

# Knowledge, attitudes, and perceptions: Understanding regenerative agriculture among vegetable farmers in Cross River State, Nigeria

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Received 7th February 2025; Accepted 26th February 2025

**ABSTRACT:** This study investigated the knowledge, attitudes, and perceptions of vegetable farmers regarding regenerative agriculture (RA) in Cross River State, Nigeria. With the backdrop of increasing environmental degradation and the need for sustainable agricultural practices, the research aimed to assess the current understanding of RA among farmers, identify the challenges they face in its implementation. Using a mixed-methods approach, data were collected from 300 farmers through structured surveys and focus group discussions. The majority (78%) of respondents were young and female smallholder farmers. While farmers acknowledge RA's potential benefits such as food security ( $\bar{x}$ = 3.3) and improved soil health ( $\bar{x}$  = 2.5) adoption remains limited due to financial constraints (81.3%) and insufficient training (78.0%). Moreover, the study highlights a critical gap in awareness of fundamental RA practices, which underscores the need for comprehensive educational programs and financial support. The findings advocate for community engagement initiatives and policy advocacy to foster a supportive environment for the adoption of regenerative agricultural practices. This research contributes to the understanding of RA's role in enhancing agricultural sustainability and resilience, providing a framework for future interventions aimed at empowering farmers in Cross River State.

**Keywords:** Cross River State, regenerative agriculture, sustainable farming, vegetable farmers.

## INTRODUCTION

The world's population continues to grow, adding an estimated 83 million people per year, with projections to reach an estimated 9.7 billion in 2050. A significant portion of this growth is attributed to developing countries, which contribute through higher birth rates, rapid urbanization, and increasing food demand (United Nations, 2019; De Wrachien *et al.*, 2021). The critical question remains whether agricultural production systems, especially in developing countries, can continue to meet their goals sustainably or not. Agroecosystems, unlike natural ecosystems, lack inherent balance and self-regulation, ecological succession, and are characterized by low genetic diversity and incomplete nutrient cycling, among

other things. Given the extent of land and environmental degradation that has already occurred, simply maintaining agricultural ecosystems will not be sufficient to ensure long-term agricultural production (EIT Food, 2022). This calls for an approach that goes beyond preservation and seeks to regenerate the productive capacity of natural resources (Mengistu, 2022). In the words of Moore (2021), "The creation of a new farming future will thus cascade a series of positive impacts across sectors, creating a pathway to more prosperous, resilient and sustainable futures".

Thus, regenerative agriculture (RA) suffices as one of the most recent and robust solutions within the sustainable

agriculture movement. According to the Food and Agriculture Organization (2020), building on decades of farming experience and scientific research in organic agriculture, agroecology, agroforestry, and holistic rangeland management, regenerative agriculture is a farming approach that seeks to internalize present-day negative externalities of food production. RA encompasses a wide range of farming practices aimed at the restoration and sustainable management of soil health through the sequestration of soil organic carbon. RA aims to apply the concept of “more from less” (Tittonell *et al.*, 2022). Less land area, less input of chemicals, less use of water, less emission of greenhouse gases, less risk of soil degradation, and less use of energy-based inputs.

Regenerative agriculture (RA) differs fundamentally from industrial farming by focusing on the continuous restoration of soil rather than its degradation. According to EIT Food (2022), this approach enhances the sustainability and resilience of ecosystems while providing both environmental and economic benefits to farmers, communities, and nations. RA emphasizes collaboration with nature to support essential ecological processes and services. These include nutrient cycling, nitrogen fixation, natural pest regulation, soil and water conservation, biodiversity preservation, and carbon sequestration. In addition to producing food and fiber, regenerative agricultural systems also generate various other ecosystem services (Babaniyi *et al.*, 2024). Notably distinct from organic farming, RA prioritizes no-till methods for soil stabilization, microbial activity, and sustainability, embracing core principles like minimal soil disturbance, crop diversity, soil cover, year-round living roots, and livestock integration. RA benefits diverse stakeholders, fostering environmental productivity and sustainable practices beyond conventional agriculture (Burgess *et al.*, 2019; Mpanga *et al.*, 2021).

### Problem statement

The current trajectory of conventional agricultural practices, marked by industrialization, chemical inputs, and unsustainable land management, poses a significant threat to both the environment and the socio-economic fabric of farming communities. In Cross River State, Nigeria, as in many other regions, the intensification of agriculture has led to soil degradation, loss of biodiversity, water contamination, and a myriad of interconnected issues affecting the livelihoods of arable crop farmers. The existing challenges are exacerbated by the escalating global population, which is expected to reach 9.7 billion by 2050. The negative impacts of industrial agriculture, including soil and ecosystem degradation, micronutrient loss, and biodiversity decline, call for a paradigm shift towards more regenerative and sustainable practices.

In the face of these challenges, the proposed research

recognizes the urgent need to address the detrimental consequences of current agricultural practices and seeks to empower arable crop farmers in Cross River State through the adoption of regenerative agriculture. This research aims to investigate the current knowledge, attitudes, and perceptions of farmers regarding regenerative agriculture, thereby identifying critical gap for its implementation. By doing so, the research aspires to contribute to the development of a regenerative and resilient agricultural system that not only enhances environmental sustainability but also improves the socio-economic well-being of farming communities.

### Objectives of the study

The major objective of this project is to assess the knowledge, attitudes, and perceptions of regenerative agricultural practices by vegetable farmers in Cross River State, Nigeria. The specific objectives include to:

1. describe the socioeconomic characteristics of participants.
2. to assess the current knowledge, attitudes, and perceptions of farmers on RA.
3. determine the application of regenerative agriculture practices by farmers.
4. assess the current utilisation of RA practices.
5. highlight the challenges in the implementation of regenerative agricultural practices by farmers.

## METHODOLOGY

### Study area

This study was carried out in Cross River State, which is located within the tropical rainforest belt of Nigeria. It lies between latitudes 4°28' and 6°55' north of the equator and longitudes 7°50' and 9°28' East of the Greenwich meridian. Cross River State occupies an area of 20,156 square kilometers with a population of 2.89 million (National Population Commission, 2006). The State comprises eighteen (18) Local Government Areas (LGAs), which are Abi, Akamkpa, Akpabuyo, Bakassi, Bekwarra, Biase, Boki, Calabar Municipal, Calabar South, Etung, Obanliku, Obubra, Obudu, Odukpani, Ogoja, Ikom, Yala, and Yakurr, and three agricultural zones, which are Southern, Central and Northern zones. The mangrove and rain forest belts covering Calabar agricultural zone in the South lie between latitudes 8°10' and 8°51' North and longitudes 8°10' and 5°50' East, the predominantly rainforest belt of the Ikom agricultural zone lies between latitudes 5°51' and 6°40' North and longitudes 8°10' and 8°51' East and the Northern Savannah Belt with fringes of rain forest covering Ogoja agricultural zone lies between latitudes 6°40' and

6°58' North and longitudes 8°50' and 8°31' East.

### Population, sampling technique, and sample size

The population of the study comprises all the vegetable farmers in Cross River State. A multi-stage sampling technique was adopted to select the sample size for this project. Since Cross River State consists of three (3) agricultural zones, the first stage involved a purposive selection of two (2) agricultural zones based on arable crop production, second stage involved a random selection of two (2) agricultural blocks each from each of the selected zones making a total of four (4) blocks. In the third stage, five (5) agricultural cells were selected from each of the four (4) blocks selected to make a total of twenty (20) cells. The final stage involved a random selection of 15 arable crop farmers each from the twenty selected cells to make a sample size of three hundred (300) respondents.

### Source and method of collection

Primary data was obtained using a structured questionnaire, interview schedule, and focus group discussion. The questionnaire was divided into various sections based on the specific objectives of the study. The questionnaire contained both closed-ended and open-ended items. Content validity was employed to determine the adequacy and relevance of the items in the instrument. The reliability of the instrument was determined using the test-retest technique, with a correlation score of 88.3%.

### Data analyses

Data generated from the study was analyzed using descriptive statistics such as mean, percentages, frequency distribution, and ranking. This was achieved with the aid of IBM SPSS version 23.

## RESULTS AND DISCUSSION

### Socioeconomic characteristics of respondents

The data presented in Table 1 provides a comprehensive overview of the demographic and socio-economic characteristics of vegetable farmers in the study area. The result of age distribution reveals a youthful demographic, with the most respondents (30.3%) falling within the 31-40 age range. Additionally, 28.3% are under 20 years old, suggesting a potential influx of young individuals into vegetable farming. This trend is consistent with findings in other literature, which highlight the importance of engaging younger farmers in sustainable practices to ensure the

longevity of agricultural systems (Alrawashdeh *et al.*, 2023). The gender breakdown reveals a predominance of female farmers (78%) compared to male vegetable farmers (22%). This finding aligns with existing research that demonstrates women's significant role in vegetable farming, particularly in developing countries where they often contribute substantially to food production and household nutrition (Balayar and Mazur, 2022).

Table 1 also reveals that the majority of respondents are married (55.7%), which may influence their farming practices and decisions due to shared responsibilities and resources within households. The presence of a significant number of single farmers (29.3%) also highlights a diverse demographic that may have varying motivations and challenges in agricultural engagement. According to Gcaba *et al.* (2025), married farmers prioritize stability and long-term investments, while single farmers are more receptive to new ideas and flexibility because they have fewer family responsibilities. This finding is consistent with the study's findings that marital status has a significant impact on farming decisions. This difference in viewpoints may have an impact on the sustainability and overall productivity of agriculture.

On the other hand, the educational levels of respondents show that a substantial portion has completed secondary education (34%) or attained a National Certificate in Education (36%). However, the low representation of higher education (only 5% with an M.Sc. and none with a Ph.D.) suggests a need for targeted educational programs to enhance knowledge and adoption of sustainable practices like RA. This observation is supported by the findings of Kangogo *et al.* (2021), who found of indicating that higher educational attainment is positively correlated with the adoption of innovative agricultural techniques.

The result of household size shows that 85.3% of respondents have a household size of four or fewer members, which may impact labour availability for farming activities. Additionally, the majority of farmers operate on small plots (52.7% on less than 1 hectare), emphasizing the significance of smallholder farming in the region's agricultural landscape. Also, the data reveals a strong preference for specific vegetables, with okra (97%) and waterleaf (93.3%) being the most commonly cultivated. This specialization may provide insights into market demand and local dietary preferences. However, the estimated monthly income of respondents indicates that most (38.7%) vegetable farmers earn less than ₦50,000, highlighting the economic challenges faced by vegetable farmers in the region. This finding agrees with the studies of Rahman *et al.* (2021), who discussed the financial constraints of vegetable farmers and their limited access to markets.

Furthermore, Table 1 revealed that the awareness of regenerative agriculture in Cross River State is relatively low, with only 44.7% of respondents acknowledging knowledge of RA practices. This is concerning given the

**Table 1.** Socioeconomic characteristics of respondents.

Variables	Frequency	Percentage
Age (years)		
<20	85	28.3
20-30	61	20.3
31-40	91	30.3
41-50	41	13.7
51 and above	22	7.3
Sex		
Male	66	22.0
Female	234	78.0
Marital status		
Single	88	29.3
Married	167	55.7
Widowed	21	7.0
Divorced/separated	24	8.0
Educational level		
SSCE	102	34.0
NCE	108	36.0
B.Sc.	46	15.3
M.Sc.	15	5.0
Ph.D.	0	0.0
No formal education	29	9.7
Household size		
01-Apr	256	85.3
05-Aug	35	11.7
9 and above	9	3.0
Farm size (ha)		
<1	158	52.7
01-Feb	78	26.0
2.1-3	54	18.0
3.1 and above	10	3.3
Type of vegetable cultivated*		
Pumpkin	235	78.3
Waterleaf	280	93.3
Okra	291	97.0
Melon	143	47.7
Bitter leaf	156	52.0
Amaranth (Green leaf)	208	69.3
Alternative occupation		
Civil service	69	23.0
Trading business	157	52.3
Others	52	17.3
	22	7.3

**Table 1.** Contd.

Variables	Frequency	Percentage
Years of experience in farming		
<10	213	71.0
Oct-20	61	20.3
21 and above	26	8.7
Estimated monthly income		
<50,000	116	38.7
50,000-100,000	122	40.7
100,001 – 150,000	56	18.7
150,001 and above	6	2.0
Awareness of regenerative agriculture (RA)		
Yes	134	44.7
No	166	55.3
Source of awareness		
Training/workshop	87	29.0
TV	12	4.0
Other farmers	16	5.3
Extension agents	18	6.0
NGOs	1	0.3
Other sources	0	0.0
Access to extension service		
Yes	217	72.3
No	83	27.7
Frequency of access to extension service		
Weekly	34	11.3
Twice a month	96	32.0
Monthly	148	49.3
Quarterly	22	7.3
Total	300	100

\* = multiple response

potential benefits of RA in enhancing soil health and productivity. The primary source of awareness is training and workshops (29%), indicating the need for more structured educational initiatives to promote sustainable practices. The findings reveal that access to extension services is notably high (72.3%), which is a positive indicator for the dissemination of agricultural knowledge. However, the frequency of access suggests that while farmers have access, the consistency and intensity of engagement with extension services vary, with nearly half

**Table 2.** Farmers' knowledge of regenerative agricultural practices.

S/N	Items	SA	A	D	SD	$\bar{x}$	Ranks
1.	Understanding of regenerative agriculture (RA)	89	67	124	98	2.3	17 <sup>th</sup>
2.	RA practices focus on improving soil health	78	101	145	47	2.5	9 <sup>th</sup>
3.	Crop rotation is an essential practice in RA	98	111	114	65	2.5	9 <sup>th</sup>
4.	RA can help in carbon sequestration	45	48	165	45	2.3	17 <sup>th</sup>
5.	RA practices can help in mitigating climate change	76	65	117	87	2.4	14 <sup>th</sup>
6.	Zero tillage methods are part of RA	156	67	58	39	3.0	6 <sup>th</sup>
7.	RA practices can enhance biodiversity on farms	56	87	112	68	2.4	14 <sup>th</sup>
8.	Cover cropping is beneficial in RA	132	49	98	79	2.5	9 <sup>th</sup>
9.	Livestock integration is a component of RA	137	87	26	48	3.1	3 <sup>rd</sup>
10.	RA practices reduce the need for chemical inputs	99	58	116	87	2.4	14 <sup>th</sup>
11.	RA can help in water conservation	79	65	128	77	2.3	17 <sup>th</sup>
12.	RA practices can increase farm productivity	88	212	23	14	3.1	3 <sup>rd</sup>
13.	Composting is a practice used in RA	145	78	25	32	3.2	2 <sup>nd</sup>
14.	RA helps in reducing greenhouse gas emissions	53	44	123	87	2.2	20 <sup>th</sup>
15.	The use of perennial crops is encouraged in RA	91	49	111	66	2.5	9 <sup>th</sup>
16.	RA practices can improve crop resilience to pests and diseases	98	98	23	105	2.5	9 <sup>th</sup>
17.	Mulching is an important practice in RA	138	98	25	16	3.1	3 <sup>rd</sup>
18.	RA can contribute to long-term food security	196	25	76	15	3.3	1 <sup>st</sup>
19.	RA emphasizes the use of natural fertilizers	89	77	19	45	2.7	7 <sup>th</sup>
20.	Plant diversity is crucial in RA	87	67	101	45	2.7	7 <sup>th</sup>

accessing these services monthly. Regular and targeted extension services could play a crucial role in promoting the adoption of RA practices among farmers.

### Farmers' knowledge of regenerative agriculture

The data presented in Table 2 provides a detailed overview of farmers' perceptions regarding various aspects of regenerative agriculture (RA), as indicated by the mean scores and ranks of their responses. This analysis reveals the level of understanding among farmers and highlights areas where further education and outreach may be necessary. Specifically, the item "RA can contribute to long-term food security" ( $\bar{x} = 3.3$ , rank = 1<sup>st</sup>) stands out with the highest mean score, ranking first among all items. This indicates a strong consensus among farmers regarding the critical role of RA in enhancing food security. Such findings are corroborated by existing literature, which emphasizes that sustainable agricultural practices are essential for maintaining food production systems in the face of environmental challenges, including climate change (Ayi, 2022; Wijerathna-Yapa & Pathirana, 2022). The recognition of RA's potential to secure food supplies suggests that farmers may be receptive to adopting these practices if they are adequately supported.

In contrast, several items received lower mean scores, notably "Understanding of regenerative agriculture" and "RA can help in carbon sequestration" ( $\bar{x} = 2.3$ , rank =

17<sup>th</sup>). This indicates a significant gap in farmers' awareness and comprehension of fundamental concepts related to RA. The low ranking of these items suggests that while farmers may recognize the importance of RA, they may lack a comprehensive understanding of its principles and benefits. This gap could pose a barrier to the widespread adoption of RA practices, as effective implementation often relies on a solid understanding of the underlying concepts (O'donoghue *et al.*, 2022).

Other items, such as "Zero tillage methods are part of RA," "RA practices can enhance biodiversity on farms," and "Composting is a practice used in RA," ( $\bar{x} = 3.0, 2.4$ , and 3.2, respectively). The item on zero tillage ranked 6<sup>th</sup>, highlighting farmers' acknowledgment of this practice as a beneficial component of RA. This finding aligns with that of Sadiq *et al.* (2021), who found that zero tillage can significantly improve soil health and moisture retention. Similarly, the recognition of composting as a valuable practice reflects an understanding of the importance of organic matter in enhancing soil fertility and structure. Conversely, items related to the environmental benefits of RA, such as "RA practices reduce the need for chemical inputs" and "RA can help in water conservation," ( $\bar{x} = 2.4$  and 2.3, respectively), both ranking 14<sup>th</sup> and 17<sup>th</sup>. These lower scores may reflect a lack of awareness regarding the environmental advantages of RA, which could hinder farmers' willingness to transition away from conventional practices that rely heavily on chemical inputs.

The findings reveal that while there is a strong recognition

**Table 3.** Farmers' attitude towards regenerative agricultural practices.

S/N	Items	SA	A	D	SD	$\bar{x}$	Ranks
1.	RA is a beneficial approach to sustainable farming.	134	46	87	65	2.6	14 <sup>th</sup>
2.	Willingness to adopt RA practices	117	78	76	35	2.9	5 <sup>th</sup>
3.	RA can improve farm productivity.	98	87	76	25	2.9	5 <sup>th</sup>
4.	RA practices are too difficult to implement.	221	65	24	12	3.5	1 <sup>st</sup>
5.	RA can enhance the quality of the soil on my farm.	134	14	76	15	3.0	2 <sup>nd</sup>
6.	Interest in learning more about RA practices.	102	79	34	34	2.8	7 <sup>th</sup>
7.	RA practices are more expensive than conventional methods.	78	101	37	36	2.7	10 <sup>th</sup>
8.	RA can reduce the negative environmental impact of farming.	100	87	35	65	2.7	10 <sup>th</sup>
9.	RA can increase farm resilience to climate change.	89	75	26	24	3.0	2 <sup>nd</sup>
10.	RA requires more labor than conventional farming methods.	34	5456	115	68	2.3	19 <sup>th</sup>
11.	RA can help in achieving long-term food security.	89	90	89	35	2.8	7 <sup>th</sup>
12.	RA practices might not yield immediate results.	46	58	98	45	2.2	20 <sup>th</sup>
13.	RA can improve the health of my crops.	56	89	87	35	2.7	10 <sup>th</sup>
14.	Willingness to learn and implement RA.	135	78	23	43	3.0	2 <sup>nd</sup>
15.	RA is a viable solution to combat climate change.	87	65	88	56	2.6	14 <sup>th</sup>
16.	RA practices are impractical for small-scale farmers.	34	76	54	33	2.7	10 <sup>th</sup>
17.	RA can provide economic benefits in the long run.	87	89	46	98	2.5	17 <sup>th</sup>
18.	Skepticism about the effectiveness of RA practices.	87	57	49	78	2.4	18 <sup>th</sup>
19.	RA can promote biodiversity on my farm.	76	87	68	51	2.6	14 <sup>th</sup>
20.	Motivated to transition to RA practices.	113	87	45	65	2.8	7 <sup>th</sup>

of the potential benefits of RA, particularly in terms of food security, significant gaps in understanding remain. The data suggest a pressing need for targeted educational initiatives aimed at enhancing farmers' knowledge of RA principles and practices. By addressing these gaps, stakeholders can facilitate the broader adoption of regenerative practices, ultimately contributing to more sustainable agricultural systems and improved resilience in the face of environmental challenges.

### Farmers' attitude towards regenerative agriculture

The data presented in Table 3 shows that one of the most striking findings is the item "RA practices are too difficult to implement" ( $\bar{x} = 3.5$ , rank = 1<sup>st</sup>), suggesting a prevalent concern among vegetable farmers regarding the complexity of RA practices. Such apprehension is echoed in the findings of Laurett *et al.* (2021), where challenges related to the implementation of sustainable practices are commonly cited as barriers to adoption. The perception that RA is difficult to implement may deter farmers from transitioning from conventional methods, despite the potential benefits associated with RA. The item "RA can enhance the quality of the soil on my farm" ( $\bar{x} = 3.0$ , rank = 2<sup>nd</sup>), reflecting a strong acknowledgment of the benefits of RA for soil health. This aligns with the research of Cárceles-Rodríguez *et al.* (2022) that emphasizes the critical role of soil quality in sustainable agriculture.

Furthermore, the recognition of RA's potential to increase farm resilience to climate change ( $\bar{x} = 3.0$ , rank = 2<sup>nd</sup>), underscores the growing awareness among farmers of the need to adapt to changing environmental conditions.

In contrast, the items "Willingness to adopt RA practices" and "RA can improve farm productivity" ( $\bar{x} = 2.9$ , rank 5<sup>th</sup>), indicates a moderate level of openness among vegetable farmers to adopt RA, coupled with a recognition of its potential to enhance productivity. These findings align with studies of Khangura *et al.* (2023) that highlight the positive impact of RA on agricultural output, particularly through improved soil health and biodiversity. However, the willingness to adopt is tempered by the perception of implementation challenges, suggesting that education and support may be necessary to facilitate this transition. Table 3 reveals that several items received lower scores, indicating skepticism or concerns regarding RA. For instance, "RA can provide economic benefits in the long run" ( $\bar{x} = 2.5$ , rank = 17<sup>th</sup>), suggest that farmers may doubt the financial viability of RA compared to conventional practices. This skepticism is further reflected in the item "Skepticism about the effectiveness of RA practices" ( $\bar{x} = 2.4$ , rank = 18<sup>th</sup>), which implies that such doubts may hinder the adoption of RA, as economic considerations are often paramount in agricultural decision-making.

The findings from Table 3 reveal a complex interplay of perceptions among farmers regarding regenerative agriculture. While there is a notable willingness to learn about and adopt RA practices, significant concerns about

**Table 3.** Farmers' attitude towards regenerative agricultural practices.

S/N	Items	SA	A	D	SD	$\bar{x}$	Ranks
21.	RA is a beneficial approach to sustainable farming.	134	46	87	65	2.6	14 <sup>th</sup>
22.	Willingness to adopt RA practices	117	78	76	35	2.9	5 <sup>th</sup>
23.	RA can improve farm productivity.	98	87	76	25	2.9	5 <sup>th</sup>
24.	RA practices are too difficult to implement.	221	65	24	12	3.5	1 <sup>st</sup>
25.	RA can enhance the quality of the soil on my farm.	134	14	76	15	3.0	2 <sup>nd</sup>
26.	Interest in learning more about RA practices.	102	79	34	34	2.8	7 <sup>th</sup>
27.	RA practices are more expensive than conventional methods.	78	101	37	36	2.7	10 <sup>th</sup>
28.	RA can reduce the negative environmental impact of farming.	100	87	35	65	2.7	10 <sup>th</sup>
29.	RA can increase farm resilience to climate change.	89	75	26	24	3.0	2 <sup>nd</sup>
30.	RA requires more labor than conventional farming methods.	34	5456	115	68	2.3	19 <sup>th</sup>
31.	RA can help in achieving long-term food security.	89	90	89	35	2.8	7 <sup>th</sup>
32.	RA practices might not yield immediate results.	46	58	98	45	2.2	20 <sup>th</sup>
33.	RA can improve the health of my crops.	56	89	87	35	2.7	10 <sup>th</sup>
34.	Willingness to learn and implement RA.	135	78	23	43	3.0	2 <sup>nd</sup>
35.	RA is a viable solution to combat climate change.	87	65	88	56	2.6	14 <sup>th</sup>
36.	RA practices are impractical for small-scale farmers.	34	76	54	33	2.7	10 <sup>th</sup>
37.	RA can provide economic benefits in the long run.	87	89	46	98	2.5	17 <sup>th</sup>
38.	Skepticism about the effectiveness of RA practices.	87	57	49	78	2.4	18 <sup>th</sup>
39.	RA can promote biodiversity on my farm.	76	87	68	51	2.6	14 <sup>th</sup>
40.	Motivated to transition to RA practices.	113	87	45	65	2.8	7 <sup>th</sup>

implementation difficulties and skepticism regarding long-term benefits persist. Addressing these challenges through targeted education and support initiatives will be essential for promoting the adoption of RA practices. By enhancing farmers' understanding and confidence in the viability of RA, stakeholders can facilitate a transition towards more sustainable agricultural systems, ultimately contributing to improved environmental outcomes and food security.

### Farmer's perception of regenerative agriculture

Results in Table 4 offer a comprehensive overview of farmers' perceptions regarding various aspects of regenerative agriculture (RA) practices, particularly in the context of vegetable farming. Notably, the item "The quality of vegetables produced through RA is superior to conventional methods" ( $\bar{x} = 3.5$ , rank = 1<sup>st</sup>) suggests a strong belief among farmers in the qualitative advantages of RA, aligning with existing research that indicates regenerative practices can lead to higher nutritional values and better taste in produce (Miller-Klugesherz and Sanderson, 2023). This perception is crucial as it may motivate farmers to adopt RA practices, viewing them as beneficial not only for the environment but also for consumer satisfaction and market competitiveness.

On the other hand, the perception that "RA practices are more labor-intensive compared to conventional farming" ( $\bar{x}$

= 2.9, rank = 3<sup>rd</sup>), indicates a common concern about the labor demands of RA. This aligns with findings of Ntawuhiganayo *et al.* (2023), suggesting the transition to regenerative practices often requires more hands-on management and labor, particularly in the initial stages of implementation. Such perceptions may deter farmers, especially those operating on limited resources or labor availability.

Interestingly, the item "RA practices can help in conserving water resources" and "RA can significantly reduce soil erosion on my farm" ( $\bar{x} = 2.8$ , rank = 4<sup>th</sup>), reflect an understanding of the environmental benefits associated with RA, which is in line with Ghosh *et al.* (2024), who emphasized the role of regenerative practices in promoting water conservation and reducing erosion. This recognition is vital, as it frames RA as not only a method for enhancing productivity but also as a means to address pressing environmental challenges. However, several items received lower scores, suggesting lingering doubts among farmers. For instance, the statement "RA can help in achieving long-term food security" ( $\bar{x} = 2.5$ , rank = 18<sup>th</sup>), indicating a lack of confidence in the long-term viability of RA for ensuring food security, despite its potential benefits. This skepticism reflects broader concerns within the agricultural community regarding the immediate versus long-term outcomes of transitioning to regenerative methods.

The findings from Table 4 reveal a complex landscape of perceptions regarding regenerative agriculture among

**Table 4.** Farmer's perception of regenerative agriculture

S/N	Items	SA	A	D	SD	$\bar{x}$	Ranks
1.	RA practices can improve vegetable yield.	98	58	110	45	2.7	8 <sup>th</sup>
2.	RA practices are more sustainable than conventional farming	89	54	68	67	2.6	11 <sup>th</sup>
3.	RA can enhance soil fertility for vegetable farming.	88	69	77	89	2.4	20 <sup>th</sup>
4.	RA practices are suitable for the climate	98	76	88	54	2.8	4 <sup>th</sup>
5.	RA is more labor-intensive compared to conventional farming.	117	78	76	35	2.9	3 <sup>rd</sup>
6.	RA can reduce the need for chemical fertilizers and pesticides.	98	87	76	25	2.8	4 <sup>th</sup>
7.	The quality of vegetables produced through RA is superior to conventional methods.	221	65	24	12	3.5	1 <sup>st</sup>
8.	RA practices can help in conserving water resources.	134	14	76	15	3.0	2 <sup>nd</sup>
9.	RA methods are cost-effective in the long run.	34	76	54	33	2.7	8 <sup>th</sup>
10.	RA can improve biodiversity on the farm.	87	89	46	98	2.5	18 <sup>th</sup>
11.	RA can help farms become more resilient to climate change.	89	65	71	67	2.6	11 <sup>th</sup>
12.	RA practices can lead to higher market value for vegetables.	98	47	43	56	2.6	11 <sup>th</sup>
13.	RA practices are practical and feasible for small-scale vegetable farmers.	98	89	65	78	2.6	1 <sup>th</sup>
14.	RA can significantly reduce soil erosion on my farm.	89	65	78	45	2.8	4 <sup>th</sup>
15.	RA can help in reducing farming costs over time.	98	47	89	76	2.6	11 <sup>th</sup>
16.	RA practices can improve the taste and nutritional value of vegetables.	89	54	37	89	2.6	11 <sup>th</sup>
17.	RA practices require a high level of expertise and knowledge.	95	47	17	87	2.6	11 <sup>th</sup>
18.	RA practices can positively impact the environment.	98	57	87	48	2.7	8 <sup>th</sup>
19.	RA can help in achieving long-term food security.	88	67	69	115	2.5	18 <sup>th</sup>
20.	The benefits of RA outweigh the challenges associated with its implementation.	110	76	67	45	2.8	4 <sup>th</sup>

vegetable farmers. While there is strong recognition of the qualitative benefits of RA, significant concerns regarding labor intensity and skepticism about soil fertility enhancement persist. Addressing these concerns through targeted education and demonstration projects may be essential for fostering greater confidence in RA practices. By enhancing farmers' understanding of the long-term benefits and practical implementation of RA, stakeholders can facilitate a more widespread adoption of these sustainable practices, ultimately contributing to improved agricultural resilience and environmental sustainability.

#### Application of regenerative agriculture by farmers

The data presented in Table 5 provides an insightful analysis of the frequency with which various regenerative agriculture (RA) practices are employed by farmers. One of the most significant findings is the high ranking of "Intercropping" ( $\bar{x} = 3.2$ , rank = 1<sup>st</sup>). This suggests that farmers frequently engage in this practice, likely due to its recognized benefits in enhancing biodiversity and improving soil health, as documented in previous studies. The popularity of intercropping may stem from its ability to optimize land use and mitigate pest pressures, aligning

well with the principles of sustainable agriculture. Additionally, the practices of "Organic compost or manure" and "Maintaining a diverse range of crops to enhance biodiversity" ( $\bar{x} = 3.0$ , rank = 2<sup>nd</sup>), indicating a strong inclination towards these practices, which are fundamental to enhancing soil health and promoting ecological balance. The emphasis on organic amendments is consistent with the studies of Bertola et al. (2021), which suggests that organic practices can significantly improve soil fertility and microbial diversity.

In contrast, the item "Water conservation techniques, such as drip irrigation," ranked lowest ( $\bar{x} = 1.7$ ). This low frequency of adoption may reflect barriers such as high initial costs and a lack of access to appropriate technology, which align with the findings of indicating that financial constraints often hinder the adoption of water-saving technologies (Tai *et al.*, 2024). The limited use of such techniques is concerning, given the increasing challenges posed by climate change and water scarcity. Conversely, the items "Crop rotation" and "Integration of livestock into existing farming systems" ( $\bar{x} = 2.2$ , rank = 10<sup>th</sup>), suggesting that while these practices are recognized as beneficial, they are not frequently employed. This finding resonates with studies that highlight the complexities involved in implementing crop rotation and integrated livestock

**Table 5.** Application of regenerative agriculture by vegetable farmers

S/N	Items	Never	Rarely	Often	Always	$\bar{x}$	Ranks
1.	Cover crops	45	67	87	99	2.8	6 <sup>th</sup>
2.	Crop rotation	110	35	87	34	2.2	10 <sup>th</sup>
3.	Integration of livestock into existing farming system	156	67	76	46	2.2	10 <sup>th</sup>
4.	Minimal soil disturbance by using no-till or minimal-till	154	78	67	65	2.4	8 <sup>th</sup>
5.	Organic compost or manure	23	67	89	87	3.0	2 <sup>nd</sup>
6.	Agroforestry practices (e.g., planting trees among crops).	123	48	56	23	1.8	17 <sup>th</sup>
7.	Maintaining diverse range of crops to enhance biodiversity	12	47	88	87	3.0	2 <sup>nd</sup>
8.	Natural pest control methods	87	87	68	57	2.3	9 <sup>th</sup>
9.	Mulching to retain soil moisture	9	78	100	46	2.9	4 <sup>th</sup>
10.	Intercropping	0	88	76	149	3.2	1 <sup>st</sup>
11.	Water conservation techniques, such as drip irrigation.	156	65	12	15	1.7	18 <sup>th</sup>
12.	Checking soil health indicators (e.g., organic matter content, soil pH) regularly.	122	87	24	18	2.0	14 <sup>th</sup>
13.	Participation in training programs on RA practices.	145	21	78	56	2.2	10 <sup>th</sup>
14.	Collaboration with other farmers to share knowledge and resources on RA.	152	26	54	13	1.9	16 <sup>th</sup>
15.	Utilization of green manure to improve soil fertility.	23	89	98	57	2.7	7 <sup>th</sup>
16.	Maintaining living roots in the soil year-round	69	76	36	68	2.2	10 <sup>th</sup>
17.	Adoption of practices that enhance carbon sequestration	187	16	14	36	1.7	18 <sup>th</sup>
18.	Active monitoring and management of soil erosion	14	18	156	35	2.9	4 <sup>th</sup>
19.	Use of renewable energy sources (e.g., solar, wind)	198	102	0	0	1.3	20 <sup>th</sup>
20.	Seeking advice from agricultural experts on RA implementation.	176	34	87	35	2.0	15 <sup>th</sup>

systems, which often require significant changes in management practices and may be perceived as risky by farmers (Darnhofer *et al.*, 2010).

The findings in Table 5 illustrates a varied landscape of RA practice adoption among farmers, highlighting both strengths and areas for improvement. While practices like intercropping and organic composting are widely adopted, significant gaps exist in the use of water conservation techniques and practices that enhance carbon sequestration. Addressing these gaps through targeted education, access to resources, and financial support will be crucial for promoting the broader implementation of regenerative agriculture. As the agricultural sector faces mounting environmental challenges, fostering a deeper understanding and application of RA practices will be essential for achieving sustainable agricultural systems and enhancing resilience to climate change.

#### Utilization of regenerative agricultural practices

Table 6 shows that the practice of cover cropping ( $\bar{x} = 3.4$ , rank = 1<sup>st</sup>) emerged as the most frequently utilized method. This high adoption rate aligns with the findings of Koudahe

*et al.* (2022), which underscores the benefits of cover crops in enhancing soil health, preventing erosion, and improving moisture retention. The strong inclination towards cover cropping suggests that farmers recognize its multifaceted advantages, which may encourage further adoption of other RA practices. The practices of reduced fertilizer usage and use of legumes ( $\bar{x} = 3.2$ , rank = 2<sup>nd</sup>), indicate a strong commitment among farmers to reduce chemical inputs and enhance soil fertility through natural means. Furthermore, practices such as no-till farming, crop rotation, and polyculture and crop diversity ( $\bar{x} = 3.0$ , rank = 4<sup>th</sup>). These methods are well-documented in agricultural studies for their roles in improving soil structure and biodiversity (Levin, 2022; Khangura *et al.*, 2023). However, the moderate adoption rates suggest that while farmers appreciate the benefits, practical challenges such as knowledge gaps and resource limitations may impede broader implementation.

In contrast, renewable energy integration ranks lowest ( $\bar{x} = 1.8$ ). This finding resonates with the findings of Rahman *et al.* (2021), which indicates that financial constraints and lack of technical knowledge often hinder the adoption of renewable energy solutions in agriculture. The minimal use of renewable energy highlights a

**Table 6.** Utilization of regenerative agricultural practices by vegetable farmers.

S/N	RA practices	Frequently used	Occasionally used	Rarely used	Not Used	$\bar{x}$	Rank
1.	Cover Cropping	189	56	35	0	3.4	1 <sup>st</sup>
2.	No-Till Farming	78	98	36	25	3.0	4 <sup>th</sup>
3.	Crop Rotation	13	76	14	15	3.0	4 <sup>th</sup>
4.	Compost Use	148	19	57	25	2.9	8 <sup>th</sup>
5.	Agroforestry	23	14	102	89	2.1	17 <sup>th</sup>
6.	Integration of Livestock	78	45	6	45	2.9	8 <sup>th</sup>
7.	Polyculture and Crop Diversity	98	78	35	12	3.0	4 <sup>th</sup>
8.	Conservation Tillage	13	56	109	67	2.2	15 <sup>th</sup>
9.	Biological Pest Control	14	16	138	68	2.0	18 <sup>th</sup>
10.	Integrated Pest Management (IPM)	9	18	98	78	2.2	15 <sup>th</sup>
11.	Soil Health Monitoring	6	21	98	133	1.9	19 <sup>th</sup>
12.	Seed Saving and Plant Breeding	17	67	79	87	2.4	13 <sup>th</sup>
13.	Renewable Energy Integration	0	5	158	98	1.8	20 <sup>th</sup>
14.	Use of legumes	179	16	18	41	3.2	2 <sup>nd</sup>
15.	Avoiding bush burning	123	79	34	12	3.0	4 <sup>th</sup>
16.	Use of quality seeds	59	99	101	0	2.6	11 <sup>th</sup>
17.	Reduced fertilizer usage	156	45	12	34	3.2	2 <sup>nd</sup>
18.	Water Harvesting and Management	25	88	79	36	2.4	13 <sup>th</sup>
19.	Biochar Application	15	101	87	43	2.5	12 <sup>th</sup>
20.	Keeping living roots in the soil year-round	76	56	99	19	2.8	10 <sup>th</sup>

significant gap in the potential for sustainable practices that could mitigate greenhouse gas emissions and reduce dependency on fossil fuels. Also, the low rankings of biological pest control and soil health monitoring, ( $\bar{x} = 2.0$  and 1.9, respectively), indicate a concerning trend. The limited adoption of biological pest control methods may reflect a reliance on conventional chemical pesticides, which contradicts the principles of sustainability inherent in regenerative practices. Furthermore, the lack of regular soil health monitoring underscores a critical gap in farmers' practices, as understanding soil health is essential for effective management and the successful implementation of RA.

The results in Table 6 illustrate a diverse landscape of RA practice adoption among vegetable farmers, revealing both strengths and areas for improvement. While practices such as cover cropping and reduced fertilizer usage are widely embraced, significant barriers remain for methods like renewable energy integration and biological pest control. Addressing these gaps through targeted education, access to resources, and financial incentives will be essential for promoting the broader implementation of regenerative agriculture. As the agricultural sector faces increasing environmental challenges, enhancing farmers' capabilities and confidence in adopting sustainable practices will be crucial for fostering resilience and sustainability in food systems.

### Challenges in the implementation of regenerative agriculture

The results in Table 7 reveal that a significant challenge in the implementation of RA practices, identified in the study area, is financial constraints, reported by 81.3% of respondents. The high percentage implies a need for targeted financial support and incentives to facilitate the adoption of RA. This finding is consistent with the findings of Rahman *et al.* (2021), which emphasizes the financial challenges faced by farmers, particularly in developing regions, where the initial costs of transitioning to sustainable practices can be prohibitive. Additionally, the majority (78.0%) of respondents identified insufficient information and training as another critical barrier. This implies that the lack of training not only limits farmers' understanding of RA but also contributes to their reluctance to adopt these practices, suggesting that comprehensive educational programs are essential for fostering a more informed farming community. This aligns with studies of Kangogo *et al.* (2021), which highlight the importance of education and knowledge dissemination in promoting sustainable agricultural practices.

Conversely, the issues of labor availability and resistance from fellow farmers were reported less frequently, at 22.3% and 21.7%, respectively. While these barriers are significant, their lower prevalence suggests

**Table 7.** Challenges faced by farmers in the implementation of regenerative agriculture

S/N	Items	Yes	
		Freq.	%
1.	Insufficient information and training on regenerative agriculture practices	234	78.0
2.	Financial constraints	244	81.3
3.	Difficulties in sourcing appropriate seeds or plant materials	198	66.0
4.	Problems of adapting regenerative agriculture practices to specific farm conditions	201	67.0
5.	Problems of labor availability	67	22.3
6.	Inaccessibility of necessary equipment or tools	124	41.3
7.	Resistance or skepticism from fellow farmers or community members	65	21.7
8.	Regulatory or policy	33	11.0
9.	Poor monitoring and observation of the effectiveness of RA practices	65	21.7
10.	Problems of integrating RA practices with other farming activities	101	33.7

that they may be less critical than financial and informational constraints. However, the presence of skepticism within the community could hinder collective action and knowledge sharing, which are vital for successful transitions to RA (Kenny and Castilla-Rho, 2022).

The findings in Table 7 reveal several key barriers to the adoption of regenerative agriculture among vegetable farmers, with financial constraints and insufficient training emerging as the most significant challenges. Addressing these barriers through targeted educational initiatives and financial support will be essential for enhancing the uptake of RA practices. Furthermore, fostering a supportive community environment and ensuring access to appropriate resources will be critical for overcoming the challenges identified. As the agricultural sector increasingly confronts environmental pressures, understanding and addressing these barriers will be vital for promoting sustainable agricultural practices that enhance resilience and sustainability in food systems.

## Conclusion

This study reveals the complex landscape of regenerative agriculture (RA) adoption among vegetable farmers in Cross River State, Nigeria. The findings reveal that while there is a significant awareness of the potential benefits of RA practices—such as improved soil health, enhanced biodiversity, and long-term food security—substantial barriers hinder their widespread implementation. Chief among these barriers are financial constraints and insufficient access to training and information. Furthermore, the findings indicate that a considerable proportion of farmers face challenges in sourcing appropriate seeds and adapting RA practices to their specific conditions, further complicating the transition to more sustainable farming methods.

Moreover, while practices such as cover cropping and reduced fertilizer usage are gaining traction, the adoption of other critical methods, such as biological pest control and renewable energy integration, remains limited, suggesting a need for targeted interventions that address both the knowledge gaps and the practical challenges faced by farmers. The findings also highlight the importance of community dynamics, as resistance from fellow farmers can significantly influence individual decisions regarding the adoption of RA practices. Overall, the study emphasizes the necessity of fostering a supportive environment that encourages collaboration and knowledge sharing among farmers. From the findings, the following recommendations were made:

1. The state's ministry of agriculture should develop and implement comprehensive training programs focused on regenerative agriculture practices. These programs should be tailored to the specific needs and conditions of vegetable farmers in Cross River State, ensuring that they are relevant and applicable.
2. Policymakers should consider establishing financial assistance programs, such as grants or low-interest loans, to help farmers offset the initial costs associated with transitioning to RA practices. This financial support could alleviate the burden of upfront investments and encourage more farmers to adopt sustainable methods.
3. To combat skepticism and resistance among farmers, the ministry of agriculture should establish community engagement initiatives. These could include workshops, field demonstrations, and peer-to-peer learning opportunities that facilitate knowledge sharing and showcase the benefits of RA practices.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

## ACKNOWLEDGEMENT

The researchers would like to acknowledge the Tertiary Education Trust Fund (TETFund) for sponsoring this research in the 8<sup>th</sup> batch of the Institution Based Research (IBR).

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