro-ecological practices in the study area. The findings of the study are of significant importance to both the government and other agricultural stakeholders. Firstly, understanding farmers' perceptions can provide valuable insights for policymakers in designing agricultural policies and interventions to better meet the needs and preferences of farmers, thereby improving the effectiveness and acceptance of agricultural initiatives. Secondly, they can shed light on their awareness of the factors that influence farmers' perceptions toward agro-ecological practices. Inspired by Meijer *et al.* (2015), perception in this study pertains to farmers' views about the agro-ecological practices disseminated in their local areas based on their felt needs and past experiences; and these may not always align with reality.

2. Methodology

2.1. Overview of the study area

The study was conducted in Ruangwa, one of the six districts in the Lindi Region, Tanzania, as shown in Figure 1. It lies within the latitude range of 9.5° S to 10° S and longitude range of 38.5° E to 39.5° E. The elevation of the district varies from 213 to 549 meters above sea level, and temperatures typically range from 24 °C to 34 °C, with an average annual temperature of 26 °C. The area is mostly covered by clay soil, followed by black cotton soil and in a few areas, there is sand soil. According to URT (2022), Ruangwa District has a population of 185,573 with an average household size of three persons. The majority of the population resides in rural areas and relies on agricultural activities as the main economic activity (Ruangwa District Council, 2013). Ruangwa District was selected purposefully because a project titled Agro-ecology for the holistic improvement of small-scale farming systems for food security and poverty reduction was implemented therein using the RIPAT approach. The project covered four villages from different wards as follows: Mandarawe in Mandarawe Ward, Namilema in Mbekenyela Ward, Kipindimbi in Nkoe Ward, and Chimbila B in Mnacho Ward.

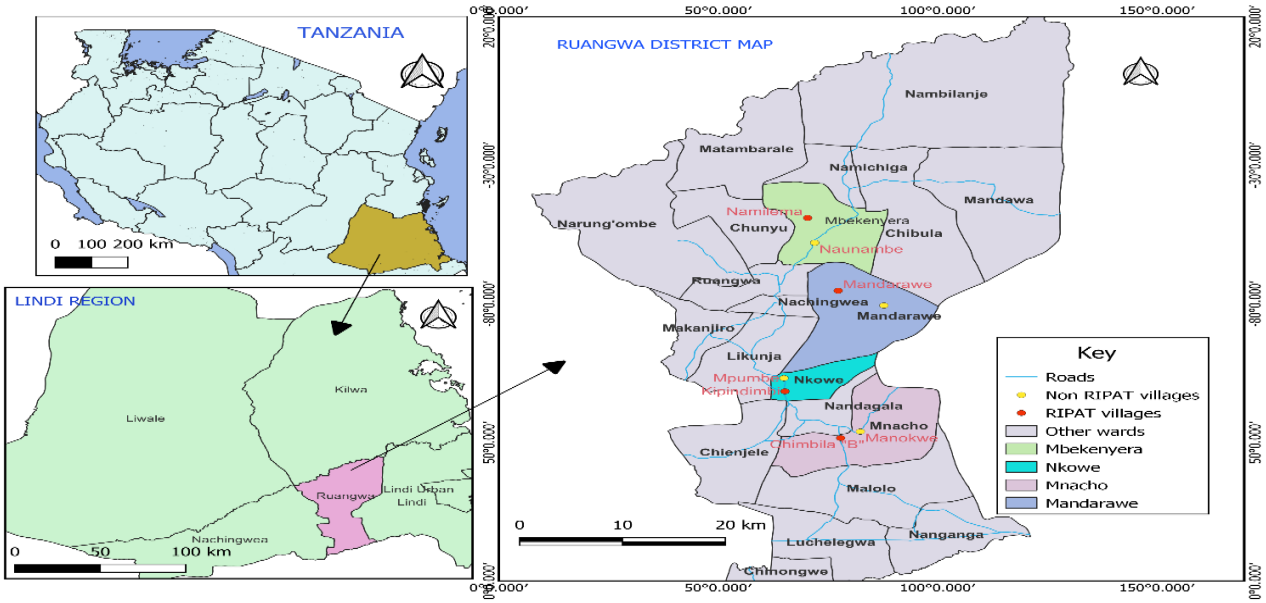

Figure 1: Map representing the study area

2.2. Sampling procedure and sample size

The study employed a multi-stage sampling method to obtain a representative sample. In the first stage, the study area was deliberately selected based on the criteria of exposure to the RIPAT approach. Four wards were chosen, and subsequently, two villages

per ward (one RIPAT approach exposed village and one non-RIPAT approach exposed village) were selected. In the second stage, respondents were randomly selected from the chosen villages. A total of 126 farmers were selected from villages exposed to the RIPAT approach, while an equal number of farmers (126) were selected from villages not exposed to the RIPAT approach. The total sample size of 252 farmers was determined using a formula adopted from Kothari (2004).

$$n = \frac{z^2 pqN}{e^2(N-1) + z^2 pq} \quad [1]$$

Where, N represents the population size, n denotes the sample size, e signifies the desired level of precision, p indicates the estimated proportion of the attribute within the population, q is equivalent to 1- p, and Z represents the value of the standard normal distribution, which is 1.96 at a 95% confidence level.

2.3. Research design and data collection

The study utilized a cross-sectional research design which allows the collection of information on many cases at once. Additionally, the design is desirable for both descriptive and analytical purposes (Kesmodel, 2018). Primary data were collected in May and June 2023 using a questionnaire survey, focus group discussions (FGDs) and key informant interviews (KIIs). The questionnaire for this study comprised questions on farmers' characteristics (such as gender, marital status, age, farming experience, education, household size, and farm size) as well as farmers' perceptions of the characteristics of agro-ecological practices. The perception of farmers regarding agro-ecological practices was captured using a Likert scale with five response options: 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree) and 5 (strongly agree) to measure the existing variation in perception among smallholder farmers. The scale consisted of 19 statements, and the participants were asked to indicate their agreement level for each statement using the provided five alternative responses. The Cronbach's alpha coefficient was computed to assess the reliability of the data collected regarding farmers' perceptions of agro-ecological practices.

Furthermore, four FGDs with farmers were conducted to elicit more information on farmers' perception of agro-ecological practices. In total, 36 farmers participated in the FGDs, of which 47.22% were male, and 52.78% were female. The participants for the FGDs were chosen based on consideration of gender balance and inclusion of farmers who did not participate in a questionnaire survey. Each FGD consisted of 8 to 10 farmers. Additionally, three KIIs were conducted with ward extension officers to gather complementary information.

2.4. Data analysis

The Statistical Package for Social Sciences (SPSS, version 26) software was deployed to analyze data. Descriptive statistics including frequencies and percentages were generated to understand farmers' perception of agro-ecological practices. Qualitative data collected through FGDs and KIIs were analyzed through content analysis in which themes and strong statements were explored. Furthermore, a binary logistic regression model was employed to identify factors that influence farmers' perception of agro-ecological practices. A dummy for the dependent variable for this study was whether the farmer perceived agro-ecological practices positively or negatively, with a value of 1 assigned if the farmer perceived positively and 0 if the farmer perceived negatively. The equation of the logistic regression model is given as follows:

$$log\,[Pi/(1-Pi)] = B_0 + B_1X_1 + B_2X_2 + \cdots B_{10}X_{10} + e \quad [2]$$

Where; log [Pi/ (1-Pi)] is the natural logarithm of the odds of positive perception = 1, while negative perception = 0, Pi is the probability of the farmer to perceive agro-ecological practices positively, 1-Pi is the probability of the farmer to perceive agro-ecological practices negatively, B_0 is intercept, B_1 through B_{10} are coefficients of independent variables, e is error term/stochastic and X_1 through X_{10} are independent variables described in Table 1.

Table 1: Explanation of independent variables entered into the model

Variable	Measurement
X_1 = Exposure to the RIPAT approach	Farmers participation in RIPAT approach, 1= RIPAT farmer, 0= non-RIPAT farmer
X_2 = Sex	Sex of respondent, 1= Male, 0= Female
X_3 = Marital status	State of being married, 1= Married 0= Other status
X_4 = Age	Age of respondent, (Years)
X_5 = Education	Attainment of education, 1 = Having formal education, 0 = Otherwise
X_6 = Household size	Total number of household members
X_7 = Income	Amount of income earned per season
X_8 = Access to information	Accessibility to sources of agricultural information, 1= Yes, 0= No
X_9 = Farm size	The size of the farm (ha) used for production
X_{10} = Access to credit	Accessibility to credit, 1 = Yes, 0 = No

3. Results and Discussion

3.1. Demographic characteristics of the respondents

The attributes of the farmers in the study area are summarized in Table 2. Out of 252 farmers who were interviewed, 132 were females (52.4%) and 120 were males (47.6%) which indicates almost equal gender participation in the study. This can be elucidated by the fact that the RIPAT approach is a gender-sensitive approach encouraging more women participation. The ages of farmers ranged from 18 to 61 and above years; the higher proportion of farmers (57.9%) were in the 41 - 60 middle age group, followed by young farmers (30.2%) who were in the 18 - 40 age group. With regards to education, most of the farmers 188 (74.6%) attained primary education which is a lower level of education while 39 farmers (15.5%) had no formal education. In addition, based on marital status, the majority of farmers (78.6%) were married. This could be due to the reason that married farmers have more people to feed making them engage in agricultural activities to obtain more food for their families.

The number of members per household ranged from 1 to 10 members; most of the farmers (41.2%) had household sizes ranging between 4 and 6 members, followed by farmers (28.8%) with household sizes ranging between 1 and 3 members. The farmers' experience in farming activities ranged from 1 to 51 and above years old; 27.8% of farmers were in the 31 – 40 years of farming experiences group followed by 23% of farmers in the 21 – 30 years experiences group. Most of the farmers (52.6%) were cultivating a total area of an average of less than 2 ha. This implies that most of the farmers were small-scale farmers. The result further from Table 2 indicates that there was a significant influence of farm size on farmers' perceptions of agro-ecological practices. It appears that farmers operating smaller farms are more inclined to perceive agro-ecological practices positively compared to those operating larger farms, possibly due to the labor-intensive nature associated with these practices.

Table 2: Demographic characteristics of farmers

Characteristics		All farmers (n = 252)	Perception		Chi square	P-Value
			Positive	Negative		
Sex	Female	132 (52.4)	69 (52.3)	63 (47.7)	2.012	0.156
	Male	120 (47.6)	52 (43.3)	68 (56.7)		
Marital status	Single	23 (9.1)	12 (52.2)	11 (47.8)	2.284	0.516
	Married	198 (78.6)	98 (49.5)	100 (50.5)		
	Divorced	14 (5.6)	5 (35.7)	9 (64.3)		
	Widow/Widower	17 (6.7)	6 (35.3)	11 (64.7)		
Education	Primary	188 (74.6)	91 (48.4)	97 (51.6)	3.874	0.275
	secondary	21 (8.3)	10 (47.6)	11 (52.4)		
	Certificate/diploma	4 (1.6)	0 (0.0)	4 (100)		
	No formal education	39 (15.5)	20 (51.3)	19 (48.7)		
Age	18 - 40	76 (30.2)	42 (55.3)	34 (44.7)	2.669	0.263
	41 - 60	146 (57.9)	64 (43.8)	82 (56.2)		
	61 and above	30 (11.9)	15 (50.0)	15 (50.0)		
Household size	1 - 3	93 (28.8)	43 (46.2)	50 (53.8)	3.507	0.173
	4 - 6	133 (41.2)	61 (45.9)	72 (54.1)		
	7 - 10	26 (8.0)	17 (65.4)	9 (34.6)		
Farming experience (years)	1 - 10	53 (21.0)	32 (60.4)	21 (39.6)	8.045	0.154
	11 - 20	53(21.0)	26(49.1)	27 (50.9)		
	21 - 30	58 (23.0)	29 (50.0)	29 (50.0)		
	31 - 40	70 (27.8)	27 (38.6)	43 (61.4)		
	41 - 50	17 (6.7)	6 (35.3)	11 (64.7)		
	51 and above	1 (0.4)	1 (100)	0 (0.0)		
Farm size (ha)	Below 2	170 (52.6)	99 (58.2)	71 (41.8)	23.221	0.000
	2.1 - 4	66 (20.4)	18 (27.3)	48 (72.7)		
	4.1 - 6	12 (3.7)	4 (33.3)	8 (66.7)		
	6.1 and above	4 (1.2)	0 (0.0)	4 (100)		

N.B: Numbers in the brackets are percent

3.2. Farmers' perception on agro-ecological characteristics

The Cronbach's alpha value obtained from the data gathered on farmers' perceptions of agro-ecological practices was 0.773 (Table 3), indicating that the collected data were reliable for analysis. A Cronbach's alpha coefficient, falling between 0.71 and 0.79, signifies strong consistency in the responses (Bujar *et al.*, 2019).

3.2.1. Relative advantage

In this study, relative advantage expresses the extent to which agro-ecological practices are perceived as better than conventional practices. Since the highest score for positive responses is 5.0, the overall mean of 4.29 for RIPAT farmers and 3.57 for non-RIPAT farmers implies that both groups perceive the benefits of agro-ecological practices over conventional ones positively (Table 4). This positive perception indicates that farmers are aware of the relative advantages that can be gained from implementing agro-ecological practices. Based on the results of focus group discussions (FGDs), it was discovered that agro-ecological farming methods offer greater profitability, as farmers can cultivate smaller areas and achieve high yields with crops that are safe from contamination by agrochemical inputs throughout the cultivation, storage, and consumption as well.

Compared to conventional practices, the results in Table 4 reveal that most RIPAT and non-RIPAT

farmers agreed that agro-ecological practices promote environmental conservation and reduce the intensive use of resources. This suggests that farmers consider the integration of agro-ecological practices helpful in conserving the environment and protecting resources. During focus group discussions with farmers in Namilema Village, it was discovered that the application of agro-ecological practices, such as mulching (using live or dead mulches), enhances soil fertility management. Live mulches, especially legumes such as cowpeas and lablab, contribute to soil nitrogen through atmospheric nitrogen fixation, while dead mulches release nutrients into the soil as they decompose. The preservation of soil moisture content for extended periods was also mentioned as another advantage of mulching. These findings align with observations by Hayran *et al.* (2018) that planting cover crops ranked high among farmers in improving soil fertility and reducing erosion.

Furthermore, the findings indicate that the majority of both RIPAT and non-RIPAT farmers agreed that agro-ecological farming practices improve human health and nutrition by promoting diversified agricultural production without using agrochemical inputs. This finding is consistent with that of Thanh *et al.* (2015), who noted that farmers were deeply concerned about the potential health effects of uncontrolled agrochemical input use. In terms of increasing production, the majority of RIPAT farmers seem to agree that the integration of agro-ecological practices helps boost agricultural productivity, while most non-RIPAT farmers appear indifferent. Additionally, most RIPAT farmers perceive that agro-ecological practices help reduce production costs. These findings align with those of Durham and Mizik (2021), who discovered that input costs are lower in organic farming compared to conventional methods. This is attributed to the fact that agro-ecological farming mitigates the increased production costs associated with the use of synthetic inputs like industrial agrochemical pesticides and fertilizers.

Table 3: Scale reliability statistics

Number of Items	Mean	Variance	Std. Deviation	Cronbach's Alpha
19	67.20	89.931	9.483	0.773

Table 4: Mean scores of the relative advantage

Statements	RIPAT farmers			Non-RIPAT farmers		
	Mean	Standard deviation	Overall mean	Mean	Standard deviation	Overall mean
Agro-ecological practices promote the conservation of the environment, reduce the intensive use of resources	4.40	0.62	4.29	3.89	0.88	3.57
Agro-ecological practices increase agricultural productivity	4.46	0.53		3.44	1.02	
Agro-ecological practices reduce production cost	4.01	1.29		3.40	1.19	
The risk of crop production failure decreases when employing agro-ecological practices	4.19	1.05		3.40	1.01	
Agro-ecological practices enhance human health and nutrition	4.38	0.68		3.73	0.96	

3.2.2. Compatibility

Compatibility indicates the extent to which agro-ecological practices are perceived as consistent with existing values, experiences, and farmers' demands, especially regarding increasing agricultural production. With an overall mean score of 4.12, it is

implicit that most RIPAT farmers perceive the compatibility of agro-ecological practices positively. However, in the case of non-RIPAT farmers, the perception of the majority appears to be indifferent, as their overall mean score was 3.23 (Table 5). According to the results presented in Table 5, it seems that most RIPAT farmers perceive that agro-ecological practices are compatible in reducing vulnerability to the effects of climate change. This was evidenced by the focus group discussion results in Kipindimbi Village, where the implementation of minimum soil tillage practices using nine-seeded holes mixed with manure was found to have great capacity for collecting runoff water and storing soil moisture content. Most RIPAT farmers also consider that agro-ecological practices fit into the existing farming system and enhance efficiency in terms of increasing productivity per unit area.

On the other hand, the majority of non-RIPAT farmers seem to have a skeptical perception regarding all pro-compatibility statements of agro-ecological practices.

Table 5: Mean scores of the compatibility

Statements	RIPAT farmers			Non-RIPAT farmers		
	Mean	Standard deviation	Overall mean	Mean	Standard deviation	Overall mean
Agro-ecological practices are well-matched with farmers' need/demand	3.98	0.86	4.12	3.23	0.94	3.23
Agro-ecological practices are compatible with local/social/cultural values	4.05	1.26		3.41	1.08	
Agro-ecological practices are compatible in responding to the impact of climate change	4.19	0.94		3.06	1.07	
Agro-ecological practices fit into existing farming system and enhances efficiency	4.25	0.82		3.21	0.89	

3.2.3. Complexity

In this study, complexity refers to the extent to which agro-ecological practices are perceived as challenging to comprehend and implement. With overall mean scores of 3.30 for RIPAT farmers and 3.00 for non-RIPAT farmers (Table 6), it appears that the complexity of agro-ecological practices was perceived indifferently by the majority of farmers. The findings in Table 6 indicate that most farmers tend to disagree that agro-ecological practices are less labor-intensive. These results are consistent with those of Gunawan *et al.* (2022), who reported that farmers felt organic farming requires more labor since it is more intensive than conventional farming. Moreover, during focus group discussions with farmers in Chimbila 'B' Village, it was revealed that while agro-ecological farming is perceived as more beneficial, it is also seen as tedious due to the collection and transportation of manure to the field. It was further learned that practicing minimum soil tillage using nine-seeded holes is labor-intensive, especially on larger farms, as each hole must be 60 cm x 60 cm and 60 cm deep, with 15 cm of topsoil mixed with one bucket of manure and then returned into the hole. The results also show that most RIPAT and non-RIPAT farmers disagreed with the assertion that implementing agro-ecological practices does not require a significant amount of time. Regarding the ease of implementing agro-ecological practices due to input availability, most RIPAT farmers appeared indifferent, while non-RIPAT farmers disagreed.

3.2.4. Trial-ability

Trial-ability expresses the degree to which agro-ecological practices can be tried by farmers. With an overall mean score above 3.5 for RIPAT farmers (Table 7), it is implicit that most of them perceive the trial-ability of agro-ecological practices positively. However, most non-RIPAT farmers seem to have a negative perception of the trial-ability of agro-ecological practices. This suggests that farmers are likely to try adopting agro-ecological practices if they

are encouraged and motivated through training. Unlike non-RIPAT farmers, those exposed to the RIPAT approach received training accompanied by participatory demonstrations, leading many of them to willingly apply these practices after observing their benefits. The results in Table 7 show that most RIPAT farmers agreed that farmers may try to implement agro-ecological practices due to fewer technical challenges and easy access to information on agro-ecological farming. However, it appears that the majority of non-RIPAT farmers expressed disagreement.

Additionally, most RIPAT farmers considered that farmers may apply agro-ecological practices because agricultural goods generated using agro-ecology are marketable and fetch high prices. This aligns with the research conducted by Gunawan *et al.* (2022), which revealed that the majority of organic rice farmers in Tasikmalaya, Indonesia believed that organic rice is more expensive than non-organic rice farmers.

Table 6: Mean scores of the complexity

Statements	RIPAT farmers			Non-RIPAT farmers		
	Mean	Standard deviation	Overall mean	Mean	Standard deviation	Overall mean
It is easy to learn and understand agro-ecological practices	3.60	1.36		3.06	1.17	
Agro-ecological practices are more practicable to implement	3.96	1.05		3.34	1.04	
Agro-ecological practices are not labour intensive	2.46	1.13	3.30	2.98	1.19	3.00
It is easy to implement agro-ecological practices due to the availability of inputs	3.48	1.37		2.79	1.17	
Agro-ecological practices do not take too much time to implement	2.79	1.38		2.81	0.94	

Table 7: Mean scores of the trial-ability

Statements	RIPAT farmers			Non-RIPAT farmers		
	Mean	Standard deviation	Overall mean	Mean	Standard deviation	Overall mean
It is easy to obtain information about agro-ecological practices so farmers can perform a small trial	3.95	0.88		2.22	1.07	
The agricultural products produced under agro-ecological farming practices are more marketable, so farmers can implement agro-ecological practices in their farms	4.10	0.79	3.82	3.19	0.93	2.65
The technical difficulty of agro-ecological practices is low, so farmers can try them on their farm	3.40	1.28		2.54	1.08	

3.2.5. Observe-ability

In this study, observe-ability refers to the extent to which the results of agro-ecological practices are visible to farmers. Unlike non-RIPAT farmers, most RIPAT farmers agreed with the assertion that the performance and benefits of agro-ecological practices are easily observable (Table 8). Regarding the dissemination of agro-ecological practices, RIPAT

farmers concurred that it is simple to share an understanding of agro-ecological practices with other farmers. With overall mean scores of 4.11 and 3.42 for RIPAT and non-RIPAT farmers (Table 8), respectively, the observe-ability of agro-ecological practices was perceived positively by RIPAT farmers, while non-RIPAT farmers perceived it indifferently. During focus group discussions, it was learned that RIPAT farmers are highly attracted to and motivated by agro-ecological farming practices. For instance, conservation agriculture using nine-seeded holes for minimum soil tillage was observed by farmers to perform better in terms of increasing yield compared to conventional practices. Similarly, in banana production, using holes mixed with manure was observed to yield better results than in normal agricultural practices, where you simply dig a hole and plant a seedling.

Table 8: Mean scores of the observe-ability

Statements	RIPAT farmers			Non-RIPAT farmers		
	Mean	Standard deviation	Overall mean	Mean	Standard deviation	Overall mean
Performance and benefits of agro-ecological practices are easily observed by farmers	4.30	0.75	4.11	3.37	0.91	3.42
The understanding of agro-ecological practices is easier to be passed on to other farmers	3.91	1.40		3.47	1.06	

3.3. Overall perception of RIPAT and non-RIPAT farmers

The overall farmers' perception of agro-ecological practices was assessed using a five-point Likert scale containing 19 statements. The lowest score was 19, whereas the highest was 95, and the mean score was 67. Farmers with a mean score of 67 and above were categorized as having a positive perception of agro-ecological practices, while those with a mean score below 67 were categorized as having a negative perception.

The findings in Table 9 show a statistically significant difference between the two groups of farmers regarding the perception of agro-ecological practices ($\chi 2 = 114.863$, $p = 0.000$). The results indicate further that 81.7% of the farmers exposed to the RIPAT approach (RIPAT farmers) had a positive perception, whereas only 14.3% of farmers not exposed to the RIPAT approach (non-RIPAT farmers) had a positive perception. This difference can perhaps be attributed to the fact that farmers exposed to the RIPAT approach have knowledge of agro-ecological practices compared to their counterparts, as they received agro-ecological training, which positively influences their perception. The results validate the observation from Oyesola and Obabire (2011) that farmers with greater knowledge about organic farming tend to have a more positive perception of it than those with less knowledge. According to Meijer *et al.* (2015), farmers' perception of an innovation is strongly linked to their understanding of the innovation.

Table 9: Overall perception of RIPAT and non-RIPAT farmers on agro-ecological practices

Exposure to the RIPAT approach	Perception		Chi-Square	Sig
	Positive Perception	Negative Perception		
Non-RIPAT farmers	18(14.3%)	108(85.7%)	114.863	0.000
RIPAT farmers	103(81.7%)	23(18.3%)		

3.4. Determinants of farmers' perception

The results from the binary logistic regression model in Table 10 show that exposure to the RIPAT approach, household size, income, and access to credit had a significant influence on farmers' perception of agro-ecological practices in the study

area. The findings indicate that exposure to the RIPAT approach has a positive and statistically significant influence on farmers' perception ($p < 0.01$), with a logit coefficient (β) of 3.145. This suggests that for every one-unit increase in exposure to the RIPAT approach, farmers are 3.145 times more likely to perceive agro-ecological practices positively. Under the RIPAT approach, farmers receive agro-ecological training based on reflective and participatory demonstration in the group field. It is apparent that farmers are becoming more cognizant of agro-ecological practices as a result of training, which positively affects their perception. The findings of this study align with those of David and Abbyssinia (2017), who reported that farmers' perception of soil conservation practices in the Eastern Cape of South Africa was statistically significantly influenced by farmers' participation in extension programs on soil conservation.

The results further show that household size had a positive and significant influence on the farmers' perception of agro-ecological practices ($p < 0.05$), with a logit coefficient (β) of 0.273. This suggests that for every one-unit increase in household size, farmers are 0.273 times more likely to perceive agro-ecological practices positively. This could be associated with the labor-intensive nature of the implementation of agro-ecological practices, which requires more active labor. More family labor will be available to work in the field as the household size increases, which positively can influence perception. This finding aligns with the findings of a prior study conducted by Mekuria *et al.* (2022), that farmers' decision to implement a variety of agro-ecological practices was strongly influenced by family size, which acts as a source of active labor. A study by Kanjanja (2022) provides more support to these results that although farmers perceived that agro-ecological practices require a lot of labor, they opt to implement them since family members could perform the necessary tasks.

The results further in Table 10 show that income positively and significantly affects farmers' perceptions ($p < 0.05$), with a logit coefficient (β) of 1.206. This implies that for every one-unit increase in income, farmers are 1.206 times more likely to perceive agro-ecological practices positively. Some of the agro-ecological practices require capital expenditure. For instance, it was discovered during FGD with farmers that the majority of farmers do not keep livestock as a result the availability of manure is very scarce. This situation forces farmers to buy manure from their fellows and sometimes travel to nearby villages in search of manure which increases transportation costs. Compared to farmers in the community with lower incomes, farmers with higher incomes are more inclined to view the implementation of agro-ecological methods favorably.

In addition, access to credit had a positive and significant influence on farmers perception ($p < 0.01$), with a logit coefficient (β) of 0.951. This implies that for every one-unit increase in access to credit, farmers are 1.206 times more likely to perceive agro-ecological practices positively. This probably could be elucidated by the fact that accessibility to credits reduces the financial barriers to the implementation of agro-ecological practices. Unlike this, farmers with access to credit are able to cover the initial cost of implementation of agro-ecological practices which positively can shape their perception of the same. However, the finding contradicts with those of Thanh *et al.* (2015) and Hayran *et al.* (2018) who discovered that farmers' perception of sustainable agriculture was adversely affected by the use of credit.

Table 10: Factors influencing farmers' perception of agro-ecological practices (n = 252)

Variables	Coefficient (β)	Standard errors	Wald	Exp(B)	Sig.
Exposure to the RIPAT approach	3.145	0.467	45.305	23.221	0.000***
Sex	-0.072	0.391	0.034	0.931	0.854
Marital	-0.924	0.487	3.599	0.397	0.058
Age	-0.005	0.017	0.084	0.995	0.772
Education	0.348	0.538	0.418	1.416	0.518
Household size	0.273	0.112	5.938	1.314	0.015**
Income	1.206	0.511	5.566	3.339	0.018**
Access to information	0.580	0.528	1.210	1.787	0.271
Farm size	-0.170	0.130	1.695	0.844	0.193
Access to credit	0.951	0.375	6.431	2.588	0.011***
Constant	-9.811	3.076	10.172	0.000	0.001

N.B: -2 Log likelihood = 199.257, Cox & Snell R Square = 0.448, Nagelkerke R Square = 0.598, *** = Significant at 1% level, ** = Significant at 5% level

4. Conclusion and Recommendations

The study focused on farmers' perception of agro-ecological practices and determinants of their perception. The findings revealed that farmers' perception regarding agro-ecological practices was different between RIPAT and non-RIPAT farmers. Most of the RIPAT farmers perceived agro-ecological practices more positively than non-RIPAT farmers. The relative advantage of agro-ecological practices especially in the conservation of environmental resources and enhancement of human health and nutrition was positively perceived by both groups of farmers. In addition, both farmers consider the implementation of agro-ecological practices as too demanding in terms of labor and time. Also, the study showed that RIPAT farmers perceive agro-ecological practices are compatible with their farming experience, and social values and farmers can try to implement them to enhance agricultural production. Four variables, namely exposure to the RIPAT approach, household size, income, and access to credit influence on farmers' perception of agro-ecological practices in the study area. Exposure to the RIPAT approach is the most significant variable that positively influences farmers' perception of agro-ecological practices. Exposure to the RIPAT approach increases cognizance of agro-ecological practices mostly because farmers receive reflective and experiential training which equips them with knowledge and skills regarding the implementation of agro-ecological practices. Awareness of agro-ecological practices, which could be brought about by training, increases the likelihood of positive perception of the same. Therefore, the study recommends the implementation of additional agro-ecological training programs to augment farmers' understanding and awareness. This, in turn, has the potential to positively influence their perceptions, ultimately leading to the adoption of agro-ecological practices for sustainable food production.

Data availability statement

Data will be made available on request.

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Conflicts of interest

The authors declared that there is no conflict of interest.

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