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RESEARCH ARTICLE

Enhancing soil health among smallholder farmers in Tanzania: A study of land management practices using non-parametric method

Justine N. Mbukwa

Department of Mathematics and Statistics, Faculty of Science and Technology, Mzumbe University-Tanzania, P.o.Box 87, Mzumbe

Abstract

Effective land management is crucial for improving soil fertility and increasing crop productivity. However, the literature lacks clear documentation on the extent to which these practices are used, as well as rankings based on farmers' perspectives and levels of importance they attribute to these practices. The present paper used secondary data covering the two districts (Mvomero and Mbozi) to find out actual practices among the randomly selected smallholder farmers (421) for improving the land fertility. The data scrutiny was handled using Excel and SPSS. The findings have been presented using tables, whereas the importance of each practice based on the farmers' perceptions has been analysed using the non-parametric statistical method (relative importance index (RII)), ranging between" 0-1". Of 13 land management practices, all were found important as per RII and classified as High-Medium in the relative importance index (0.6-08). As noted in previous studies, soil health is essential for agricultural productivity and sustainability. However, implementing these practices can be costly. Thus, small farmers are advised to select the most cost-effective practices to achieve benefits in the shortest time, while ensuring the sustainability of agriculture..

***Keywords*:** land management, soil health, non-parametric statistical method

1. Introduction

Worldwide, statistics depict that 5-6 million sizes of land for cultivation is irrecoverably vanished annually as a result of land degradation progressions. Output losses due to the recession will likely outweigh future productivity growth, as future productivity growth is expected to fall below 1% per year over the coming decades. This can be more severe in dry and semi-desert areas due to the collection of resources, economic factors, and lack of infrastructure (Hamady and Aly, 2014), cited in (Gadana *et al*., 2020). Besides, long-term soil enrichment remains a difficult task due to the increasing world population and current agrarian goings-on. Along with legume cultivation, the agricultural system is an effective approach to continuously meeting food demand. Maintaining and improving soil health is key to sustainability in agricultural systems that use low-input or organic methods. Therefore, soil nutrients and organic material function, legume green fertilizer, mixed cropping principles, and soil maintenance are of great importance in maintaining soil fertility (Jiang et al., 2010). In North America, Baumhardt et al. (2015) argues that soil can be damaged by a number of usual or human activities such as erosion by wind, water, or cultivation, and the introduction of unwanted physical, chemical, or biological land-related factors from industrial operations or the use of unsuitable agricultural applies. Carbon dioxide ($C0_2$) and greenhouse gases originate from land. Investment in sustainable land management (SLM) applies, the extra C02 can be captured and stored in plants and soil. Sustainable practices diminish the rate of carbon emissions from land. The land management practices stand as a land-based resolution to climate change moderation. It offers operational climate change adaptation dealings, such as the integration of pastures, trees, and crops; cover, and water reaping. It helps to figure flexibility and, in turn, ensure agricultural productivity. This is treasured for farmers in Sub-Saharan Africa (SSA),

***Corresponding author:** Justine N. Mbukwa,
Email: jnmbukwa@mzumbe.ac.tz
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whose farming activities rely on rainfall (Critchley *et al*., 2023). Addressing the issue of soil fertility is pivotal to sustainable food security. It contributes to the achievement of the universal sustainable development goals (Agyarko *et al*., 2011), cited in (Tsufac *et al*., 2019). It has been noted that by 2050, the world's population is expected to increase from 7.3 billion to 9.7 billion. Furthermore, Africa will experience the greatest increase in population replication from 1.2 to 2.5 billion (UN, 2015), cited in (Stewart *et al*., 2020). This growth rate is expected to increase pressure on land-dwelling animals and others in sub-Saharan Africa. From this viewpoint, the issue of improving soil fertility by all available options (inorganic and organic bases) for sustainable agricultural systems is widely advocated (Stewart et al., 2020). Due to the loss of the soil (20-40 tons) per hectare annually, the soil value depletion remains an obstinate delinquent. Statistics show that 5 to 6 million hectares of land are affected each year. This accelerates the loss of important nutrients (IFAD, 2016). Furthermore, statistics indicate that the African continent is highly affected by soil depletion, whereby more than 50% of the erosion affects the inhabitants (FAO, 2009). Similarly, in this region, it is argued that 5-6 million hectares are affected by soil erosion yearly (IFAD,2016b). To emphasize its position in Asia, India has been mentioned. In this place, the effort to correct the micronutrient soil management shortages has been shown to increase crop yields by 20-66% in Karnataka State. From 2009 to 2013, statistics show that more than 5 million farmers in the state have benefited, and the net economic benefit from the increase in production is estimated at $353 million (Rs 1,963 crore) (Rakshit *et al*., 2017). Furthermore, it has been argued that out that long-term solutions, such as organic and nutritional reservoir construction styles, besides the use of inorganic fertilizers, may be indispensable for achieving sustainable fertility of soil crops in the SSA region. Sustainable land management practices should be seen as a program that drives farmers towards agricultural productivity. Low agricultural productivity leads to low incentives in terms of income, nutrition, and farmer empowerment (Vanlauwe *et al*.,2015). On the other hand, it has been argued that the lack of access and availability to food is an issue concern in African societies. This is vital to understand because it affects human well-being and economic prosperity. Therefore, in this region, soil nutrient diminution is a foremost threat to food security and conservation of untouched resources. It should be noted that the use of natural fertilizers is an effective way to preserve soil health. In this regard, Africa loses $4 billion a year due to the overuse of the land, with the replenishment of micronutrients. In countries in this region, sustainable farming and land management, along with reducing life-threatening poverty and food shortages, should be taken as the core agenda (Nkonya et al., 2008) cited in (Bekele et al., 2021). In most parts of sub-Saharan Africa, including Ethiopia, land deprivation is a widespread problem. In this country, more than 85% of the land is characterized by moderately to very severely depleted, whereas 75% is affected by semi-arid or dryland (ibid). Similarly, nutrient constraints and poor soil health due to unceasing cultivation without replenishment of fertility affect the agricultural production of smallholder farmers. Low soil level affects food storage and thus leads to malnutrition. Therefore, increasing crop yields to meet current and future food needs will be difficult to achieve without increasing the use of nutritional fertilizers in an efficient and effective manner (Rusinamhodzi et al., 2011; ten Berge et al., 2019). In Cameroon, Tsufac et al. (2019) argues that land improvement (agroforestry) should be applied using a locally identified fertilizer as well as controlling erosion along areas characterized by slopes. It has further been noted that soil provides a reserve for the existence of living organisms, either directly or indirectly. Increasing the efficiency of agrarian production is necessary to meet farmers' food and income needs. Nevertheless, this cannot happen without investments in land management sustainably (Takoutsing *et al*. 2013b), cited in (Bertin et al., 2014). The proper skills in line with management practices and environmental quality are desirable and are important bases of maintaining crop productivity. It should be noted that direct management tillage can increase soil organic C and

N absorptions at 0-20 cm penetration by up to 7-17% over 8 years. Similarly, planting cover crops and applying 80-180 kg N ha-1 per year can increase soil organic C and N absorptions by up to 4-12% compared with no cover crops or nitrogen fertilization by increasing plant biomass and C and N Soil inputs (Sainju et al., 2003). On the other hand, a poverty reduction strategy program called "one cow for a poor family was introduced in Rwanda. In this program, resource-poor farmers get a dairy cow and develop different skills and assets to improve their coping skills. One potential benefit of the program was to improve soil health via fertilizer and manure (Kim et al., 2013). In Ethiopia, based on laboratory experiments, all soil management practices are significantly important in improving both chemical and physical structure, such as soil texture, bulk density, total absorbency, humidity content, organic carbon, and contents of macro and micronutrient elements. The combinations of soil bund (SB) and farm yard manure (FYM) have been noted as significantly superior to separate farm yard manure (Gadana et al., 2020). Furthermore, it has been noted that population pressure, land use patterns, unrestricted animal grazing, in the absence of energy sources, problems with land possession, and issues with poor government policy contribute to soil fertility depletion. Inadequate fertilizer use, complete crop residue removal, continuous cropping systems, soil types and climate, improper cropping practices, soil erosion, and continuous cultivation are the main contributors to the depletion of soil fertility. Integrated nutrient management, crop residue management, green manuring and cropping sequences, management of farmyard manure, applications of chemical fertilizers and soil amendments, agroforestry practices,

conservation agriculture and implementation of soil-water conservation practices are among the promising technologies for increasing soil fertility (Aleminew & Alemayehu, 2020). In Tanzania, the implementation rate of soil management technologies (SCTs) is very low compared to other countries in Africa. Despite the interventions taken to familiarize themselves with soil conservation measures, their adoption is still much lower than expected (Lasway et al., 2020). It noted that the enhancement of soil health among smallholder farmers is a significant area of research, mainly in the context of achieving Sustainable Development Goals (SDGs). A baseline survey was carried out in Ethiopia, concentrating on the production of white lupin, emphasizing the crop's potential to enhance soil fertility and offer various advantages such as food, feed, and income. The study found that incorporating white lupin into agricultural practices can mitigate soil health challenges encountered by smallholder farmers, which is in line with the Sustainable Development Goals aimed at fostering sustainable agriculture and improving food security (Atnaf et al.,2020). Also, a study by N'Guessan Diby (2024) has observed that practices that are not sustainable, like the recent transition to monoculture aimed at achieving greater yields, have led to soil degradation, reduced biodiversity, and a rise in pest and disease occurrences. This case study highlights the urgent necessity for sustainable soil health management to boost cocoa production while safeguarding the environment in West Africa. By evaluating soil health issues and applying effective management strategies, including agroforestry, integrated nutrient management, and measures to control erosion, cocoa farmers can enhance soil fertility, raise yields, and support efforts to combat climate change. Concerning this study conducted in West Africa, some of the identified sustainable development goals were: To begin with, *Goal 1: No poverty*, posits that enhancing the health of cocoa soil boosts crop yields, which subsequently increases the income of smallholder farmers and helps reduce poverty in rural regions. Next, *Goal 13: Climate action*, suggests that improving cocoa soil health aids in both above and below-ground carbon sequestration, fostering sustainable and resilient cocoa farming systems. Furthermore, *Goal 15: Life on land,* tackling soil degradation and restoring already compromised soils in agricultural systems, safeguards biodiversity and enhances ecosystem functionality. Consequently, these emphasized key SDGs align closely with the current study. Thus, this research aligns with the global sustainable development goals.

2. Literature review

2.1. Conservation of Resources (COR) Theory

This paper is supported by the Conservation of Resources (COR) Theory, invented by Hobfoll (1989). It is centred on motivation that drives humans to both preserve their existing resources and to track innovative resources. The author argues that psychological tension occurred on three occasions: when there was a risk of damage to resources, an actual net damage to resources, and a deficiency of gained resources after the outlay of resources. Based on the author's standpoints, resources are defined as things that one values, explicitly objects to, states, and conditions. In this viewpoint, damage to these types of resources will shift individuals into certain levels of anxiety or tension. The main dependent factor is the loss or gain, whereas the independent factor is the perceived importance of an individual's resources, personal values, perceived resource damage, or improvement. The theory is relevant to the present study because land is perceived as a resource for producing the crop harvest. It has to be preserved so that it can bring the gain and not the loss of the crop harvest. It is the role of the individual to ensure that the loss of land fertility is prevented**.**

2.2. Empirical evidence and contribution

Studies on land management practices have been conducted and documented elsewhere(Amgain *et al*., 2022; Baumhardt *et al*., 2015; Bekele *et al*., 2021; Dallimer *et al*., 2018; Eze et al., 2022; Ikazaki *et al*., 2011; Kambiré *et al*., 2017; Kikuu, 2013; Michael, 2022; Mng'ong'o *et al*., 2021; Mutegi *et al*., 2018; Odendo *et al*., 2010; Owoade, 2020; Schwilch *et al*., 2014; Shrestha, 2015; Thapa & Yila, 2012). However, in the body of knowledge on the question of how important land management practices among smallholder farmers are is not addressed. Therefore, in this present paper, the non-parametric statistics known as the Relative Importance Index (RII) has been fitted to the best farm practices in terms of rank. It is important to address this gap because it helps assess how smallholder farmers evaluate indigenous technologies for maintaining soil health without harming other species, while also improving crop productivity and their livelihoods**.**

3. Materials and Methods

Study area: was conducted in Vomero and Mbozi districts in Tanzania. Mvomero district is located between a latitude of 6°14'8.22"S and a longitude of 38°41'37.49"E, whereas the Mbozi district is located between latitudes 80 and 90 12' south of the Equator and Longitudes 320 7' 30" and 330 2 0" East of the Greenwich Meridian. The rainfall distribution is bimodal and unimodal, respectively. *Source of data:* In the Mvomero district (Morogoro region) and Mbozi district (Songwe region), from October 2015 to February 2016, secondary data were gathered through a survey approach. From this standpoint, the study has been limited to only two districts under study, where the data were gathered in line with the correctional-based design. *Study population:* smallholder farmers who are responsible for the maize cultivation in both areas of the study. *Sampling:* A quantitative research approach was used along with the cross-sectional survey. To get to the lowest level of analysis (smallholder farmers), five-stage random sampling techniques were carried out. In the first stage, two agricultural zones, namely Eastern and Southern Highlands, were selected randomly out of five zones. In stage two, one study district was chosen at random in each chosen zone. Stage three involved selecting two divisions at random from each chosen study district. In the fourth stage, one ward in each division of the Mvomero district was chosen randomly. In the case of the Mbozi district, two wards were arbitrarily chosen from the first chosen division, and one ward was purposefully chosen from the second chosen division to conserve the available resources. Fifthly, three villages were chosen at random from each selected ward in Mvomero, whereas in Mbozi district, two villages were chosen from each selected ward from each selected first division (Igamba). However, one village was purposefully chosen in Itaka's chosen ward to save money (ibid). From the same list of smallholder farming households that were available in the MVIWATA database as well as the village offices, a representative sample of 430 households was ultimately chosen using simple random sampling along with the lottery method. Only 421 respondents, with a response rate of 97.9%, fully participated for the analysis's purposes, providing complete information based on the study's research questions. *Data analysis:* both SPSS 20 and Excel were used to analyse the collected data. The rated frequency of each farmer to the respective indicator from 1-5 Likert scale, with "5=Extremely important to 1=not important) were revealed using SPSS, interpreted as maximum to minimum. The frequencies were tabulated in Excel, followed by the computation of the RII along with the rank of land management practices as perceived by the farmers. All the indicators were ranked in terms of importance using the relative importance index (RII) has been documented by Kometa *et al*. (1994) and Sambasivan and Soon (2007), respectively, and cited in Gündüz *et al*. (2013)**.**The rank of each indicator in terms of importance was determined. The RII may be presented using the following mathematical notation:

$$RII = \frac{\sum_{i=1}^{n} Z_i}{a*n};$$

whereby

(i) Z_i stands for the weighted sum of the number of cases per score times the score that is $Z_i = Z_5*5+Z_2*4+Z_3*3+Z_2*2+Z_1*1$

(ii) "a", stands for a total number of scales per indicator. In this paper, the smallholder farmers were interrogated to rate the extent to which they value the land practices using a scale of 1-5

(iii) "n", stands for the sample size of the present research paper

The interpretation of the RII was adopted (Chougule, 2020), classified as: High(H) [0.8<RII<1.0], High-Medium (H-M) [0.6<RII<0.8],Medium (M) [0.4<RII<0.6], Medium-Low (M-L) [0.2<RII<0.4] and Low (L) [0.0<RII<0.2].

A cronbach's alpha reliability test has been pointed out in the literature as a measure of the reliability of the instrument and scale items inter-correlation(Mat Nawi et al., 2020).Therefore, a reliability index (Cronbach's alpha coefficient) was determined to reveal the internal reliability of the responses. the index is determined using the following algebra expression:

$$\alpha = \frac{k}{k-1}\left(1-\frac{\sum S_i^2}{S^2}\right)$$

α = Cronbach's Alpha

k = the number of items in the scale

S_i^2 = sum of the item scores for each indicator

S = sum of the all scores for all indicators

The rule of thumb was used to assess how well the scale items converge to the true land management practices in the study areas. In this paper, Hair et al (2016) cited in (Mat Nawi et al., 2020) classified on the following ranges was adopted: poor $(\alpha :< 0.6)$, moderate $(\alpha : 0.6 - < 0.7)$, good $(\alpha : 0.7 - < 0.8)$, very good $(\alpha : 0.8 - < 0.9)$ and excellent $(\alpha :> 0.9)$. However, the author argued that the alpha test above 0.7 is acceptable. In this paper, the internal validity has been addressed since the study was designed and conducted following the scientific protocol. The analysed data has yielded truth for the identified research question. The selections of the units of analysis adhered to the principles of randomization, which was free from selection bias. Furthermore, there is no conflict with the culture within which the study subjects' dwell.

4. Results

4.1. Demographic status of the respondents

Table 1 depicts the study sample statistics of the respondents in the study areas. Of the studied smallholder farmers, their ages range from 20-83, with an average of 42.04 years old. Given the total number of years the farmers attended school, preliminary results show that on average, the respondents used 6.76 (approximately 7 years). Also, results disclosed that on average the family size per household was 6 members, while in the view of education, the respondents spent 0-13 years (7 years on average) for studies (Ministry of Agriculture, 2021). Furthermore, the findings indicated that the farm sizes cultivated by these people range from 0.5 to 2 acres per family (Salami *et al*., 2010).

Table 1. Descriptive statistics by demographic variable

Variables	**Descriptive Statistics**				
	N	Minimum	Maximum	Mean	Std. Deviation
Age	421	20	83	42.04	11.905
Number of years at school	421	0	30	6.76	2.849
Family size	421	0	23	6.05	3.020

Source: Findings (2023)

Table 2 shows the distribution of the respondents by sex. Of the study sample, 239(56.8%) were male, whereas the remaining proportion was female. This means most of the small farmers' households are likely to be headed by men.

Table 2. Distribution of the study sample by sex

Sex	**Frequency**	**Percent**
Male	239	56.8
Female	182	43.2
Total	421	100.0

Source: Findings (2023)

4.2. Reliability analysis of the items

Table 3 indicates the Cronbach's alpha (α) test of scale reliability of the items observed through the questionnaire per indicator on land management in terms of ranking. The test helps to determine the average relationship of items in a survey instrument and weighs its consistency. The empirical findings revealed that the calculated standardized alpha statistics on items $(\alpha^* = 0.707)$ is greater than the recommended alpha test $(\alpha = 0.70)$. However, the scale reliability in each of the measured variables as well as the size of the alpha test, has been met since it is within the recommended threshold of 0.7 coefficients as reported by Hair et al.(2016), cited in Mat Nawi *et al*. (2020).

Table 3. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.718	0.707	11

Source: Findings (2023).

4.3. Land Management practices results

Table 4 shows the ranking of various indicators subject to the land management practices in the study areas, Mvomero and Mbozi districts in Tanzania. The farmers responsible for growing the maize and beans provided their opinions on how important the indicators are in improving the land's soil fertility. The findings revealed that the top practices indicate a very high frequency of occurrence. In this regard, it has been discovered that all indicators range from high to high-medium as per the classification scale of the RII (Chougule, 2020). The results further revealed that the relative importance index for the improved seed, terraces, and mulching ranges from 0.8 to 1. Hence are classified as high, whereas the other indicators are classified as high-medium since the relative importance index ranges from 0.6 to 0.8.

Table 4. Land management ranking and respondents' scores (n=421)

Land management practices	Respondents' scores						RII	Rank
	Extremely important (5)	Very important (4)	Fairly important (3)	Important (2)	Not important (1)	Total		
Fertilizer manure	160	165	17	33	46	421	0.771	5
Mulching	137	211	29	33	11	421	0.804	3
Terraces	191	150	35	30	15	421	0.824	2
Composit	112	206	30	54	19	421	0.761	7
Crop rotation	131	170	37	53	30	421	0.752	9
Legume rotation	116	192	46	40	27	421	0.757	8
Intercropping	137	149	52	59	24	421	0.750	10
Tillage practices	107	153	60	65	36	421	0.709	11
Weeding	181	144	32	28	36	421	0.793	4
In-organic fertilizers	95	229	54	26	17	421	0.771	6
Improved seed	214	159	23	11	14	421	0.863	1

Source: Findings (2023).

Table 5 shows the ranking of various indicators related to the land management practices in the study areas, Mvomero district. The findings revealed that the top practices indicate a very high frequency of occurrence. The farmers responsible for growing the maize and beans provided their opinions on how important the indicators are in improving the land's soil fertility. The findings revealed that the top practices indicate a very high frequency of occurrence. In terms of ranking, the improved seed was classified as medium [0.4<RII<0.6], whereas the rest of the indicators are classified as low-medium [0.2<RII<0.4]. Based on this analysis, it is very likely to argue that the farmers in Mvomero district are less knowledgeable in integrating land management practices for improving land fertility.

Table 5: Land management ranking and respondents' scores by Mvomero District (n=156).

Land management practices	Respondents' scores						RII	Rank
	Extremely important (5)	Very important (4)	Fairly important (3)	Important (2)	Not important (1)	Total		
Fertilizer manure	68	52	8	16	12	156	0.293	3
Mulching	39	87	13	10	7	156	0.289	4
Terraces	99	32	17	6	2	156	0.327	2
Compost	43	69	14	21	9	156	0.277	6
Crop rotation	43	49	19	26	19	156	0.256	9
Legume rotation	34	58	22	26	16	156	0.255	10
Intercropping	36	54	28	22	16	156	0.257	8
Tillage practices	25	58	23	23	27	156	0.237	11
Weeding	70	32	9	20	25	156	0.271	7
In-organic fertilizers	32	99	4	17	4	156	0.288	5
Improved seed	124	106	18	8	9	265	0.533	1

Source: Findings (2023).

Table 6 shows the ranking of various indicators related to the land management practices in the study areas, Mbozi district. The findings revealed that the top practices indicate a very high frequency of occurrence. The farmers responsible for growing the maize and beans provided their opinions on how important the indicators are in improving the land's soil fertility. The findings revealed that the top practices indicate a very high frequency of occurrence. In terms of ranking the improved seed, weeding, mulching, and legume rotation were classified as medium [0.4<RII<0.6] with the highest index in descending order. However, other indicators are relatively lower in terms of rank, though they fall under the medium class. Considering the revealed outcome, it is likely to commend that the farmers in Mbozi district are more knowledgeable in integrating land management practices in farming activities for improving land fertility.

Table 6. Land management ranking and respondents' scores by Mbozi District (n=256**)**

Land management practices	Respondents' scores	RII	Rank					
	Extremely important (5)	Very important (4)	Fairly important (3)	Important (2)	Not important (1)	Total		
Fertilizer manure	92	113	9	17	34	265	0.478	9
Mulching	98	124	16	23	4	265	0.515	3
Terraces	92	118	18	24	13	265	0.497	5
Compost	69	137	16	33	10	265	0.483	8
Crop rotation	88	121	18	27	11	265	0.495	6
Legume rotation	82	134	24	14	11	265	0.502	4
Intercropping	101	95	24	37	8	265	0.493	7
Tillage practices	82	95	37	42	9	265	0.472	11
Weeding	111	112	23	8	11	265	0.522	2
In-organic fertilizers	63	130	50	9	13	265	0.482	10
Improved seed	124	106	18	8	9	265	0.533	1

Source: Findings (2023)

5. Discussion

The current paper intends to find out the extent to which smallholder farmers integrate land management practices to improve soil health. Based on pooled samples of both districts under study, the results have revealed that RII for improved seed, terraces, and mulching is very high in descending order, respectively, whereas the remaining indicators have been classified as high-medium (Chougule, 2020). These results suggest that, irrespective small farmers are dwelling in rural areas, they are likely to be exposed to either indigenous knowledge or formal education. Also, it is very likely to argue that maybe small farmers are also members of the social group or farming groups where they teach each other the importance of this local knowledge for sustainable agriculture.

Disaggregating the results in terms of the district or geographical location, it has been revealed that Mvomero district, located close to the coast region, is classified as medium for improved seed and medium-low for the rest of the indicators. This means the future land of the district under study will not be sustainable as long as the RII is somehow low. However, the Mbozi district, based on the Songwe region (formerly Mbeya), is somehow good in terms of practicing land management practices compared to the Mvomero. This has been justified by the relatively high RII classified as Medium (M) [0.4<RII<0.6]. Comparatively, Mbozi district is very good in terms of efforts to preserve the land, which in turn leads to sustainable agriculture. This study is similar to a study conducted by Thapa and Yila (2012) in Jos Plateau, Nigeria, where 13 land management practices were ranked. The results found four outstanding practices: chemical fertilizers, farm animals, intercropping, and crop rotation. On the other hand, the results of this study contrast with actual practice in the Jos Plateau, where agroforestry, mulching, leguminous cropping, and crop deposit barriers were temperately popular. That is why it is not practiced much because it takes time to be effective and sometimes up to 3 years before certain benefits are shown. In addition, Dallimer et al (2018) pointed out in Kenya that the implementation of a certain practice varies from country to country, as does the nature of the household, the characteristics of the farm, and the availability of subsidies and advice. Implementation is based on the high initial and maintenance costs of terraces and agroforestry. They also praised those simple methods, such as fertilizer and intercropping, that have low production costs and high yields with high present value. Also, the current research findings support the findings of Eze *et al*. (2022) on soil conservation practices in the East Usambara Mountains of Tanzania. based on their paper, the findings discovered that farmers (66-83%) incorporating fanyajuu terrace into organic amendments resulted in better soil, resulting in the change the colour from red to black, and thus increased the yield. As for similar geographical areas, all small farmers in Morogoro, Songwe, and Mbeya Mountain can find it useful in restoring soil fertility. On the other hand, the present study matches with the study by Mutegi *et al*. (2018) who discovered the significance of the improved cereal-legume intercrop technologies practices? This is important because the previous author revealed that indigenous farm practices raise maize productivity between 2.8 to 3.3 t/ha (≈ 300%). Using similar practices in Kenya, Uganda, Rwanda, Tanzania, and Ghana, the P fertilization + inoculation raised the soybean crop yields by supplementary than 200% in each country while the maize productivity rises by up to 300% in dryland stricken Sadore and Dasso regions in Niger. Compared to most developed countries, the current study findings match with a study conducted by Baumhardt *et al*. (2015) in Florida, which found that soil degradation requires integrated management solutions that include cover crops or crop residue administration. This is because it reduces the impact of raindrops, maintains higher infiltration, increases soil water reserves, and eventually increases crop productivity. The present findings match with the previous study conducted in the Southern Highlands Tanzania (Usangu Basin), where the focus was to monitor the soil fertility status using management strategies and discovered that most micronutrients were available in the deficient amount in many studied sites except for iron (Fe) and manganese (Mn), which were observed to be above optimal prerequisite. This indicates that the soil has been deprived in terms of nutrients which unfavourable condition for plant flourishment (Mng'ong'o et al., 2021). The findings discovered that Indigenous practices are very crucial because it is one of the key issues to consider in line with sustainable agriculture. This supports the argument that the practices are based on cost-effectiveness(Rahmawati & Dewi, 2020). This is may be true because the use of local flexible and cost-operative approaches such as animal dung, ash from grassland fire, agroforestry, untilled, termitaria, and earthworm castings help to manage soil fertility. Based on the revealed results, I have noted that indigenous people (farmers) have acquired local skills as a coping strategy to cope with shocks. It is likely to argue that some of them might be aware of clustering the manure superiority based on physical appearance such as colour, humidity, presence of moulds and sand contents that make soil richness management verdicts. The relative importance results revealed from the present paper are less similar to the findings obtained from the laboratory experiments where all soil management practices were found to be significant in improving both chemical and physical structure (Gadana et al., 2020). Given a combination of these practices, the previous results revealed different patterns whereby the soil bund and farm yard manure (SB-FYM) were found to be significantly superior to FYM and SB while in terms of relativity, the results found as SB-FYM>FYM>SB>NM. Furthermore, it has been discovered that the pooled sample for both districts indicates that the land management practices of smallholder farmers are highly valued in terms of importance being a signal of having sustainable agriculture in both studied areas (table 4). However, based on the disaggregated results by district, it has been discovered that the stallholder farmers in Mvomero district in Morogoro region are less proactive in valuing the farm management practices compared to Mbozi district in Songwe region since the relative importance index is classified as medium-low and medium (table 5 and 6) respectively. Observing the RII index at individual small farmers, comparatively, it is likely to argue that the farmers in Mbozi district are likely to curb the problem of hunger (food insecurity) and, even malnutrition.

6. Conclusion

These results can be used to understand how farmers engage in land management practices to enhance agricultural sustainability. It appears that improved seeds, terrace construction, and mulch usage are highly important practices for farmers in the area. In this paper it been have noted that the indigenous knowledge among the community or stallholder farmers is very important and should not be ignored. It should be practiced it is a key component of soil richness for sustainable crop efficiency. On the other hand, the study findings revealed very useful evidence for policy improvement on land productivity. The revealed results match the established theory of resource conservation, which is centred on keeping the land with its original fertility for future use. Future research direction: given the significance of the present research question of land management as one of the engines of agricultural sustainability, which improves the people's livelihood, two important questions need to be addressed in the future. Future research should find out: (i) the determinants of the adoption of the farm management practices by fitting the statistical machine learning for assessing the patterns discovery, (ii) secondly, I recommend the study on a qualitative basis that looks into the experiences of the impact of land management practices on crop productivity.

Declarations

Authors' Contributions

All authors are contributed in this research

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Data Availability Statement

Data presented in this study are available on fair request from the respective author.

Ethics Approval and Consent to Participate

Not applicable

Consent for Publication

Not applicable.

Conflicts of Interest

The authors disclosed no conflict of interest.

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