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Infrastructure and its Impact on Agricultural Development. A Case Study of Matsangoni Ward, Kilifi County, Kenya

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Abstract: *It is generally accepted that infrastructure can have a big impact on any kind of development. This includes agricultural development, where a good infrastructure can quickly improve the ability to convey yields to market, store it properly if required and even enhance the capacity to produce more. This study's goal was to find out how infrastructural conditions affect development of agriculture in Matsangoni Ward., Kilifi County, Kenya. The sample size for the study, which comprised 200 farmers and one Agricultural Officer, was determined using the Yamane formula. Stratified random sampling was used. The data was collected using questionnaires and interview schedules. Descriptive, inferential and thematic analysis were used to analyze the data. The highest number of farmers had murram roads access but generally, farmers do not have good access roads. Lack of proper storage facilities is also a major challenge. There are no water storage facilities too. These conditions have had a slowdown effect on transformation of agriculture, in an area where the large majority of farmers are smallholders. The study can initiate policy initiatives towards addressing rural agricultural infrastructural management in Kenya. The information from this study will be disseminated to the stakeholders and wider audience through publishing the findings in various academic platforms and agricultural journals.*

Keywords: *Agriculture, Infrastructure, Rural roads, Storage facilities*

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1. Introduction

Agriculture contributes significantly to the economic well-being of a large proportion of the world's population. Agriculture is also the primary source of income for the majority of Kenyans. The aim of this study was to examine infrastructure as a socioeconomic factor affecting agricultural development in Matsangoni ward, Kilifi district, Kenya.

As part of the outcome of agricultural output, food security is recognized as one of the most difficult challenges for rural development. Key factors to improve agricultural productivity and ensure food security include; capacity building of farmers to not only grow their food but to produce more, give them access to it and make more effective use of their land in a sustainable manner (Food and Agriculture Organization, 2017).

The contribution of agricultural development in advancing the economy and alleviating poverty has often been glossed over in as much as it is crucial in driving the growth of incomes (Development Studies Network, 1999). Agriculture is not only crucial to the growth of the economy, but it is one of the most powerful tools that can be used to raise incomes, end extreme poverty and boost shared prosperity (World Bank, 2020). The Global Agriculture and Food Security Program's publication on Ending poverty and hunger (2018) states that, ` More than 80 percent of food is generated by agricultural small holders, and it has been demonstrated that the growth of agriculture is 2-3 times more successful in alleviating severe poverty than the growth of any other sector.'

The economic growth of most developing countries is pegged on agriculture, which not only supplies food but also provides employment. This, in turn increases the incomes of the people. According to the Food and Agriculture Organization of the United Nations (2000), 67% of the total population is engaged in agriculture, 43% of exports are agricultural products and therefore contributing to 39.4% of GDP. More and more land is being converted to agricultural production, accounting for a quarter of the arable land. To accomplish sustainable development, poverty reduction, and food security. It is imperative to improve agricultural practices and land use. Many regions of the world have taken a more ingenious approach to increasing yields through the use of fertilizers, pesticides, and organic fertilizers.

On the continent of Africa, agriculture is the most significant economic sector, accounting for around 25% of GDP and providing jobs for 75% of the labor force (Africa Economic Commission, 2014). More than 80% of people reside in rural areas and depend on agriculture for their primary source of income (Billson, 2019). Therefore, the performance of the economy is a representation for the performance of the industry. Unfortunately, food imports still take place in many countries, which shows how far the region has come.

Agriculture in Africa faces a broader economic growth backdrop and a brighter medium-term market outlook in international, regional and national markets than at any point in the 40 to 50 years. Macro-economic and sectoral policies have been more favorable (Olson, 2018). By strengthening the system of the agricultural sector, the opportunities for local governments, communities and the private sector to function have been improved more than ever, and the environment for business prosperity has also improved.

Lisbon (2017), found that smallholder-dominated agricultural sectors in Africa responded with significantly higher growth rates. 90% of rural Africa's revenue comes from agriculture and accounts for the majority of Africa's share of world trade. Traditional and non-traditional agricultural exports have experienced a rise in market opportunities that need to be taken advantage of as domestic and regional markets give way for medium and long term agricultural growth that small farmers can seize. In 2004, sub-Saharan Africa accounted for 60% of the top 20 agricultural product importers. In terms of global agricultural or exports, African nations make up half of the top 20 countries (Okumu, 2017).

Agriculture is facing fundamental changes. However, rapid population growth, shrinking arable land, changing climatic conditions and increasing demand for food and other agricultural products are posing serious challenges for its development, more so as the natural resources which are the bedrock of agriculture are continually depleted. Land and water degradation caused by human activity and pollution threaten the genetic diversity and decrease the potential for high yields. Agriculture increases food security in a number of ways, principally by increasing the supply of food and by giving people a means to buy it (Milton, 2019). Therefore, increased agricultural productivity leads to increased profits and incomes for the poor in rural areas, increasing their ability to buy more and more food, as well as a variety of foods.

Despite the many East African countries' policies for addressing agricultural and rural development, the situation has not altered. Particularly in rural areas, where poverty and inequality still exist. Kenya's Vision 2030 lists agriculture as one of the important reform sectors, but the country's goal of becoming one of the world's powerful economies is threatened by the underdevelopment of many rural areas (Vision 2030). Many (financial) resources have been put into agriculture, but to no avail (Yakubu, 2019). If agriculture is to be transformed in Africa, strategies will need to be devised to address some of the challenges facing the industry**.** These include; scaling up the investment in agriculture, improvement of road infrastructure, improving productivity, setting aside funds for agricultural research, embracing modern technology aimed at increasing the yields, strengthening linkages between agriculture and the other sectors of the economy and putting in place policies that promote agricultural development (Okumu, 2017).

Agriculture plays an important role in Kenya's economy, as evidenced by its contributions to raw materials for income generation, job creation, food security and industrial development. The agricultural sector contributes significantly to Kenya's gross domestic product, from which the majority of Kenyans make a living. The Government of Kenya, in its Economic Recovery Strategy (ERS) document, has identified agriculture as an important vehicle for achieving its goals of job creation and poverty eradication (Government of Kenya, 2013). This sector contributes directly to 26% of GDP and 60% of export revenue. In addition, agriculture indirectly contributes 27% to GDP through collaboration with manufacturing, distribution and service industries. Furthermore, 80% of Kenya's population lives in rural areas and derives income from agricultural activities (Selma, 2014).

Agricultural development in Kenya focuses on poverty alleviation. Other vulnerable groups, including herders, self-sufficient farmers, and landless people, who make their living primarily from agriculture. Consequently, compared to other sectors, the expansion of the agriculture sector will significantly affect the bulk of the population. Improved food security, accelerated and intensified productivity, commercialization, and increase in income particularly for smallholders, equity, and

prominence on irrigation for output stability, participatory policy formulation and environmental sustainability are the primary objectives that agricultural policy is centered on (Future Agricultures, 2006).

Kilifi, which occupies an area of the Indian Ocean that is 109 square kilometers, is one of Kenya's five coastal counties. Its overall size is 12,246 square kilometers, and there are 1,109,735 inhabitants. In Kilifi, agriculture is possible on more than half of the area. Rice, bananas, green beans, cowpeas, cassava, and maize are some examples of subsistence crops. The socioeconomic health of rural areas is greatly influenced by horticultural crops. Mango, cashew, and coconut are the three principal horticultural crops farmed. Additionally, grown are pineapple, lemon, passion fruit, lime, papaya, watermelon, as well as a number of vegetables. According to the Kilifi County Integrated Development Plan (KCIP), 2018–2022, these are essential for raising household income and reducing poverty.

Problem Statement

More than half of the land in Kilifi is conducive for farming but only 31 per cent of the farmers hold titles to their land (Kilifi County Factsheet, 2021). There are many types of industrial crops grown including citrus fruits, cashews, coconuts and sisal, with cassava and maize being the main subsistence crops. However, several factors negatively affect agricultural productivity in the area. These include poor condition of rural roads connecting farmers to facilities, poor farmer organization, low literacy rates and lack of interest in agriculture by the youth. High costs of production and poverty further hampers effort to improve agricultural output (Kilifi County Factsheet, 2021).

In Matsangoni, there is lack of water storage facilities for irrigation, lack of genuine title deeds and recurring land ownership disputes. Untarmacked roads, impassable feeder roads and lack of enough clean water, combined with poor education infrastructure and lack of a functioning cooperative society also hamper agricultural activities (KCIDP, 2018 – 2022). In this study, the research sought to establish how infrastructure impacts agricultural development in Matsangoni Ward, Kilifi County, Kenya.

The Matsangoni ward, the focus of this survey, is a 41.2 square kilometre area located in Kilifi County's north. The 2019 census and housing report indicated that there were 18806 people living in the area. Matsangoni is 12 meters above sea level and has a tropical climate. Industrial crops like maize, cassava, coconut, cashew nuts, sisal, and citrus are primarily grown in the region. Melons and mangoes are also widely consumed there. However, rural roads connecting farmers to facilities are in bad shape (Kilifi County Factsheet, 2021).

Farmers face difficulties as a result of the study area's poor road infrastructure. The roads are generally unpaved, and the feeder roads are impassable during the rainy season. There are no irrigation water storage facilities or alternative water resources (KCIDP, 2018 – 2022). There are only two major types of storage amenities in the entire Kilifi County. These are the traditional facilities known as granaries that are used at Matsangoni and are built by smallholder farmers out of grass or "makuti" for storing farm produce. The other category is modern go-downs, which are owned by the National Cereal and Produce Board (NCPB) and are located in Kilifi town. The facility is used to store huge amounts of grains (KCIDP, 2018-2022).

2. Literature Review

According to Dethier and Effenberger (2012), Agricultural development is essential for achieving economic progress, food security, increasing rural incomes and promoting the development of excluded sectors in developing economies. Countries with well-established rural infrastructure have achieved higher and more advanced levels of rural development than countries that have not developed rural infrastructure (ECA, 2013). According to Llanto's (2012) research, deficiencies in rural infrastructure, such as transportation, electricity, and related infrastructure, have a negative impact on agricultural productivity and poverty eradication in Africa. The availability of good infrastructure encourages investment in developing regions by facilitating extensive movement of commodities and people, as well as aiding in the development and expansion of the economy.

Ran (2021) conducted a study on the effect of agricultural infrastructure investment on economic growth using the National Bureau of Statistics of China's provincial panel data for the years 2010 to 2019. It concluded that Infrastructure is an important support for economic and social development. He opined that economic growth had not been aided by better irrigation practices for farming, but spending money on field water conservation facilities can enhance irrigation capabilities and agricultural output in rural areas. It demonstrated that in order to achieve economic growth in agriculture, a greater emphasis on innovative science and technology should be made. Current information science and technology can provide efficient development space for agricultural and economic growth. When rural power supply, transportation, machinery and communication conditions are improved, the impact of information infrastructure investment on economic growth is significant. Therefore, Agricultural infrastructure is significant to economic growth overall.

Efficient and effective transportation, according to Adedeji et al. (2014), is one of the best means of exchanging goods and services, moving people,

disseminating information, and accelerating the development of rural economies. According to Taiwo and Kumi (2013), the presence of a convenient, satisfactory, and structured transportation system is required for connecting farm areas that are remote from customer markets with agricultural production services. A good transportation system also improves interconnection between geographic and economic divisions, bringing economic focus to underdeveloped areas (Tunde, Adeniyi 2012).

In addition to promoting connectivity to rural areas, rural road conditions influence cropping methods through market access, increased farm yield through the availability of farming inputs such as pesticides, seeds, and fertilizers, the realization of better prices for agricultural produce by farmers, and the creation of employment opportunities in spheres and services related to farming (Sangwan, 2010). Aside from connecting rural areas to expanding markets, well-maintained rural roads reduce input costs and purchasing prices for producers and consumers. According to Nkonya et al. (2011), the reduction in transaction costs combined with connecting farmers to markets and correlated rural services boosts investment returns and induces farmers to embrace and capitalize on improved technologies for managing their farms. Roads of the highest quality are enablers for boosting agricultural produce marketing and allowing for better access to larger markets, reducing waste and stumbling blocks in agricultural produce movement (Ikejiofor and Ali, 2014). Rural road connections are critical because they connect farmers to their farms, inputs, and markets for their produce, as stated by Gibbons et al., (2019), who believe that road interconnectivity increases farm output.

According to Gollin and Rogerson (2010), the primary factor impeding agricultural productivity is not a lack of natural resources or a lack of technological advancement, but rather poor road networks that discourage the use of advanced technology and transformation. Poorly maintained road networks limit farmers' ability to communicate and travel to distant farming areas, limiting their access to such areas and, as a result, eliminating competition for their produce (Gollin and Rodgerson, 2010). Furthermore, such roads limit smallholders' ability to compete effectively in the agricultural market. This is due to the farmers' limitations when it comes to market essential services that they require to compete in agricultural markets (ECA, 2013).

Given the important role that road networks play in agricultural production, both directly and indirectly, road improvement increases farmers' profits because transportation costs are greatly reduced (Kiprono and Matsumoto, 2014). Llanto (2013) agrees with this viewpoint, arguing that an efficient road network facilitates labor-market engagement, removing a significant barrier to labor-market penetration.

It is also critical to have adequate storage facilities to aid in the preservation of agricultural products. The primary goal of storage is to balance the supply and demand for produce and to stabilize market prices at the food and marketing levels, allowing for postponed (annual and multi-year) use of harvested produce (Food and Agricultural Organization, 1994). Warehouses serve an important marketing function by holding and preserving items from manufacture to consumption. Goods stockpiling from production to consumption ensures a constant flow of goods in the market (Tamil Nadu Agricultural University (TNAU), 2015). Fresh and semi-perishable products are preserved to maintain their quality. It also helps to keep prices stable by adjusting supply and demand. Through price advantage, storage generates employment and income (TNAU, 2015). According to Perry (2018), farmers have been able to increase their investment in on-farm storage solutions over the last decade. These solutions, which include steel grain silos and grain sacks, have allowed farmers to wait for the best prices, reduce transportation costs, and avoid long lines at storage facilities during the busy harvest season.

3. Methodology

3.1 Design

Ogula (2005) defines research design as a study plan, structure, and strategy for answering research questions and controlling variance**.** This study employed mixed methods research design as it effectively captured the reality on the ground since it provided a chance for an exhaustive investigation of the study. The act of gathering, analyzing, and combining quantitative and qualitative studies and techniques inside a study to comprehend the research problem is known as "mixed method study design." Quantitative descriptive survey and qualitative approach were both used.

3.2 Instruments

This research used a questionnaires and interview guide to collect data. Questionnaires are survey tools that consist of a series of questions aimed at gathering information from participants. The questionnaire can be understood as a type of written interview. The questionnaire consisted of structured, open and closed questions. It included two parts. The first section sought to collect general information about respondents' characteristics. The second part was devoted to the infrastructural impact on development of agriculture in Matsangoni. The questionnaire helped in collecting as much information as possible. The main advantage of using both questionnaires and interview guides is the study could quite readily and cheaply reach a huge number of people. Standard surveys offer measurable

responses to research questions. The analysis of these responses is not too difficult (Kothari, 2014). The self-administered questionnaire consisted of structured, open, and closed questions. Self-administered questionnaires were preferred because participants could answer at their convenience; there was no need to set up interview appointments. This type of questionnaire used closed-ended questions, which have predetermined answers and usually collect quantitative data.

A list of topics served as the interview guide. The list was covered in the interview with questions to be answered on each topic. It was limited to one page for easy reference and to ensure that it was not too low. When conducting the interview, a fresh copy of the guide was availed so that questions that were already covered could be crossed. Some questions could be answered during the course of conversation with the interviewee, hence using the guide made it easier to check off questions on the guide in order to avoid repetition.

3.3 Validity and Reliability

To ensure validity, a questionnaire was created based on the study goals and questions. The questionnaire was also discussed with supervisors**,** colleagues and experts. The researcher pre-tested some sample questionnaires with a selected number of farmers who were outside of the main study area. The answers from this pilot survey were used to measure the internal reliability of the questionnaire as well as the construct and content validity of the questionnaire. Any question that was not understood as appropriately as possible was restructured so as to give the appropriate meaning which would improve the instrument's validity and reliability. An internal consistency method using Cronbach's alpha was used to assess the reliability of the data**.** A reliability coefficient must not be below 0.90, less than this would have indicated inadequate reliability (Biology online, 2021).

3.4 Sampling and Sample Size

A stratified random sample was used to choose 200 study participants. Stratified random sampling is a technique that first divides a population into subgroups or strata, all of which share common characteristics (Goel, 2014). The study sample is obtained by taking random sample sizes from each stratum. In this case the strata was the different villages within Matsangoni ward from which randomized samples were obtained. This ensured that all the villages were fairly represented resulting in accuracy of the results by reducing representation biasness. Data was gathered for this study mostly through interviews and interview guidelines. The study participants were questioned during the interviews and given the opportunity to respond. These were primarily in-person interviews with individuals.

3.5 Data collection procedures

The data collection process began with an application to Tangaza University College for a clearance letter. This was granted. Application for a research license to the National Committee for Science, Technology and Innovation (NACOSTI) was subsequently done and the License was given. This allowed the researcher to proceed to the Kilifi County Headquarters for clearance. The County authorities granted permission and eventually collection of data was conducted in the ward. Data was collected primarily using interviews and interview guide**.** The interviews consisted of asking questions and receiving answers from the study participants. These were mainly personal face-to-face interviews.

3.6 Data Analysis

The collected data was analyzed mainly using inferential statistics, descriptive analysis, document analysis and thematic analysis based on the new topics under investigation. Quantitative data were analyzed with SPSS and descriptive statistics and presented in tables, means and standard deviation. To analyze qualitative data, content analysis was used. It has also been used to analyze responses from interviewee farmers.

4. Results and Discussion

4.1 Demographic Characteristics of the Participants

Varied demographic details were solicited from the participants in order to build their
demographic profile. This focused on the age, gender, participants' level of education, years practiced as a farmer, number of members in the participants' household, participants' source of income and the type of farming used by the participants.

4.1.1 Distribution of the participants by Gender

Participants' gender was inquired. The survey found that the majority of participants were men. Figure 1 shows the participants by gender.

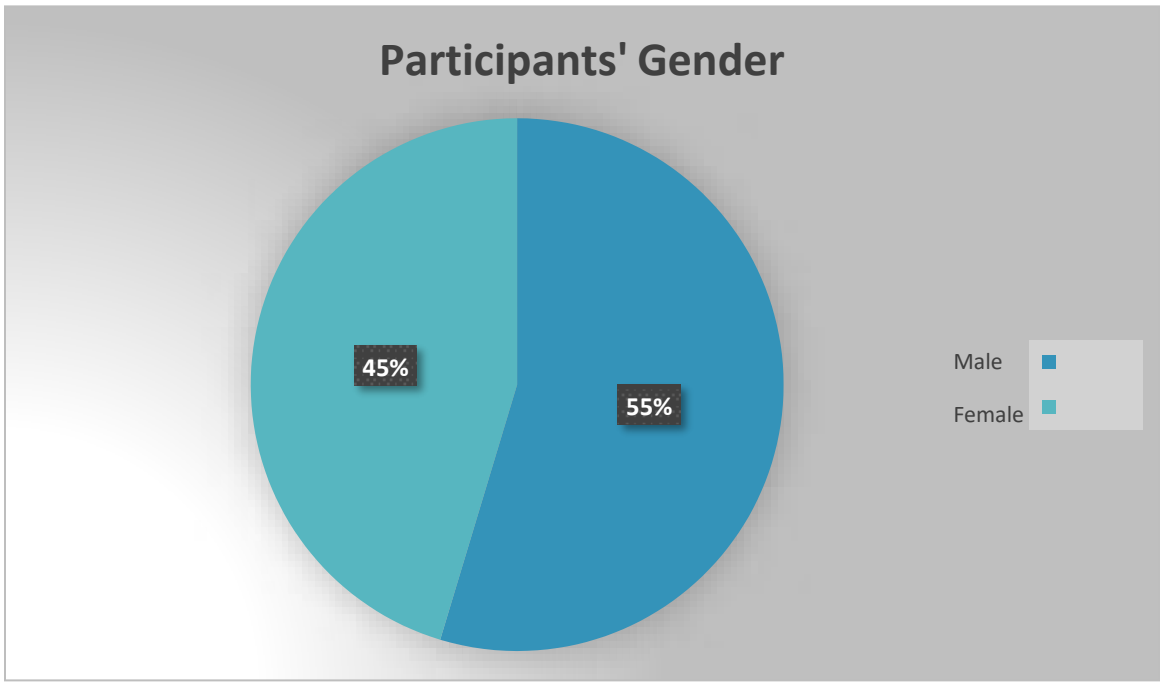

Figure 1: Distribution of the participants by Gender

Table 1 further outlines the gender distribution of the local smallholder farmers.

Table 1: Distribution of the participants by Gender

Gender	Frequency	Percentage
Male	82.0	54.67
Female	70.0	45.33
Total	**152.00**	**100.00**

4.1.2 Distribution of the participants by Age

On the question of the participants' age range, the study revealed that majority of the participants represented by 69.74 % were over 40 years. 11.84% of the participants' age variance was between 36-40 years. 9.86% of the participants were between the age of 31-35 years while the other percentage (8.54%) was shared between 26-30 age range and those between 18- 25 years 4.60% and 3.94% respectively. Table 2 displays the participants' age distribution.

Table 2: Age range distribution

Age Range	Frequency	Percentage
18-25 years old	6	3.94
26-30 years old	7	4.60
31-35 years old	15	9.86
36-40 years old	18	11.84
Over 40 years old	106	69.74
Total	**152**	**100.0**

4.1.3 Distribution of the participants by the Education Level

Education levels were sought to understand the literacy levels of the participants. This could affect their understanding of the research topic. Table 3 shows the

results on the educational levels of the participants.

Table 3: Education level distribution of the participants

Education Level	Frequency	Percentage
Never been to school	4	2.63
Primary	18	11.84
Secondary	96	63.16
College/University	34	22.37
Total	**152**	**100.00**

According to the survey results, the majority of participants (63.16%) had Secondary level of education while 22.37% had College/University education and a small percentage of 11.84% had primary level. This showed that the majority of participants had a high school certificate or college / university degree, therefore in a position to give the intended information.

4.1.4 Distribution of the participants by the number of years practiced in Farming

Regarding the number of years participants practiced agriculture, the study indicated that majority of the participants, accounting for 78.95%, had practiced agriculture for more than 15 years**.** 13.16% of the participants had practiced farming for a period of 11-15 years while 7.89% had practiced farming for 5-10 years. This suggests that the participants were in a good position to provide information on the topic under study. The distribution of participants by number of years of agricultural practice is shown in Table 4.

Table 4: Distribution of the participants by the number of years practiced in farming

Years Worked	Frequency	Percentage
5-10 years	12	7.89
11-15 years	20	13.16
Over 15 years	120	78.95
Total	**152**	**100.0**

4.1.5 Number of Members in the Participants' Household

Information was sought on the number of members that the participants had in their households. The study revealed that 46.05% of the participants had 10-15 members in their households. The study also shows that 38.16% of the households had between 5-10 members while 15.79 households had less than 5 members in their households. Table 5 shows the number of household members of the participants.

Table 5: Number of members in the participants' household

Range No of members	Frequency	Percentage
Less than 5 members	24	15.79
5-10 members	58	38.16
10-15 members	70	46.05
Total	**152**	**100.0**

4.1.7 Main source of income

Participants were asked if agriculture was the region's main source of income. According to the survey, 132 people, or 86.84 percent, considered agriculture to be their primary source of income. Twelve participants were employed in local facilities and received salaries as their primary source of income. The remaining 13.16 percent is accounted for by the other eight participants who have businesses as their primary source of income. According to Table 6, the survey found that agriculture was the primary source of income for the majority of participants.

Table 6: Source of Income

Occupation	Frequency	Percentage
Agriculture	132	86.84
Salary	12	7.90
Business	8	5.26
Total	**152**	**100.0**

4.1.8 Description of the type of farming

Information was sought on the type of farming the participants were practicing. The vast majority of survey participants, accounting for 78.94% practice subsistence farming. 21.06% of the participants indicated that they practiced cash-crop farming. Table 7 shows the type of farming practiced by the participants.

Table 7: Type of farming

Type of farming	Frequency	Percentage
Subsistence	120	78.94
Cash-crop	32	21.06
Total	**152**	**100.0**

The survey questioned the participants in an effort to record the condition of the storage facilities and road infrastructure. The participants were asked to answer a question about the road infrastructure, including the distance from their farms to the closest road and the state of the roads.
Table 8 summarizes the results from the questions.

Table 8: Condition of rural roads

Statement	Response	Frequency	Percentage (%)
How far is the nearest road to your farm?	Less than 1 km	78	51.32
	1 to 2 km	54	35.52
	3 to 4 km	18	11.84
	5 and above	2	1.32
Is the road above	Tarmacked	30	19.74
	Murram	80	52.63
	Gravel	42	27.63
How would you describe The condition of roads in Your area	Very good	24	15.79
	Good	46	30.26
	Poor	74	48.68
	Very poor	8	5.27
Total		**152**	**100.0**

According to the findings in Table 1, 51.32% of the participants were situated within 1 km of the closest road, 35.52% were between 1 and 2 km away, 11.84% were between 3 and 4 km, and only 1.32% were situated more than 5 km from the closest road. Roads were tarmacked on 19.74% of the participants' roads, murram on 52.63% of their roads, and gravel on 27.63% of their roads. 15.79% of participants said their roads were in excellent shape, and 30.26% said the roads were in good condition when asked to describe the status of the roads. 5.27% of participants said their roads were in extremely poor condition, and 48.68% said their roads were in poor shape.

The participants were also asked to describe the kinds of storage facilities they utilized to keep their products after harvest and how their storage practices affected their farming. The majority (72%) of participants utilized gunny bags and granaries, whereas just a tiny fraction (15%) used sisal bags. Individuals gave several answers, and the results show that participants employed a variety of solutions. During the interview conducted on 20th March 2022:

Interviewee number 14 had this to say:

"The absence of suitable storage facilities has been the biggest issue we have been facing as farmers in Matsangoni. Rats and other pests have caused significant losses due to our primary storage method of gunny sacks".

Only a small percentage of participants (7%) increased corn storage by using storage bags. Additionally, 6% of the individuals employed various storage methods, mainly drums. Other participants claimed that because they produce and sell or consume the yields right away, they had never employed the storage method. The majority of farmers in Matsangoni continue to preserve agricultural products using conventional methods, according to the study's findings.

Interviewee number 21 stated that:

"*After drying our fruits, we use a section of our house as our storage space. This is due to a lack of space and resources that would allow us to construct granaries and use more advanced storage techniques.*

Interviewee number 24 said:

"*We usually purchase used oil drums, clean them well and convert them into storage bins. They are not the best but they are better than nothing. If properly sealed, they provide good protection against rodents. But they also get rust fast because of the climatic conditions of our area. They are not a long term solution."*

The analysis of the data therefore revealed that murram was present on 52.63 percent of the routes. This would suggest a motorability level of about 50/50. The roads may still be used despite the fact that 48.68% of participants said their roads were in poor condition and 5.27% said they were in really poor shape. Poorly maintained road networks limit farmers' access to remote farming areas, preventing them from communicating with one another and traveling there, eliminating competition for their produce (Gollin and Rodgerson, 2010).

The majority of participants (72%) used gunny bags and conventional granaries, while only 15% preferred to use sisal sacks for storage. This implied that farmers in Matsangoni are faced with a problem because there are not adequate storage facilities. This discourages large-scale farming in part because farmers are afraid of post-harvest losses as well as losses from rats and other pests. Some participants hadn't used any sort of storage because they sold or consumed their produce. Farmers in the Matsangoni ward continue to employ traditional methods of preserving farm products, which prevents the development of large-scale farming and limits it to subsistence farming. A significant problem is expanding to larger storage facilities due to a lack of resources and available space to build barns and implement modern storage techniques. Due to the lack of irrigation water storage facilities and alternative water sources (KCIDP, 2018–2022), Matsangoni farmers have been unable to use irrigation to increase the yield of their crops, which also prevents larger-scale agriculture from being practiced.

5. Conclusion and Recommendations

5.1 Conclusion

The analyzed data indicates that slightly more than half of the roads (52.63%) had murram. This would indicate a roughly 50/50 degree of motorability. Despite 48.68% of the participants indicating that their roads were in a poor condition and 5.27% noting that their roads were in a very poor condition, the roads can still be used. Road networks that are in poor condition inhibit the capacity of farmers to communicate and travel to distant farming areas, restricting their access to such areas thus doing away with competition for their produce (Gollin and Rodgerson, 2010). In the case of Matsangoni, the distances to the main tarmacked roads are not vast, hence road infrastructure may not be hampering agricultural development of agriculture in the area. Nevertheless, if the condition is allowed to deteriorate then definitely there will be a negative impact. It is therefore imperative that maintenance works be a continuous process if the ability of the farmers to use the current roads is to be sustained.

The majority of participants used gunny bags and traditional granaries for storage, while a smaller percentage preferred sisal sacks. Farmers in Matsangoni face a challenge due to a lack of proper storage facilities.. This discourages farming of higher scales due to fear of post harvest losses and also losses caused by rats and other pests. Some participants consume their products or sale them as soon as possible. The traditional systems of storing farm produce means that growth of large scale farming is inhibited and restricted to subsistence farming. Modern methods of storage are hampered by a lack of funds and space to build barns. Since there are no water storage facilities for irrigation and no alternative water resources it has not helped the farmers at Matsangoni to try irrigation in order to boost their produce output hence this is also preventing agriculture of higher scale to be

practiced. Rain-dependent agriculture and a lack of irrigation are limiting output and jeopardizing food security.

For the farmers of Matsangoni to be able to safely store their produce and transport it readily when necessary, the Central and County governments should both take into consideration raising more financing for infrastructural (road and storage) development. Storage of yields as well as storage of water can be of great help in enhancing the agricultural output of the area. Croplands benefit from irrigation by creating a cooler environment for plant growth by cooling the soil and atmosphere. Crop output and agricultural productivity are significantly impacted by irrigation technique, frequency, and duration. Rainwater collection tanks can be utilized for a challenging water issue. These can be achieved by empowering families with basic infrastructure and training needed to change their own lives.

5.2 Recommendations

Both the Central and County governments should consider increasing more funding for infrastructural (road and Storage) development so that the farmers of Matsangoni can be able to properly store their produce and transport it easily when necessary.

It is also imperative that the current roads be upgraded and maintained properly lest they become an impediment to increased output. Water storage facilities should be constructed. This will enable the farmers adopt Irrigation as opposed to the current reliance on rains only.

Financial institutions should be encouraged to come up with attractive terms of lending to the poor farmers so that they are able to develop their capacity by building better storage granaries. Availability of loans will also allow the farmers to invest in other infrastructural investments like solar irrigation, which can also go a long way towards improving output and enhancing food security.

The Government should also increase the number of agricultural extension officers to the area. The smallholder farmers can learn a lot concerning modern methods of farming, including improvement of basic storage facilities.

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