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Smallholder Farmers' Perceptions on Effective Farming Practices in Semi-Arid Areas of Tanzania

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ABSTRACT

Crop farming in semi-arid agroecological zones is underperforming based on several constraints including longer dryness, low soil nutrient levels and poor farming practices being the core. The study was conducted to identify essential farming practices potential for semi-arid crop farming. The study was carried out in rural semi-arid regions of Tanzania using Sanjaranda and Ipande villages as cases adopting cross-sectional design employing both quantitative and qualitative approaches. The sample size was 137 heads of households being 10% of total target population. Findings identified effective farming practices which revealed a significant correlation ($P< 0.05$) with increasing crop production based on farmers experience and perceptions. Effective practices included zero tillage to some localities, minimum tillage, use of cover crops, crop rotation practice, intercropping practice, farming through ridges and terraces. Furthermore, use of farmyard manure, appropriate spacing and management of crop residues in farm were also found effective to increasing crop production. The study recommends to enhancing higher production and capacitating smallholder farmers in semi-arid areas with extension knowledge and assistance on potential farming practices and in terms of agricultural technology.

Keyword: Agriculture, Farming practices, Semi-arid, Smallholder farmers

1. Introduction

Economy of many countries depend on agriculture as one of the primary sources [1]. Agriculture contributes greatly in internal and external earning and therefore providing large share of nationals' income, reginal generations, household earnings and individual welfare [2]. In Africa, agriculture leads to employment opportunities to more than 80% of settlers while in sub-Saharan Africa it contributes by 32% of the GDP [3]. Tanzania rural population lives on agriculture by 80% and agriculture is centrally considered as the prime strategy to end poverty, hunger and malnutrition [4].

Agriculture sector in Tanzania still underperforms contrary to the rapid expansion of farmland, political initiatives and existing role of the crop to the people's livelihood and country's economy [5]. A number of factors a considered as setbacks mentioning some being inappropriate farming practices, climate change effects, land degradation, low agrotechnology and limited agricultural investments [4],[6]. Reciting the factors, farming practices are centrally accounted to low production and agricultural losses [7].

Tanzania has taken a number initiatives to enhance agricultural production and centrally focusing on potentializing farming practices and capacitating farmers [8]. Some of national strategies included Iringa declaration of 1974 on *Siasa ni Kilimo* literary means 'Politics is Agriculture', Arusha declaration of 1967 on *Vijiji vya ujamaa* literary means Villagization focusing of putting people in villages to raise agricultural labour [9]. Also, Kilimo Kwanza meaning Agriculture First in 2009. With this, farmers were trained on potential farming practices, given agricultural subsidies and formation f cooperative societies to support farmers [10].

In Tanzania, farmers consider farming practices as tools for crop production and for soil management. Based on the agro-ecological zones, farmers adopt the use of certain specific practices as enhance agricultural production and managing soils [11]. Semi-arid areas in Tanzania utilizes farming practices potentially to higher

their agricultural production [12]. Considerate to crops types as such cereals, oils, pulses, roots, tuber crops, vegetables crops, cotton, tobacco and other commercial crops are adaptive to certain practices in these semi-arid areas in Tanzania for their sustainable production [13].

In the country's semi-arid areas, cereals are underproduced as due to use of unpromising farming practices including monocropping, poor tillage, inappropriate use of fertilizers and other agricultural inputs [15]. Pulses benefiting high the livelihood in the semi-arid as income generation, meeting nutritional demands are underproduced due to use of local seeds varieties, unsustainable soil management practices, wrong beliefs on fertility of darks soils and inappropriate post-harvest practices [16]. As other crops in the country, oils as well are adversely affected by poor farming practices.

Consequently, speaking of farming practices in Tanzania, poor land use practices have been affecting agriculture, water resources and leading to forest degradation. Such outcomes lead to devastating of human livelihood enhancing poverty, malnutrition and endless hunger [10]. Semi-arid areas of Tanzania are underperforming in agricultural production centrally due to use of inappropriate farming practices and other environmental limitations [5]. Poor farming practices use affects several Agro-ecological zones but to most adverse effect in Tanzania semi-arid areas leading to decline in agricultural production and enhanced land degradation [7]. With regard to the such situations which makes semi-arid areas of Tanzania experience decline of fertility, decline of crop production and rising cost of maintaining agricultural production, the study ought to identify, document and suggest potential farming practices to semi-arid areas of Tanzania and other areas with similar Agro-ecological zone for higher agricultural production and enhanced soil productivity. Therefore, the study examined existing farming practices and determined their potential impacts on crop production among farmers in rural areas of Tanzania.

2. Methods

The study was carried on in rural areas of central Tanzania which are centrally semi-arid agro ecological zones. The study villages were Sanjaranda and Ipande of Itigi District in Singida region. The two villages were selected due to the fact that they are semi-arid areas, agriculture is the dominant and prominent economic activities to more than 95% of dwellers whom grows more than five varieties of crops including cereals, pulses, oils and root crops. Geographically, the two villages are in the district in coordinates 5° 42' S and 34° 29' E. The area experiences low rainfall ranging between 500 to 700 mm annually with a dry year after every four years. Temperature ranges between 20°C to 32°C. In term of topography the study areas lie between 1244m and 1300m above the mean sea level having sandy soils, brown greyish soils and dark cracking clayey.

A cross-sectional research design was used by the study utilizing both quantitative and qualitative methods while simple random sampling for household representatives was used while purposive sampling was used for key informant respondents. The study used 10% considered representative as a sample size based on Boyde [28] in which Ipande had a total of 82 respondents (821x0.1) and Sanjaranda had a total of 55 respondents (551x0.1) making a total of 137 study respondents. Data were collected through household questionnaires, key informant interview and transect walk as well as field observation. Data analysis was done using SPSS software in which chi square test was used to test attributes dependencies between farming practices and production levels at 0.05 set as significance level.

3. Results and Discussion

3.1 Demographic Characteristics of Respondents

The study identified some socio-economic characteristics of respondents including age, sex and level of education (Table 1). The study involved both males and females in which more respondents were males as in Ipande 69.5% and Sanjaranda 56.4% This reflects the prominent feature of African households that are mostly headed by men [27]. In terms of age, most respondents were aged between 36 to 60 years old which implicate the working class in most African countries [4]. Most of respondents had attained only primary education as 67.3% and 63.4% in Sanjaranda and Ipande respectively. Such results reveal the low level of education among farmers in African societies implicating low adoption of modern farming practices [13].

Table 1. Respondents' demographic characteristics

Characteristics		**Sanjaranda (N = 55)**	**Ipande (N = 82)**
		%	
Age	18 – 35	20	32.9
	36 – 60	65.5	62.2
	60+	14.5	4.9
Sex	Males	56.4	69.5
	Females	43.6	30.5
Level of education	Informal	10.9	17.1
	Primary	67.3	63.4
	Secondary	16.4	17.1
	Middle college	5.5	1.2
	Higher education	0	1.2

3.2 Farming systems and crops grown

The study identified four farming systems existing in the study areas including crop farming, livestock keeping, agropastoralism and agroforestry. Crop farming alone is practiced by 63.6% respondents in Sanjaranda and 64.6% in Ipande while livestock keeping is done by 35.4% and 43.6% of respondents in Ipande and Sarajanda respectively. 36.6% and 36.4% of respondents in Ipande and Sanjaranda respectively were practising agropastoralism and minority being 12.2% (Ipande) and 20% (Sanjaranda) were practising agroforestry.

Crops grown in the study area included maize, sorghum, millet, sunflower, lentils, chickpea, groundnuts, sweet potatoes, cassava, cowpeas, pulse, beans and onions. Maize is grown by 100% of all study respondents in the study areas while sorghum is grown by 4.9% and 23.6% of respondents in Ipande and Sanjaranda villages respectively. Furthermore, millet is grown by 3.7% and 21.8% in Ipande and Sanjaranda villages respectively. Sunflower, Chickpea, groundnuts and sweet potatoes are grown by 58.5%, 85.4%, 67.1% and 76.8% of respondents in Ipande and 94.5%, 32.7%, 7.3% and 65% of respondents in Sanjaranda respectively.

3.3 Trends of crop production

The study briefly assessed the trend of production among smallholder farmers in the study areas for a range of five years (2020 – 2024). Household questionnaires indicated an increasing production to 35.4% and 63.6% of household farmers in Ipande and Sanjaranda respectively and contrary to that 20.4% of farmers households in Ipande and 12.4 in Sanjaranda are observing a decline in crop production of their household crop production. 26% and 20% of respondents in Ipande and Sanjaranda respectively experienced a fluctuating level of crop production. Also, 18.2% and 4% in Ipande and Sanjaranda respectively had no change in the crop production for the five years. Using Focus Group Discussion, in Sanjaranda adoption of new farming techniques enhanced production as from 100kg/ha to 1500kg/ha of maize after adoption of conservation agriculture practices including minimum tillage, intercropping, cover crops and crop residue management. In Ipande, sunflower production changed from 70kg/ha to 840kg/ha.

3.4 Farming practices used by farmers

The study identified common farming practices used by farmers in the study areas. These included zero tillage, deep tillage, minimum tillage, use of cover crops, crop rotation, intercropping, terraces farming and ridges farming, manure applications and others.

Zero tillage of used by 3.7% and 1.8% of respondents in Ipande and Sanjaranda respectively in which statistically zero was effective to high production in Ipande (X^2 = 38.493; p >0.005), while having no significant relationship in Sanjaranda (X^2 = 0.582; p > 0.005) and therefore implicating that zero tillage could not counted effective for higher agricultural production in all dryland areas. Other studies like [17] recommends use of zero tillage considerate to soil types and its properties as well vegetation coverage nature.

In terms of minimum tillage which is done through hand hoes and Ox-plough, 96.3% of respondents in Ipande and 96.4% of respondents in Sanjaranda uses minimum tillage in their farming. As correlated to high

production, in both study villages minimum tillage had significant correlation to high production as; X^2 = 30.107, p = 0.000; X^2 = 31.306, p = 0.000 in Sanjaranda and Ipande respectively. As reading studies including [18] and [19] indicated the role of minimum tillage in dryland agriculture enhancing the reduction of soil erosion, minimizing organic matter breakdown while meeting conducive environment for crop growth.

Deep tillage is used by 30.5% of respondents in Ipande while being almost the same in Sajaranda (32.7%) done by tractors. Statistically using chi square test, study found insignificant relationship between deep tillage and increasing production as in Ipande; X^2 = 2.544, p = 0.111 and Sanjaranda; X^2 = 0.074, p > 0.000. in dryland agriculture deep tillage seems inappropriate as has been due to its outcomes including disconnecting of the seed bed, degradation of farm soil and easier soil erosion [20].

Cover crops including legumes are grown to reduce soil moisture loss and diversify food sources by 79.3% of respondents in Ipande and 80% in Sanjaranda. To certain extent most of cover crops including beans, chickpea, pumpkins and lentils are grown in intercropping. Chi square results show a significant correlation between farming of cover crops and increase of production trends in households' farms as in Ipande (X^2 = 4.866, p = 0.042) and in Sanjaranda (X^2 = 12.277, p < 0.005). The study by [21] had shown a significant increase of maize produced when were intercropped with *Mucuna* and *Cajanus Spp* being cover crops.

Crop rotation is practiced by most farmers in Sanjaranda (72.2%) contrary to those in Ipande (39%) in which in the study area crop rotation is done commonly for sunflower and maize in Sanjaranda while Sunflower and chickpea in Ipande. Those practicing crop rotation in bioth study villages have been significantly increasing production as in Ipande (X^2 = 9.134, p < 0.005) and in Sanjaranda (X^2 = 12.182, p < 0.005). Crop rotation practice is crucial for dryland agriculture enhancing nutrient recycling, diminishing soil pathogens and improving soil nitrogen fixation [22].

Ridges are used in both study villages as by 75.6% in Ipande and 67.3% in Sanjaranda villages. Using of trench and pits in Sanjaranda have been very common as forms of ridges. In both study villages as practicing smi-arid agriculture, ridges were significant to increasing crop production by X^2 = 12.869, p < 0.005 and X^2 = 10.618, p < 0.005 for responses in Ipande and Sanjaranda villages respectively. Potentially farming in semi-arid areas could potentially adopt ridge farming to reduce runoff and soil erosion, humification of crop residues and weeds management, while improving soil moisture and conservation [23].

Farmyard manure application is also used in the study villages though at different rates. Manure use in Sanjaranda is very high as by 67.3% of respondents while very in Ipande as by 25.6% of respondents as the difference being influenced by differences on ideologies regarding soil fertility beliefs on dark soils. Most of farmers in Ipande belief that dark cracking soil is very fertile due to its colour and therefore minimally prefer the use of manure. A significant correlation was found between use of farm yard manure and increase of crop production in both study villages as in Ipande (X^2 = 31.306, p < 0.005) and in Sanjaranda (X^2 = 31.900, p < 0.005). Other studies as [24] recommends the use of organic manure in semi – arid areas agriculture to increase organic matter in the soil due to limited humification and improve the soil fertility.

Spacing during sowing is considered also for higher agricultural production. Farmers in both study villages being Ipande and Sanjaranda villages were using appropriate spacing by 78% and 87% as based on specific crop requirement. Chi square test on correlation identified significant relationship between appropriate spacing and increasing of production as in Ipande X^2 = 8.320, p = 0.004 and in Sanjaranda X^2 = 16.042, p < 0.005. During a key informant Interview the agriculture extension officer acknowledged a significant role of appropriate spacing in giving adequate space for crop growth and pollination purposes. Spacing is supported as well in other studies as by [13] revealing the significant contribution of spacing in giving adequate space for crop growth and easy pollination processes.

Intercropping is also practiced by 34% of respondents in Ipande while 41% in Sanjaranda. The practice is shown to have significant correlation with increasing production as in Ipande chi square results; X^2 = 9.562, p = 0.002 and in Sanjaranda; X^2 = 19.766, p <0.005. intercropping increases production of crop varieties, enhancing soil fertility, nutrient recycling and benefit most of soil biological processes [25].

Crop residues retaining management and mulching practices are minimally done by farmers in both study villages due to grazing done after harvesting. 3% and 24% of respondents in Ipande and Sanjaranda respectively practice crop residues management in which the practice indicated a significant relationship with increasing crop production in these semi-arid areas as in Ipande X^2 = 4.866, p = 0.027, and in Sanjaranda X^2 = 4.438, p = 0.035. when not challenged by after harvest grazing, retained crop residues could contribute significantly to humification and addition of organic matter in the farmlands of semi-arid areas [26]. In the side of Mulching only 3% and 14% of respondents in Ipande and Sanjaranda villages are practicing in which are significant to increase of crop production as in Ipande X^2 = 4.886, p = 0.027 and Sanjaranda as X^2 = 10.732, p = 0.001. When mulches are used enhances an improvement of soil structure and when subjected to decomposition increases soil organic matter and enhance soil moisture retaining [26].

4. Conclusion

Understanding effective farming practices for semi-arid crop farming was the central theme of this study. Studying various farming practices, the study found effective farming practices including minimum tillage, use of cover crops, intercropping practice, mulching, ridges and terraces use, application of farm yard manure, crop rotation, crop residue management and sowing space appropriateness. Contrary to that, some farming practices were found inappropriate for dryland or semi-arid agriculture including deep and zero tillages and broadcast sowing. Such potential practices when applied in semi-arid areas may enhance high crop production, management and conservation of soil fertility, and sustainable soil nutrient recycling.

5. Conflict of Interest

The author declares no conflict of interest.

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