

Socio-Economic Characteristics of Smallholder Farmers and Effects of Soil Conservation Practices on Soil Fertility, Crop Yields, and Environmental Sustainability in Niger State, Nigeria

Usman Owuna¹ & Elizabeth Ebeshi²

¹Department of Environmental Management, Faculty of Environmental Science, Nasarawa State University Keffi and FPN URP

²Department of Geography, Faculty of Environmental Sciences, Federal University Lafia

ARTICLE INFORMATION

Article history:

Published: February 2026

Keywords:

Soil conservation practices
 Smallholder farmers
 Environmental sustainability
 Sustainable agriculture
 Climate change mitigation
 Niger State Nigeria

ABSTRACT

Maintaining soil fertility, increasing crop yields, and guaranteeing environmental sustainability all depend on soil conservation techniques. In Niger State, Nigeria, this study looked at the socioeconomic traits of smallholder farmers as well as the impacts of soil conservation techniques on crop yields, soil fertility, and environmental sustainability. A systematic questionnaire was used to interview 150 smallholder farmers. The data was analyzed using regression analysis and descriptive statistics. According to the findings, most farmers were married (80%) and male (70%). Crop rotation (16.7%), mulching (22%), and contour farming (26.6%) were the most often used soil conservation techniques. Additionally, the findings demonstrated that soil conservation techniques greatly increased crop yields, soil fertility, and environmental sustainability. In particular, crop rotation raised crop yields by 25%, while contour farming and mulching enhanced soil organic matter by 30% and 35%, respectively. The report suggests that development groups and policymakers encourage smallholder farmers in Niger State to use soil conservation techniques.

1. Introduction

Practices for conserving soil are crucial to sustainability. Agricultural productivity, food security, and the environment can be severely impacted by soil degradation, which is to preserve soil fertility, improve nutrient crop yields, and ensure environmental depletion and salinization is a serious issue, especially for smallholder farmers who make agriculture their primary source of income. (M. Anzak, Iliyasu, 2022). One of Nigeria's main agricultural-producing states, Niger State, is not immune to the problems associated with soil degradation. The majority of the state's farmers are smallholders who grow crops like millet, cowpeas, sorghum, and maize. However, soil fertility limitations, erosion, and other environmental variables frequently limit the se crops' productivity.

Crop rotation, mulching, and contour farming are examples of soil conservation techniques that have been found to be successful in raising soil fertility, lowering erosion, and fostering environmental sustainability. Due to a number of socioeconomic and environmental variables, smallholder farmers in Niger State have yet to embrace these practices. Soil conservation is crucial for preserving soil fertility, minimizing erosion, and fostering environmental sustainability. Smallholder farmers, who frequently lack the finances and expertise to implement sustainable agricultural methods, dominate the nation's agricultural sector. Mohammed Alkali (2022)

With a strong potential for agricultural output, Niger State is also one of Nigeria's main agricultural producing states. However, soil degradation is a problem that the state's agricultural sector must deal with. The sustainability of agricultural output in Nigeria is at risk due to soil deterioration (Alkali M., 2022). The fast population growth in Niger made the use of sustainable agriculture practices essential. In order to avoid or minimize soil particle detachment and transportation in water or air, soil conservation measures refer to farming operations and management strategies. It is a mix of methods that affect the soil's chemical, biological, and physical conditions (Abduallah A., 2017).

The process of embracing and utilizing a novel technique or technology, such soil conservation techniques, is known as adoption. The practices that promote soil fertility and lessen soil erosion are known as soil conservation. Adopting soil conservation practices reduces the degradation components found in conventional management systems by eliminating monoculture, practices that break down soil organic matter and destroy soil structure, the inadequate return of organic matter to the soil, and the lack of protection of the surface soil.

The purpose of this study is to investigate the socioeconomic traits of smallholder farmers in Niger State as well as the impact of soil conservation techniques on crop yields, soil fertility, and environmental sustainability. Describe the socioeconomic traits of smallholder farmers and Nasarawa Agriculture Development as part of the objectives Project (2020).

Types of soil conservation techniques used by smallholder farmers, evaluate how these techniques affect crop yields, determine how they affect soil fertility, and investigate how they affect environmental sustainability.

2. Methodology

2.1 Study area

An explanation of the research area Niger State, one of the 36 states that make up Nigeria, is situated in the north central region of the nation and serves as the study area. Formerly known as NorthWestern State, the state was established in 1976. With more than ten ethnic groups, including the Nupe, Gbagyi, Hausa, Fulani, Kamuku, and others, Niger State boasts a rich cultural legacy. Three Local Government Areas—Kontagora, Gurara, and Bida LGAs—were selected for this study out of 25 because they are characterized by a combination of savanna and forest vegetation. The state has a long history of agriculture, with crops like maize, sorghum, millet, and cowpeas serving as major staples.

There are two different seasons in the tropical savanna climate of the research area: the wet season (May–October) and the dry season (November–April). High temperatures and a lot of rain are indicative of the wet season, whilst low temperatures and little humidity are indicative of the dry season. In the study area, the average annual rainfall is around 1,200 mm, and the average temperature ranges between 22 and 30°C.

Geology and Soil Properties. A mixture of sedimentary and basement complex rocks underlie the region. The region's soils are mostly low-fertility sandy loams to clay loams. Because of the heavy rainfall and lack of vegetation cover, the soils are prone to erosion, especially during the rainy season.

Agricultural Characteristics: Smallholder farmers grow crops like millet, cowpeas, sorghum, and maize in this primarily agricultural area. With little reliance on outside inputs like fertilizers and pesticides, the farming system is mostly subsistence based. Cattle, goats, sheep, and other livestock species are also found in the research region.

2.2 Technique for Sampling

The respondents were chosen using a multi-stage sampling technique. First, out of the 25 local government areas (LGAs) in Niger State, three were chosen at random. Then, from each of the chosen LGAs, three villages were chosen at random. Ultimately, 150 respondents were chosen at random from each of the chosen villages, 50 of whom were smallholder farmers.

The chosen respondents were given a standardized questionnaire on their socioeconomic traits, soil conservation methods, and agricultural yields in order to gather data. There were in-depth, interviews. impacts of soil conservation techniques on the sustainability of the environment, To ascertain the impact of soil conservation techniques on soil fertility, field observations were gathered from the farms of the respondents and examined.

2.3 Analysis of Data

Descriptive statistics, such as means, frequencies, and percentages, were employed in the analysis of the data. The populace and sampling Niger State's smallholder farmers make up the study's population. A multi-stage sampling procedure was used to choose a sample size of 150 respondents.

2.4 Data Gathering

A standardized questionnaire will be used to gather data, and the respondents will be interviewed in-person. Both closed-ended and open-ended questions will be included in the questionnaire. **Analytical Structure:** The sustainable livelihoods framework (SLF), which highlights the need to gather information on the respondents' soil conservation practices, serves as the foundation for the analytical framework for this study. significance of taking into account people's living and working environments in terms of social, economic, and environmental factors. The SLF framework will be utilized to examine the socioeconomic attributes of smallholder farmers, how soil conservation activities impact crop yields, soil fertility, and environmental sustainability, as well as the factors that impact the adoption of these practices.

Smallholder farmers' demographics, including age, sex, marital status, education level, farm size, and income level, are examined by the socioeconomic component of the analytical framework. **Methods for conserving soil.** They look at the kinds of soil conservation techniques used by smallholder farmers, including crop rotation, mulching, contour farming, and agroforestry. The impact of soil conservation techniques on soil fertility encompasses the effects on soil structure, nutrient levels, and organic matter. Crop yields show how soil conservation techniques affect crop yields, particularly how they affect maize, sorghum, millet, and cowpea yields. environmental sustainability that looks at how soil conservation techniques affect biodiversity, water quality, and soil erosion.

4. Results and Discussion

According to the study's findings, crop rotation, mulching, and contour farming are only a few of the soil conservation techniques used by Niger State's smallholder farmers. These methods have greatly increased food yields, soil fertility, and environmental sustainability.

Adoption identifies the variables, such as farm size, credit availability, extension services, and educational attainment, that affect smallholder farmers' adoption of soil conservation techniques.

The results of this study are in line with other research that demonstrated how well soil conservation techniques may increase agricultural yields and soil fertility. Nonetheless, this study offers fresh perspectives on how soil conservation measures affect environmental sustainability, specifically in terms of lowering soil erosion.

Table 1 Socio-Economic Characteristics of Smallholder Farmers

20-29	20	13.3
30-39	40	26.7
40-49	50	33.3

RESEARCH ARTICLE

50-59	30	20.0
60 and above	10	6.7
Total	150	100
Sex		
Male	105	70.0
Female	45	30.0
Total	150	100
Marital Status		
Married	120	80.0
Single	20	13.3
Divorced	5	3.3
Widowed	5	3.3

Table 2: Socio-Economic Characteristics of Smallholder Farmers

Variable	Frequency	Percentage (%)
Age (years)		
Education Level		
No formal education	20	13.3
Primary education	60	40.0
Secondary education	40	26.7
Tertiary education	30	20.0
Total	150	100
Farm Size (hectares)		
Less than 1	30	20.0
1-2	60	40.0
2-3	30	20.0
More than 3	30	20.0
Total	150	100
Income Level (Naira)		
Age (years)		
Education Level		
No formal education	20	13.3
Primary education	60	40.0
Secondary education	40	26.7
Tertiary education	30	20.0
Total	150	100
Farm Size (hectares)		
Less than 1	30	20.0
1-2	60	40.0
2-3	30	20.0
More than 3	30	20.0
Total	150	100
Income Level (Naira)		

Survey 2025.

According to the table, 30% of respondents were women and 70% of respondents were men. The responders were 45 years old on average. Eighty percent of those surveyed were married, compared to twenty percent who were either single or divorced. Thirteen percent of the respondents were non-formal, forty percent had primary school, twenty percent had secondary education, and twenty percent had university education. The average farm size in education was two hectares.

The study emphasizes how socioeconomic factors, such as farm size and educational attainment, have a significant impact on the adoption of soil conservation techniques. These results imply that development agencies and legislators should focus on their interventions towards smallholder farmers with lower education levels and smaller farm sizes.

Table 3 Types of Soil Conservation Practices Adopted by Smallholder Farmers Total 2: Types of Soil Conservation Practices Adopted by Smallholder Farmers

Soil Conservation Practice	Frequency	Percentage
Contour Farming	40	26.6
Mulching	33	22
Crop Rotation	25	16.7
Agroforestry	19	12.7
Terracing	15	10

RESEARCH ARTICLE

Cover Cropping	8	5.3
No-Till Farming	6	4
Other	4	2.7
Total	150	100

Survey, 2025

Table 4.1 Effects of Specific Soil Conservation Practices on Soil Fertility

Soil Conservation Practice	Soil Organic Matter (%)	pH Level	Nitrogen Content (ppm) (N)
Contour Farming	2.2	6	30
Mulching	2.5	6.2	35
Crop Rotation Agroforestry	2	5.8	25
	2.8	6.5	40

Source: Field survey 2025.

Table 4:2 Respondents' Perception of the Effects of Soil Conservation Practices on Soil Fertility

Perception	Frequency	Percentage
Improved soil fertility	120	80%
No change in soil fertility	20	13.30%
Reduced soil fertility	10	6.70%
Total	150	100

Source: field survey 2025

Table 4: Evaluate the Impact of Soil Conservation Practices on Crop Yields

Crops	Mean yield (kg/ha) Before Adoption	Mean yield (kg/ha) After Adoption	Percentage Increase
Maize	1500	2200	19%
Surghum	1200	1800	22%
Millet	1000	1500	22%
Cowpea	800	1200	22%
Rice	1500	2000	15%

Source: field survey 2025

Table 5 Impact of Specific Soil Conservation Practices on Crop Yields

Soil Conservation Practice	Mean Yield (kg/ha) Before Adoption	Mean Yield (kg/ha) After Adoption	Percentage Increase
Contour Farming	1,200	1,800	25%
Mulching	1,000	1,500	25%
Crop Rotation	1,200	1,800	25%
Agroforestry	1,000	1,500	25%

Source: field survey 2025

Table 6 Relationship Between Soil Conservation Practices and Crop Yields

Soil Conservation Practice	Correlation Coefficient (r)	P-Value
Contour Farming	0.65	0.01
Mulching	0.60	0.01
Crop Rotation	0.70	0.01
Agroforestry	0.65	0.01

Source: field survey 2025

Table 7: Effect of Soil Conservation Practices on Environmental Sustainability

Environmental Sustainability Indicator	Before Adoption	After Adoption	Change
Soil Erosion	80%	40%	-50%
Water Quality	60% (Poor)	80% (Good)	50%
Biodiversity	40% (Low)	60% (High)	50%
Soil Organic Matter	20%	40%	100%
Crop Residue	30%	60%	100%
Water Conservation	50%	80%	60%

Source: field survey 2025

Table 8: 1: Perception of Respondents on the Effect of Soil Conservation Practices on Environmental Sustainability

Perception	Frequency	Percentage
Very Effective	90	60.0
Effective	40	26.7
Not Very Effective	10	6.7
Not at All Effective	10	6.7
Total	150	100

Source: field survey 2025

Table 8.2 Factors Influencing the Effectiveness of Soil Conservation Practices on Environmental Sustainability

Factor	Frequency	Percentage
Type of Soil Conservation Practice	58	38.7
Farm Size	32	21.3
Education Level	26	17.3
Access to Credit	19	12.7
Extension Services	15	10
Total	150	100

Source field survey 2025

According to the study's findings, crop rotation, mulching, and contour farming are only a few of the soil conservation techniques that Niger State's smallholder farmers have implemented. Fertility, crop yields, and environmental sustainability have all greatly increased as a result of these techniques.

Smallholder Farmers' Adoption of Soil Conservation Techniques

Crop rotation

Mulching and contour farming were the most popular soil-conservation techniques used by smallholder farmers. Most respondents reported being involved in soil conservation for over 5 years. The best methods for increasing soil fertility were mulching and contour farming.

Crop Yields and the Impact of Soil Conservation Techniques.

The findings indicate that: Crop yields were greatly increased by soil conservation measures; the mean increase in maize yields was $p < 0.01$. The two techniques that increased agricultural yields the most were crop rotation and contour farming. Soil conservation techniques' effects on environmental sustainability The findings indicate that: Soil erosion was dramatically decreased by soil conservation methods, with a mean reduction of 40% $p < 0.01$. The best methods for lowering soil erosion were mulching and contour farming.

Soil conservation practices significantly improved soil fertility, with a mean increase in soil organic matter of 25% $p < 0.01$. This study has provided valuable insights into the socio-economic characteristics of smallholder farmers and the effects of soil conservation practices on soil fertility, crop yields, and environmental sustainability in Niger State, Nigeria. The study has demonstrated that smallholder farmers in Niger State are adopting various soil conservation practices, which are having positive impacts on soil fertility, crop yields, and environmental sustainability. However, the study has also highlighted the need for policymakers and development organizations to provide support to smallholder farmers, particularly in terms of education and training, access to credit, and extension services.

5. Conclusion and Recommendations

The results of this study have consequences for environmental preservation and sustainable agriculture in Niger State. According to the study, development organizations and policymakers should give priority to encouraging smallholder farmers to use soil conservation techniques, including crop rotation, mulching, and contour farming. Targeted initiatives ought to be put in place to help smallholder farmers who have smaller farms and less education. It is important to promote crop rotation, mulching, and contour farming as efficient soil conservation techniques. Additional investigation is necessary to examine the long-term impacts of soil conservation techniques on crop yields, soil fertility, and environmental sustainability.

Acknowledgement

The Author wishes to thank the farmers in 3 Local Government Councils out of the twenty-five Local Government Areas namely; Kotagora, Gurara and Bida for their valuable collaboration.

Conflict of Interest

There is no conflict of interest bound to this research

References

- [1] Abdullallah A. (2017). Determinants of adoption of soil and water and conservation techniques: evidence from Northern Ghana. *Int. J. Sustainable Agricultural Management and Informatics*, Vol. 3, No. 1, 2017.
- [2] Aberha, .K. and Seenga, R.B (2008) Keys Influence adoption of soil conservation Practices, sustainability and socioeconomic Impacts among farmers in Mbey rural district ,Tanzania M.sc dissertation.

- [3] Agriculture Morogoro Tanzania. Abubakar, S. A & Mashi, S.A (2008) Gender, Culture and Environmental Conservation in Suleja, Niger State, Nigeria. *The Abuja Journal of Geography and Development*, Vol.2
- [4] Alkali Mohammed, Nasiru Umar & Iliyasu M. Anzak (2022) Africa Journal of Agricultural Science and Food Research. Dept of Geography Nasarawa State Keffi & BUK
- [5] Jimoh H.I, (2023) Erosion tolerance range of land use and management techniques in Ilorin, Nigeria (*International Journal Environmental Studies*).
- [6] Kehinde, A.D. and Ogundeji, A.A. 2022. Social Capital Networks (SCNs) Reducing The Poverty In Cocoa Producing Households: Evidence From Osun and Ondo States of Southwestern Nigeria. *Tropical and Subtropical Agroecosystems*, 25, #082.
- [7] Nasarawa Agriculture Development Project (2020) Agronomic Survey Report for 2019 Cropping Season Planning Monitoring and Evaluation Department. Nasarawa State Ministry of Environment Nasarawa Urban Development Board: Internets 2023.
- [8] Nasarawa Geographical Information Nasarawa State Ministry of Agriculture (2022) Agricultural Briefing paper. Odendo, M. Obare,.G. and Salasya B. (2020) Fastors responsible for difference in uptake of integrated soil fertility management practices amongst smallholders in western Kenya *Africa Journal of agricultural Research*.
- [9] Tanagahari, T.E. and Asfaw .T.K. (2010) Economics analysis of soil conservation practice in Benue State. M.sc Thesis Department of Agricultural Economic University of Nigeria NSUKKA.
- [10] World Economic Forum (2011). Private Sector Development in Haiti: Opportunities for Investment, Job Creation and Growth. Report. Geneva: World Environmental Fund. Retrieved 7 April, 2015 http://www3.weforum.org/docs/WEF_Haiti_Private_Sector_Development_Report_2011.