Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1471 – 1479
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6523

Climate Change Adaptation Variations Influencing Market Participation and Performance among Youth Farmers

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Abstract

Climate change adaptation has been essential for food security. Agricultural market participation and performance depend on climate change adaptation, posing the need for farmers to adapt to climate change to meet the food demand. The current study sought to investigate how climate change adaptation variations influence youth farmers' market participation and performance. The study was conducted in the Thulamela local municipality of the Limpopo Province. The study used the purposive sampling method to select the 115 young farmers. The study used in-person interview sessions to administer structured questionnaires to the study participants. The study findings noted that climate change adaptation variation significantly influences market participation and performance among farmers. The study findings uncovered that farmers who did not adapt to climate change settle for an informal market and must keep revenue records due to inconsistency. While farmers who had adapted to climate change had secured market shares in the formal agricultural markets. The study recommends that future research be tailored towards the blended use of climate change adaptation strategies, which significantly enhance product qualities and improve market performance.

Keywords: *Agricultural Markets, Climate Change Adaptation, Youth Farmers, Market Participation, Variation.*

Introduction

Food security, farm earnings, human well-being, and the economy depend on agricultural products, making agriculture the foundation of rural economies (Baldwin et al., 2023). However, the effects of climate change have badly impacted the sector worldwide, with Africa being the most severely affected (Habib-ur-Rahman et al., 2022). Climate change is expected to have substantial societal repercussions and present a significant obstacle to the spread of equitable and sustainable agriculture (Jaiswal et al., 2024). Furthermore, it has been established that the negative impact of climate change will result in a deterioration in animal health, productivity, and food security (Noko, 2023). Climate change brings new dynamics and uncertainties, affecting agricultural production, market participation, and performance (Gomez-Zavaglia et al., 2020). In a Habib-ur-Rahman et al. (2022) study, young farmers are most vulnerable to climate change due to low resources, low farming experience, and lack of access to the market. Hence, a study by Chepkoech et al. (2020) concluded that elderly farmers have a more substantial adaptive capacity than younger farmers due to older farmers having more experience in production and accumulating more assets than younger farmers. From the global perspective, the effectiveness of adaptation is significantly influenced by the adaptation variations primarily associated with the techniques and skills used, according to Muriithi (2021), understanding which crop to rotate and which rotation cycles are necessary for crop rotation. Moreover, crop rotation is favored by many smallholder farmers due to its links to increased yields, enhanced soil fertility, and decreased incidence of pests and diseases (Garwi et al., 2024). However, Zia et al. (2022) have demonstrated recently that although crop rotation planning yields long-term benefits, there is always a chance of short-term revenue losses, which reduces farmers' market performance and participation.

Climate variation harms the agriculture industry, groundwater, nutrition, soil quality and organic matter, health, and poverty (Panda et al., 2019). A study conducted by Fahad and Wang (2020) outlined that farmers in Pakistan employ a variety of adaptation techniques, such as altering the type of fertilizer used, crop variety, pesticides, seed quality, water storage, diversifying their farms, planting shade trees, using irrigation techniques in response to climate change. According to Raza et al. (2019), climate-smart agriculture is the only approach to mitigate the detrimental impact of climate changes on crop adaptability before they

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severely affect global crop production. Young farmers lacking financial support find adapting to climate change more challenging. This is primarily because farmers with access to capital and cash flows may choose to invest in more costly but effective farming practices, potentially lessening the adverse effects of climate change on food production (Maja & Ayano, 2021; Pickson & He, 2021). Furthermore, the inability to adapt to climate change's effects has resulted in global food insecurity, unsustainable operations, and poor agricultural output (Amare et al., 2018). Numerous adaptation measures to lessen the effects of climate change have been emphasized in previous studies; however, the high cost of climate mitigation strategies discourages most young people from engaging in agriculture (Yami et al., 2019). It has been noted that there is a need to tailor climate change adaptation variation to address local needs and their unique features (Wakatsuki et al., 2023). Furthermore, it has been noted that the likelihood of implementing climate-smart farming techniques is enhanced with gained farming experience despite the financial implications (Takele et al., 2019). A study by Tang and Hailu (2020) concluded that farmers' profitability and market competitiveness are enhanced by climate change adaptation despite the high cost of adaptive techniques. Against this backdrop, the current study sought to investigate the influence of climate change adaptation variation on market participation and performance among youth farmers.

Materials and Methods

Study Area

The study was undertaken in Vhembe District, which falls under the Limpopo province; the study area has four local municipalities: Thulamela, Musina, Makhado and Collins Chabane. Vhembe district is one of the five districts in the Limpopo province. Agricultural production is a vital economic activity in the Vhembe district (Maponya, 2021).

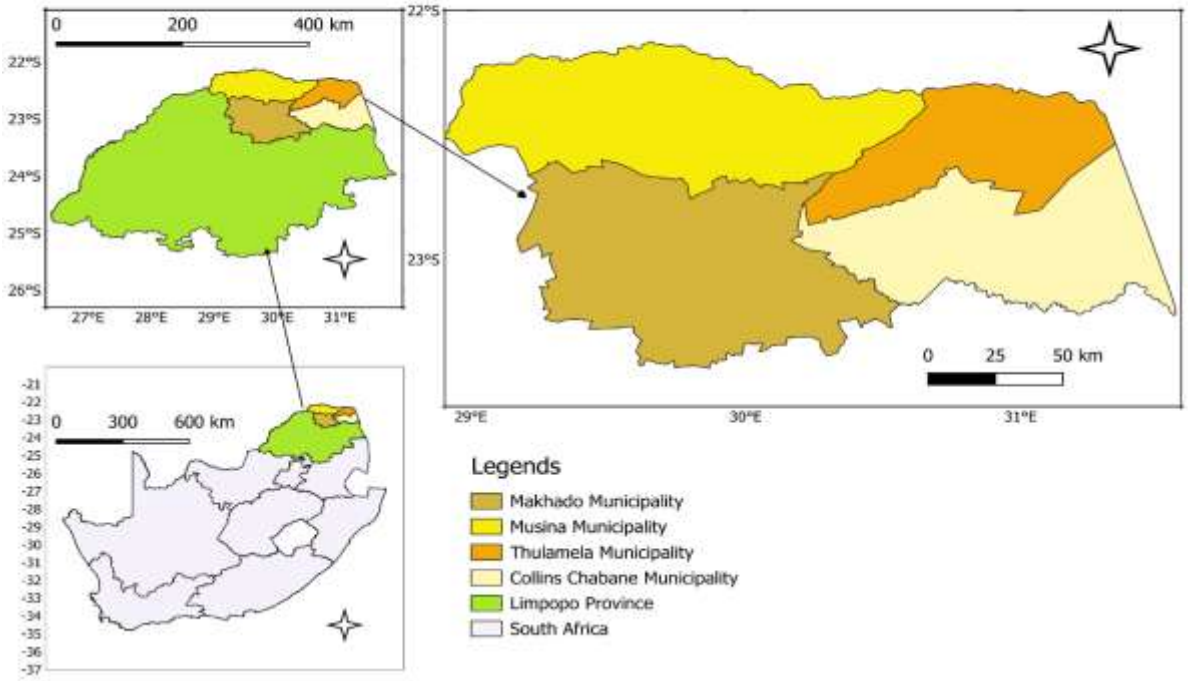

Figure 1. Map Showing the Study Area

Source: University Of Venda, GIS (2024).

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Sampling Technique and Data Collection

The purposive sampling method was employed in the study to select 115 youth crop farmers. Purposive sampling is a non-probability sampling technique where the researcher selects only those subjects that satisfy the objectives of the study based on the researcher's conviction (Obilor., 2023). The participants went through individual interviews, wherein structured questionnaires were administered.

Empirical Model

The binary logistic regression method was utilized to investigate the market participation and performance influenced by climate change adaptation variations among youth crop farmers. Binary logistic regression is a statistical approach for estimating the association between a dichotomous dependent variable (with just two possible outcomes) and independent variables (Harris, 2021). The dependent variable of the study was measured as farmers' climate change adaptation efforts (adapt=0 or do not adapt=1).

The binary model employed in this study can be specified as follows:

$$logit\ P = In\left(\frac{P}{1-p}\right) = \beta 0 + \beta 1X_1 + \beta 2X_2 + \beta 3X_3 + \cdots + \beta nX_n + \epsilon$$

Where,

- P is the probability
- $(\frac{P}{1-P})$ is the odds of .
- β_0 is the intercept term
- $\beta_1 - \beta_n$ (all the independent variables).
- ϵ is the error term

the following variables will be fitted in the binary logistic model.

Logit (probability) = In $(\frac{P}{1-P})$ = $\beta_0+\beta_1+\beta_2+\beta_3+\beta_4+\beta_5+\beta_6+\beta_7+\beta_8+\beta_9+\beta_{10}+\beta_{11}\cdots+\beta_nX_n+\epsilon$

Table 1. Description of the Explanatory Variables Used for the Analysis

Variable	Measurement	Expected sign
Market access	no access=0, access=1	+
Transaction arrangements	informal=0, formal=1	+
Type of markets	local=0, national=1, international= 2	+/-
Market security	not security=0, secured=1	+
Quantity supplied	decreased=0, stable=1, increase=2	+
Quantity sold	decreased=0, stable=1, increase=2	+
Revenue trends	low=0, moderate=1, high=2	+
Standards and variation	low grade=0, high grade=1	+
Customer recruitment	non-satisfactory=0, satisfactory=1	+
Customer retention	low=0, moderate=1, high=2	+
Business continuity	not viable=0, viable=1, established=2	+
Selling price	lowers=0, stable=1, increases=2	+/-

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Source: Field survey (2024).

Results and Discussion

Discussion of Socioeconomic Characteristics Distribution Results

The distribution of the socioeconomic characteristics of the young farmers within the study sample is shown in Table 2 below. The study uncovered that most agripreneurs were females, comprising up to 60% of the study sample. Regarding age group, the dominant group within the study sample were farmers ages 24 and 29 (47.8%), followed by those between the ages 30 and 35 (35.7%). In comparison, young farmers between the ages of 18 and 23 were the minor participants, with 16.5%. Most of the farmers had secondary education qualifications, accounting for 67% of the study sample, which could be because most farmers were young, still vibrant, and willing to learn.

Regarding land ownership, most farmers do not own the land; they have a Permission to Occupy (P.T.O) from the tribal authorities at 86.1%, and only 13.9% of the farmers have inherited the land. Regarding farming experience, most farmers had between 1 and 5 years of experience, accounting for 72.2%, followed by those who have operated for less than a year. Most of the farmers within the study sample operated on five hectares, followed by farmers that operated on three to four hectares.

Table 2. Distribution Of Socio-Economic Characteristics the Study Participants

Variable	Frequency	Percentage
Gender of respondent		
Female	69	60
Male	46	40
Age group		
18-23 years	19	16.5
24-29 years	55	47.8
30-35 years	41	35.7
Farming experience		
Less than 1 year	19	16.5
Between 1-5 years	83	72.2
More than 5 years	13	11.3
Educational level		
Primary Education	8	6.9
Secondary Education	77	67
Tertiary Education	30	26.1
Land size		
1-2ha	19	16.5
3-4ha	36	31.3
5ha and above	60	52.2
Land ownership		
Rent	-	0
Inherit	16	13.9
PTO	99	86.1
Total	**115**	**100%**

Source: Field Survey (2024).

According to Figure 2, the findings show the bar graph representing the type of adaptive strategies farmers used farmers in the study area, where environmental strategies such as crop rotation, crop management, crop diversification, crop substitution, and soil conservation accounted for 45.41%, followed by biological strategies such as rain harvesting and cover crops accounting for 30.92%. In contrast, chemical strategies

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such as fertilizer usage and technological strategies such as resilient seeds, irrigation systems, and mixed landscapes had the least, with 19.32% and 4.35%, respectively. Most farmers prefer environmental strategies for their financial implications. The results are consistent with the results of Suhaeb et al. (2024), who indicate that economically disadvantaged communities often rely on low-cost, traditional methods of climate change adaptation, which, while effective in some contexts, may not always provide sufficient to give them an argument.

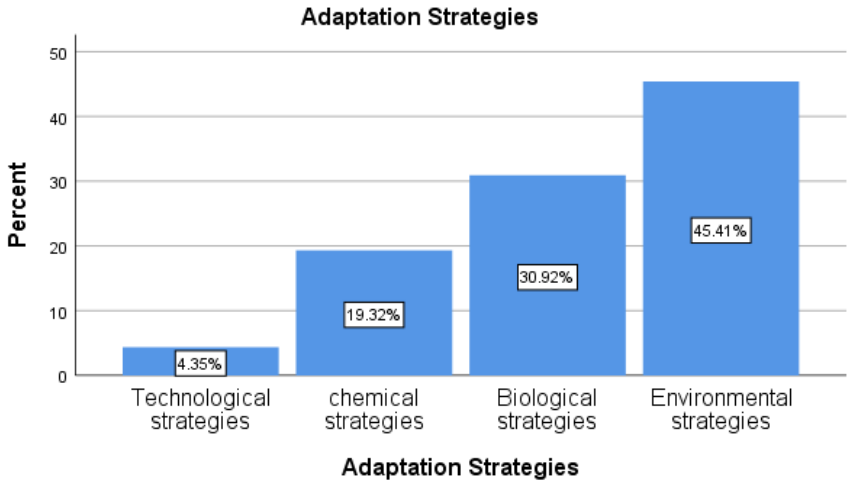

Figure 2. The Distribution of the Climate Change Adaptive Strategies

Discussion on Economic Dynamics Pertaining the Market Participation

Market Security

As part of the market participation, climate change adaptation statistically and significantly influenced market security. The study findings revealed that market security was statistically significant at a 10% significance level. From the study, it can be noted that farmers who had adapted to climate change had secured market shares in formal markets. Furthermore, farmers who had adapted to climate change using environmental and biological strategies were leading in the local markets, while those who had adapted to technological strategies, mainly resilient seeds, had a larger market share at national markets. The study findings imply that although adapting to climate change is costly, it positions farmers to gain market share. Furthermore, the study findings imply that using cost-friendly adaptation strategies, such as environmental and biological ones, gives farmers a better chance to compete in the market. However, it does not give them the edge that those using technological strategies do. The study findings were supported by Abegunde et al. (2019), who stated that farmers only adopt climate change adaptation strategies or practices if they are guaranteed returns on investment and a secured market since adapting to the adaptive strategies is costly. Another study by Gugissa et al. (2022) showed that using climate-resilient seeds improves farmers' productivity, which later helps them secure a market. Conversely, the study findings also suggest that farmers who do not adapt to climate change lose their market competitive advantage over those who have adapted to climate change due to low productivity and poor product quality.

Type of Markets

The results in Table 3 indicate that farmers' efforts to adapt to climate change influenced the types of markets where they would eventually sell their produce. The study findings have revealed differentials in the type of markets that various groups of farmers are likely to participate in. Furthermore, the results uncovered that the types of adaptation practices significantly influenced market participation at a 5% significance level. The study revealed that most farmers who did not adapt to climate change essentially sold their produce in the informal markets compared to their counterparts who sold their produce in the

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semi-structured and high-value markets. The current study's findings indicate that farmers who did not adapt to climate change mainly sold their produce in the informal market, such as the farm gate and the roadside. Landaverde et al. (2023) found that farmers who do not adopt climate change adaptation strategies could not compete in formal markets due to low-quality products. Most farmers who participated in the two markets mentioned above indicated difficulties securing the market contracts and failure to meet the market standards. Meanwhile, farmers who had adapted to climate change had the opportunity to sell their produce in the formal markets, mainly agricultural high-value fresh-produce markets and selling contracts. The study findings indicate that only some farmers could secure marketing contracts and produce seasonal crops. According to Dubbert and Abdulai (2022), farmers participating in market contracts have significantly higher production yields. Moreover, the study findings suggest that adapting to climate change gives farmers the edge to compete in formal markets, as it enhances their product qualities. The study findings imply that variations in adaptation practices will significantly influence farmers meeting market standards for various markets. As alluded, farmers relying on environmental and biological strategies have participated mainly in formal yet short-term agricultural markets such as farmers' and village markets. Those who have opted for technological and chemical strategies, exceptionally resilient seeds, irrigation systems, and fertilizer usage had the edge in agricultural national markets.

Discussion on Economic Dynamics Pertaining the Market Performance

Revenue Trends

Regarding the revenue trends, the findings revealed that farmers who had adapted to climate change had better revenue trends, with most achieving stable and gradually increasing revenues. Moreover, the results uncovered that the types of adaptation practices significantly influence revenue trends at a 5 % significance level. From the findings, most farmers who had adapted to climate change indicated that they had noted a steady increase in their revenues. However, the volatility within the agricultural markets has recently become common. A study by Ojo and Baiyegunhi (2020) showed that individuals who implemented the adaptive strategies had a much higher average net income per rice farm than those who did not; this study is also supported by Nyang'au et al. (2021), which states that farmers who adapt to climate-adaptive strategies are likely to have high income compared to the farmers that do not adapt. The study findings imply that only adapting farmers have experienced market gains due to their participation in high-value markets compared to their counterparts. It is also evident that farmers who did not adapt to climate change could not be accounted for the revenue due to their non-participation in the formal markets. Most non-adapting farmers could not indicate revenue trends due to low sales and inconsistency. Furthermore, the study findings also suggest that the market performance for those who had adapted to climate change was desirable in that they had experienced gradually increasing revenues. This could be primarily influenced by the product quality that has met the market standards, as noted by environmental and biological strategies adapting farmers being able to secure market share in local formal markets while those technological and chemical strategies adapting farmers.

Business Continuity and Viability

The study findings reveal that adapting to climate change has a strong relationship with business continuity and its viability. Business continuity and viability were statistically significant at a 10% significance level. The study findings further reveal that business continuity and viability chances are higher for adapting farmers than for their counterparts. It is argued that by building resilience, farmers can create the resources and competencies needed to avoid or mitigate business collapse by adapting to climate change adaptive strategies (Linnenluecke and Griffiths, 2010). The study results could be influenced mainly by adapting farmers achieving gradually increasing revenues, compared to their counterparts who could not keep their revenue records due to inconsistency. Furthermore, the study results could also be substantiated by allowing farmers to be in a better position to retain customers, which improves their market competitiveness and, subsequently, their viability. According to Hallegatte et al. (2020), adapting to climate change strategies helps farmers prepare for business continuity plans, which ensure they produce and continue to sell their produce. Moreover, it can be concluded from the study findings that market performance as influenced by adaptation practices enhances business continuity as farmers who sell continuously have a chance to continue farming.

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Customer Retention

As part of the market performance influenced by climate change adaptation practices, customer retention was statistically significant at a 5% significance level. The findings show that adapting to climate change positively contributes towards retaining customers, particularly those not selling seasonal crops. The study findings imply that adapting to climate change positively influences market participation and performance, including customer retention. The study findings could be largely influenced by adapting to climate change, positioning farmers to meet market standards, and satisfying customers' needs. These findings could imply that adapting to climate change for food security is essential regardless of the cost. According to a study conducted by Berlian et al. (2024) the quality of vegetable products directly influences both customer satisfaction and customers loyalty this is due to the fact that customers are more inclined to suppliers who supply good quality products of these variables.

Standardization and Variations

The current study findings indicated that adapting to climate change gives farmers the edge in meeting market standards, including product variety requirements. The results indicate that the standardization of products was statistically significant at a 5% significance level. The study findings imply that adapting to climate change improves product quality and renders standardization feasible, particularly among seasonal crop producers. From the study findings, it was discovered that farmers who had adopted chemical strategies like fertilizers could standardize the quality of their products and thus could meet the market requirements with ease. The study could be largely influenced by the intensive skills required to carry out chemical-related strategies. Ultimately, the standardization of products, particularly during the production phase, could lead to a desired variety of products. The findings of the current study were supported by that the findings of Bisbis et al. (2018) vegetables grown in fields are more susceptible to the effects of climate change on their quality than those grown in greenhouses. In addition, extreme weather conditions can have a detrimental effect on vegetable quality, making the product unsellable and increasing waste throughout the production cycle.

Table 3. Results of the Binary Regression Model

	B	**S.E.**	**Wald**	**df**	**Sig.**
Market access	-0.037	0.047	0.637	1	0.425
Transaction arrangements	-0.439	0.642	0.467	1	0.494
Type of markets	1.252	0.608	4.241	1	0.039**
Revenue trends	.687	0.302	5.173	1	0.023**
Quantity supplied	.017	0.049	0.121	1	0.728
Market security	1.914	1.093	3.065	1	0.080*
Quantity sold	-0.493	0.724	0.464	1	0.496
Customer recruitment	-0.180	0.341	0.277	1	0.599
Business continuity	4.374	2.360	3.433	1	0.064*
Selling price	-0.738	0.839	0.773	1	0.379
Customer retention	4.231	1.999	4.479	1	0.034**
Standards and variation	2.113	1.043	4.105	1	0.043**
Constant	1.003	2.327	0.186	1	.666

Source: Field Survey (2024). Note: **= significant at 5%, * = significant at 10%.

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Conclusion and Recommendations

The current study investigated how climate change adaptation variation impacts market participation and performance among youth farmers. From the study findings, it can be noted that climate change adaptation variation significantly influences market participation and performance among farmers. The study findings uncovered that farmers who did not adapt to climate change settle for an informal market and must keep revenue records due to inconsistency. Furthermore, the study findings revealed that farmers relying on environmental and biological climate adaptation strategies were more competitive in the local markets, primarily within farmers' short-term markets. Meanwhile, farmers who adopted chemical-related and technological strategies secured market shares in national agricultural markets. Furthermore, the study also found that farmers who had adopted chemical-related strategies secured substantial market shares in formal markets due to the ease of product standardization due to the use of measured fertilizers. From the findings, the study recommends the promotion of climate change adaptation as its resistance disadvantages farmers from meeting market standards, which eliminates their chances to participate in some of the markets. Furthermore, the study recommends that farmers be encouraged to integrate various adaptation strategies as they are cost-friendly and positively enhance their market participation and performance. The study further recommends that future research be tailored towards the combination of climate change adaptation strategies, which significantly enhance product qualities and improve market performance.

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