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Assessment of Small-Scale Farmers' Perceptions Towards the Sustainability of Soybean Production in Nkangala District Municipality of the Mpumalanga Province

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ABSTRACT

To achieve the FAO's goals of increasing global agricultural productivity and soybean production by 2050, understanding small-scaler farmers' perceptions of the sustainability of soybean production is crucial. This study involved a sample size of 204 participants, randomly selected from a population of 433. Correlation and regression analyses assessed small-scale farmers' perceptions of factors affecting soybean production sustainability in Nkangala District Municipality in Mpumalanga Province. This was achieved by examining the influence of participants' perceived factors and attitudes towards soybean production's sustainability. The inferential findings revealed that farming, economic, extension and education, social, and policymaking factors affected participants' perceived attitudes towards the sustainability of soybean production in the study area. This suggests that any unit increase in these factors is associated with an increased probability of the participants' perceived attitudes towards the sustainability of soybean production. Future studies may focus on socioeconomic factors affecting

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participant's perceived attitudes towards the sustainability of soybean production. The paper concludes by recommending that these factors should be considered by the government and policymakers when implementing programs to improve soybean sustainability through the inclusion of small-scale farmers.

Keywords: Perception, Factors Affecting Sustainability, Soybean Production, Sustainability, Small-Scale Farmers

1. INTRODUCTION

Sustainability is a complex concept that includes environmental, economic, and social aspects. These three pillars are crucial for maintaining a balance between meeting current needs and ensuring that future generations can meet their needs (Mirghaderi & Mohit-Ghiri, 2019). Therefore, gaining insights into the perspectives of small-scale farmers regarding the sustainability of soybean production becomes crucial to achieving the FAO objectives of a 70% increase in global agricultural productivity and a 140% increase in soybean production by 2050 (FAO, 2017). The environmental integrity, economic viability, and social acceptability of soybean production are vital aspects of strategic planning to promote and ensure sustainability. This is particularly critical in developing countries such as South Africa, where strategic planning focuses on developing and promoting sustainable farming methods that comply with agricultural legislation while optimising farm outputs to meet the ever-growing human needs.

The concept of sustainability focuses on promoting holistic approaches to establishing flexible agricultural systems that effectively and efficiently utilise available resources to support sustainable livelihoods. It emerged as a response to the problems caused by the degradation of essential natural resources, which pose a threat to the capacity of existing agricultural systems to meet current food demands and the looming challenges of feeding an expected global population of 9 billion people by 2050 (Fereres & Villalobos, 2016). Huang, Wu and Yan (2015) assessed the notion of "sustainability of farm systems" by examining its environmental, economic, and social dimensions.

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As opined by Siamabele (2021), small-scale soybean production has the potential to help combat rural food insecurity and malnutrition issues. Soybean seeds are associated with several health advantages, as they contain, on average, 40% protein, 20% oil, and the remaining 40% vitamins, carbohydrates, minerals, and other vital micronutrients necessary to address food insecurity and malnutrition (Ghani *et al*., 2016). Sustainable rural development, which benefits the majority of South Africa's rural population, is primarily driven by the efforts of the country's small-scale farmers (Oluwatayo, 2019). In South Africa, support for sustainability in the small-scale farming sector has been implemented through various programs and projects, such as the Comprehensive Agricultural Support Programme (CASP) administered by the Department of Agriculture, Land Reform, and Rural Development (DALRRD, 2020).

Aliber and Hall (2012) stated that the government has increased the number of small-scale farmers from 250,000 in 2014 to 500,000 in 2020. Budgetary support was also provided for these farmers, such as an allocation of R2.38 billion to the Department of Agriculture for small-scale farmers' support programs in 2014. However, no study has outlined the impact of such initiatives on the perceived attitudes towards the sustainability of soybean production and the factors influencing sustainability. Its essential to consider various factors, including farming practices, economic influences, extension and education efforts, social dynamics, and policymaking decisions to ensure the long-term sustainability of crop production. These factors are interconnected and can positively and negatively affect sustainable agriculture.

To understand how these factors interact and impact farmers' engagement in sustainable practices, stakeholders can effectively develop strategies to promote sustainable agriculture. The sustainability of small-scale farmers is of utmost importance as it enables sustainable food production, utilising available natural resources to alleviate poverty and enhance the economic well-being of individuals residing in resource-constrained areas (Bisht *et al*., 2020). Perception holds significant importance in guiding primary agricultural activities. When considering the sustainability of soybean production in farming, farmers' views can be understood through the theory of planned behaviour (Sok *et al*., 2021). This theory suggests that individual actions are heavily shaped by their intentions, which are influenced by attitudes, subjective norms, and perceived behavioural control. Hence, examining farmers' perspectives is crucial as it can aid

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governmental efforts in launching rural development initiatives and projects tailored to farmers' perceptions of sustainable farming practices.

Notably, Hosseini *et al*. (2011) discovered that factors such as farming practices, economic considerations, extension and education, social factors and policymaking can influence how farmers engage in sustainable agriculture, thereby impacting the sustainability of their farming systems. Such factors harm the utilisation of scarce natural resources, pose environmental threats that result in land degradation, and cause the loss of livelihoods and food insecurity concerns. The sustainability of agricultural commodities drives small-scale farmers to engage in sustainable agriculture to produce competitive farm products. Additionally, it creates an ideal and inspiring environment that encourages both emerging and existing farmers to participate in agricultural methods that work with nature rather than against it.

However, there is limited literature on small-scale farmers' perceptions regarding the sustainability of soybean production in South Africa. Previous studies conducted outside South Africa have highlighted that farming practices, economic factors, extension and education initiatives, social aspects, and policymaking can influence farmers' adoption of sustainable agriculture, consequently linking with the perceived attitudes towards the small-scale farmer's perceptions towards the sustainability of their farming systems. Understanding these perceptions can aid in developing farming systems that enhance the sustainability of soybean production. Therefore, this study was conducted within this context to assess small-scale farmers' perceptions of the factors influencing the sustainability of soybean production in the Nkangala District Municipality of Mpumalanga Province.

2. MATERIALS AND METHODLOGY

2.1. Study Area

The study was conducted in the Nkangala District Municipalities of Mpumalanga Province, South Africa. It covered the Emakazeni Local Municipality (located at 25°35'01.2" S, 30° 04'56.3" E), Emalahleni Local Municipality (25° 52' 25.2" S, 29° 12'49.5" E), and Steve Tshwete Local Municipality (25°45'49.9" S, 29°27'21.0" E). The region is primarily characterised by small-scale black farmers who own and cultivate small plots of land. However, commercial farmers

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predominantly carry out soybean production rather than in the small-scale farming sector (Dlamini *et al*., 2014). This discrepancy may be attributed to various factors, highlighting the importance of investigating the perceptions of small-scale farmers regarding the sustainability of soybean production in the study area.

2.2. Study Design and Sampling Procedure

This study aimed to determine small-scale farmer's perceptions towards sustainability and factors affecting their perceived attitudes towards the sustainability of soybean production in the study area. A quantitative research design was deployed to address the aim. The study initially employed purposive sampling to select key soybean-producing areas in the Nkangala District Municipalities based on suitable climatic requirements. Subsequently, random sampling was utilised to choose small-scale farmers from the identified local municipalities, ensuring each respondent had an equal chance of being selected. Simple random sampling yielded a sample size of 204 from a population of 433 small-scale farmers.

2.3. Analytical Framework

The current study employed multiple linear regression analysis. The assumptions integral to multiple linear regression encompass the maintenance of homogeneity of variance, independence of observations, adherence to a normal distribution of data, and linearity. Homogeneity of variance in the linear model is upheld when residuals exhibit consistent variance at all points. The independence of observations underscores the autonomy of datasets for each observation. The assumption regarding the normal distribution of residuals is called the normal distribution assumption. Consequently, linearity in multiple linear regression presupposes a direct linear relationship between each predictor variable and the response variables. The perceived attitudes towards the sustainability of soybean production are presented as follows:

TABLE 1: Variables Utilised in the Multiple Linear Regression

Variable	Explanation	Type of measurement	Expected sign

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Dependent variable				
Perceived attitudes	Y	Importance of environmentally sustainable economic viability and socially acceptable soybean production	Scale	
Independent variable				
Farming	X_1	Perceived level of importance of farming	Scale	+/-
Economic	X_2	Perceived level of importance of economic factors	Scale	+/-
Extension and Education	X_3	Perceived level of importance of extension and education factors	Scale	+/-
Social	X_4	Perceived level of importance of social factors	Scale	+/-
Policymaking	X_5	Perceived level of importance of policymaking factors	Scale	+/-

2.3.1. Model Specification

The perceived attitudes towards soybean production (Perceived attitudes) are modelled as a function of various perceived levels of importance in relevant domains. The model equation is as follows:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \epsilon$$

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Where:

Y represents the perceived attitudes towards soybean production.

X_1, X_2, X_3, X_4, and X_5 represent the perceived importance of farming, economic, extension and education, social, and policymaking factors, respectively. β_0 is the intercept term, representing the constant effect on perceived attitudes. β_1, β_2, β_3, β_4, and β_5 are the coefficients of X_1, X_2, X_3, X_4, *and X5,* respectively, indicating the impact of each independent variable on perceived attitudes. ϵ represents the error term.

3. FINDINGS

3.1. Descriptive Findings

This section describes the study's findings. It starts by presenting the outcomes of participants' perceptions concerning farming, economics, extension and education, and social and policymaking with the sustainability of soybean production. Following that, it presents the findings of participants' attitudes towards environmentally sustainable, economically viable, and socially acceptable soybean production. The results are visually represented and elaborated upon in Tables 2 and 3.

TABLE 2: Summary of Descriptive Results of the Perceived Factors in the Sustainability of Soybean Production

Main Items	**Findings**		
	No.	Mean Score	Std. Dev
1. Farming factors	204	4.07	0.762
2. Economic factors	204	4.05	0.763
3. Extension and education factors	204	4.06	0.770
4. Social factors	204	4.05	0.770
5. Policymaking factors	204	4.05	0.763
Average mean score	204	4.06	0.766

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Table 2 presents an overview of the descriptive findings, categorised by the perceived factors contributing to soybean production's sustainability. These factors include farming, economic, extension and education, social, and policymaking aspects. With a sample size of 204, the average mean score and standard deviation are recorded as 4.06 and 0.776%, respectively. Among these factors, farming received the highest average score of 4.07, while economic, social, and policymaking factors obtained the lowest score of 4.05. Moreover, Table 2 highlights that the extension and education factors obtained a mean score of 4.06. The results from Table 2 strongly indicate that participants regarded these factors as highly significant for the sustainability of soybean production in the study area. Table 3 presents the descriptive findings of participants' perceived attitudes towards the sustainability of soybean production.

TABLE 3: Descriptive Findings of the Perceived Attitudes Towards the Sustainability of Soybean Production

Main Items	**Findings**		
	No.	Mean	Std. dev
1. Environmentally sustainable	204	4.03	0.762
2. Economic viability	204	4.04	0.751
3. Socially acceptance	204	4.04	0.783
Average mean score	204	4.04	0.768

According to Table 3, participants' perceived attitudes toward the sustainability of soybean production have an average mean score of 4.04, with a standard deviation of 0.768, based on a sample size of 204. The economic and social dimensions of soybean production sustainability received the highest mean score of 4.04. At the same time, the environmental sustainability dimension received the lowest mean score of 4.03. These results suggest a consensus among participants, indicating their agreement with the statement regarding the sustainability of soybean production.

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3.2. Correlation Results

Correlation analysis was conducted to prepare the variables for regression analysis. This analysis aimed to assess the association between the respondents' perceived ideas (mean scores) regarding the farming, economic, extension and education, social, and policymaking factors in soybean production sustainability (independent variables) and their perceived attitudes (average mean score) towards soybean production sustainability (dependent variable). This statistical analysis is crucial as it examines the relationship between variables and allows the researcher to evaluate the strength of the relationship between specific factors and indicators of soybean production sustainability. The correlation coefficients between the independent and the dependent variables and their interpretations are presented in Table 4.

TABLE 4: Correlation Matrix of the Factors

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Farming (1)	-				
Economic (2)	0.559***	-			
Extension and education (3)	0.426***	0.460***	-		
Social (4)	0.389***	0.443***	0.624***	-	
Policy Sustainability (5)	0.508***	0.517***	0.662***	0.736***	-

Table 4 displays a moderately positive relationship between participants' perceived attitudes towards the sustainability of soybean production and farming factors (0.454**) and economic factors (0.439**). The results also indicate that perceived attitudes towards the sustainability of soybean production had a strong positive (0.635**) relationship with extension and education factors (0.635**) and policymaking factors (0.736**). The relationship between perceived attitudes towards the sustainability of soybeans and social factors was found to be very strong (0.905**). The results also indicated that there was neither a mediating nor a moderating influence on how small-scale farmers perceived these factors in the sustainability of soybean production. These findings show that the study's results and interpretation were substantial and valid.

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In conclusion, Table 4 suggests a significant relationship between the participants' perceptions of farming, economic, extension and education, social, and policymaking factors and their perceived attitudes towards the sustainability of soybean production. The relationships between the independent and dependent variables were subsequently evaluated using regression analysis.

3.3. Inferential Findings

3.3.1. Model Summary

Table 5 presents model fit measures for the sustainability factor. The results R-squared was used to evaluate the model fitness. The model indicates an R-Square value of 0.89, implying that 80% of the variation in the perceived attitudes towards the sustainability of soybean production can be explained by the model containing perceived factors in the sustainability of soybean production at p = < 0.001, adjusted R square = 0.835 and F = 207. This implies that the model's fitness is good.

TABLE 5: Model Fit Measures for the Sustainability Factors

							Overall Model Test		
Model	**R**	**R^2**	**Adjusted R^2**	**AIC**	**BIC**	**RMSE**	**F**	**df1**	**df2**	**p**
1	0.916	0.839	0.835	-93.9	-70.6	0.186	207	5	198	< .001

3.3.2. Test of Multi-Collinearity

Table 6 shows the outcomes of multi-collinearity. These results revealed that the model is free from multi-collinearity as all variables considered have tolerance collinearity statistics greater than 0.1. Additionally, all VIF values are below 10, implying the absence of multi-collinearity problems among the studied variables.

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TABLE 6: Collinearity Statistics for Multi-Collinearity Tests

Predictors	VIF	Tolerance
Farming factor	1.62	0.618
Economic factor	1.67	0.599
Extension and education factor	1.99	0.503
Social factor	2.34	0.428
Policy factor	2.80	0.357

3.3.3. Model Coefficients Results

Table 7 shows the outcomes of the perceived factors affecting the perceived attitudes towards the sustainability of soybeans. The results indicate that the farming factors had a positive coefficient of 0.0955 and a p-value of 0.008. This implies that there is a statistically significant relationship between farming factors and the sustainability of soybean production as the p-value is less than .005 and that any increase in the perceived ideas on farming factors will induce an increase in the probability of perceived attitudes towards the sustainability of soybean production by 0.0955 times.

The findings from Table 7 indicate that the social factors coefficient value = 0.7513 and p-value = 0.001, implying that any increase in the social factors will increase the probability of soybean production's sustainability by 0.7513 times. The p-value indicates a statistically significant ($p<0.005$) relationship between the social factors and the sustainability of soybean production.

Extension and education factors produced a p-value of 0.124 and a coefficient of 0.0626, as shown in Table 7. As the p-value is less than 0.05, it implies a statistically significant relationship between extension and education factors and the sustainability of soybean production. The findings show that any increase in the participants' perceived ideas on extension and education factors will increase the probability of the perceived attitudes towards the sustainability of soybean production by 0.0626 times.

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According to Table 7, the coefficient value and p-value of the policymaking factors were 0.0998 and 0.033, respectively. The results infer that any increase in the participants' perceived ideas on policymaking factors will increase the probability of their perceived attitudes towards the sustainability of soybean production by 0.0998 times.

TABLE 7: Model Coefficients - Sustainability

						95% Confidence Interval	
Predictor	**Unstand. Estimate**	**SE**	**t**	**p**	**Stand. Estimate**	**Lower**	**Upper**
Intercept	-0.3174	0.1527	-2.08	0.039			
Farming factor	0.0955	0.0359	2.66	0.008	0.0965	0.02503	0.1680
Economic factor	-0.0368	0.0363	-1.02	0.311	-0.0374	-0.10995	0.0352
Extension and education factor	0.0626	0.0405	1.55	0.124	0.0620	-0.01714	0.1412
Social factor	0.7513	0.0425	17.70	< .001	0.7703	0.68449	0.8562
Policy making factor	0.0998	0.0464	2.15	0.033	0.1025	0.00845	0.1966

4. DISCUSSION

4.1. Discussion on the Perceived Factors in the Sustainability of Soybean Production

The study has actively demonstrated small-scale farmer's perceived ideas towards farming, economic, extension and education, social and policymaking factors and their perceived attitudes on the sustainability of soybean production. The findings also explained how these factors affected

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the participant's perceived attitudes towards the sustainability of the crop of interest. These findings are imperative for implementing governmental sustainability designed to enhance and improve the participation of small-scale farmers in the sustainability of soybean production.

Farming factors are fundamental for small-scale farmers. The average results on farming factors generated from perceived ideas on labour, machinery, farm inputs, access to improved cultivar and equity in access to land as sub-factors revealed that the participants viewed them as very important factors in the sustainability of soybean production. Idrisa (2012) also highlighted that soybean production is highly labour-intensive and needs advanced technologies such as improved competitive cultivars.

Participants had a strong perception of the role of economic factors in ensuring the long-term viability of soybean production, as indicated by the average mean findings on their views and ideas on these factors. Some factors considered were credit availability for farmers, financial institution assistance, transportation expenses, availability of soybean marketing data, and price stability. These findings align with those of Bicudo Da Silva (2020), who stressed the importance of ready access to farm credit for the successful operation of any farming operation, but especially for the small-scale variety in an era of scarce capital.

Education and extension may influence the perceptions of small-scale farmers regarding soybeans beyond primary production. It significantly contributes to bridging the gap between the negative attitudes toward the sustainability of soybean production and their lack of formal education. The extension and education factors results revealed that the extension training program, e-extension, demonstration, extension visits, and farmer field school were considered essential sub-economic factors for the sustainability of soybean production. Byron *et al.* (2014) endorse the study's findings because they indicate that extension and education effectively assist small-scale farmers in closing knowledge gaps, such as post-harvest data on soybean production.

Social factors incorporate farmers' beliefs, use of indigenous knowledge, formation of grower's cooperatives, and farmers' response towards sustainable practices. The results indicated that the participants strongly perceived these factors as being important to the sustainability of soybean production. According to Rajasekaran (1993), such social factors allow farmers to recruit and

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attract other farmers to participate in the sustainability of soybean production, provided the sustainable practices meet the societal norms of that area.

The present study also found that the perceived policymaking factors included items such as policy on sustainable agricultural practices, agricultural resources, price and marketing, management of pests, weeds and disease control, and food security are very important factors in the sustainability of soybean production. As opined by Parr *et al.* (2020), policymaking factors could play an important role towards sustainable development. They have shown the ability to enable farmers to utilise average resources to generate adequate farm income and improve food security while building resilience to weather and market shock.

4.2. Discussion on the Perceived Attitudes Towards the Sustainability of Soybean Production

The sustainability of soybean production may depend on farmers' perceptions of environmental, economic, and social dimensions of sustainability (Gennari & Navarro, 2019; Nair & Toth, 2016; Zhen & Routry, 2003). Participants in the study unanimously agreed that soybean production is an agricultural commodity that positively impacts environmental sustainability. This contradicts the findings of Fearnside (2001), who found that industrial soybean production has detrimental effects on environmental sustainability. The environmental threat stems from the impact of expanding soybean production on water quality, forest health, and biodiversity.

The results regarding the economic aspects of sustainability of soybean production indicate that all respondents agreed with the statement on economic sustainability. This suggests that the participants viewed soybean production as a profitable cultivating crop. These findings are consistent with the findings of Schmidt and Herman (2018), who emphasised that soy is a highly profitable and lucrative farm commodity. According to Gbegbelegbe *et al.* (2019), the soybean market and demand will double by 2050. It is especially important for enhancing small-scale farmers' economic and social well-being. The results regarding the social aspects of sustainability are overwhelmingly positive. Participants indicated that the production of soybeans is socially acceptable in their region. These results suggest that it is perceived as a commodity that can assist farms in improving their livelihoods and achieving sustainability while preserving local practices.

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4.3. Discussion on Factors Affecting Perception Of Small-Scale Farmers About the Sustainability of Soybean Production.

Correlation Coefficients and regression analysis models were used to examine the relationship between participants' perceptions of farming, economic, extension and education, social, and policymaking factors and their perceptions of their attitudes toward the sustainability of soybean production. The correlation analysis revealed a moderate relationship between perceived attitudes regarding the sustainability of soybean production and farming factors. This is supported by the regression analysis results, which revealed that farming factors had a positive coefficient of 0.0955 and a significant level of 0.008. The results indicate a statistically significant relationship between the sustainability of soybean production and farming factors and that any increase in perceived ideas on farming factors will increase the probability of the perceived attitudes towards the sustainability of soybean production by 0.0955 times.

The correlation and regression findings also indicate that the perceived ideas on economic factors had a moderate relationship with their perceived attitudes towards the sustainability of soybean production. According to the regression results, economic factors had a p-value of 0.311 and a coefficient value of -0.0368. As the p-value is less than 0.05, the correlation between economic factors and the sustainability of soybean production is statistically significant. According to the b-value, any increase in economic factors will increase the probability of sustainability of soybean production by -0.0368 times.

According to the findings, there was a significant and positive relationship between the perceived attitudes towards the perceived ideas on extension and education factors and the sustainability of soybean production. In addition, the regression analysis results showed that the factors of extension and education obtained a coefficient value of 0.0626 and a p-value of .001, respectively. The result demonstrates that any increase in extension and education factors will increase the probability of sustainable soybean production by 0.0626 times.

The results of the social factors correlation discovered a very strong relationship between perceived attitudes towards the sustainability of soybean production and perceived ideas on social factors. The regression analysis pointed out that social factors had a coefficient value = 0.7513 and

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p-value = 0.001, implying that any increase in social factors will increase the probability of the perceived attitude sustainability of soybean production by 0.7513 times.

Further correlation results on policymaking factors demonstrated a strong relationship between perceived attitudes on the sustainability of soybean production and perceived ideas on policymaking factors. At the same time, regression findings indicate that the policymaking factors had a b-value and p-value of 0.0998 and 0.033, respectively. The results infer that any increase in policymaking factors will increase the probability of sustainability of soybean production by 0.0998 times.

5. CONCLUSION

The present study has scientifically demonstrated the small-scale farmers' perceptions of the sustainability of soybean production in Nkangala District Municipality, South Africa. According to inferential findings, small-scale perceived ideas on farming, economic, extension and education, and social and policymaking factors affected the participants' perceived attitudes towards the sustainability of soybean production in the study area. This implies that any increase in these participants' perceived factors is associated with an increase in the probability of their perceived attitudes on the sustainability of soybean production. Therefore, this study recommends that the government consider these variables when implementing initiatives to improve the sustainability of soybean production among small-scale farmers. Future studies may incorporate other factors, such as agronomic and socioeconomic factors, in the sustainability of soybean production.

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7. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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