

# Factors Influencing Smallholder Tomato Producers Adoption To Modern Agricultural Technologies in Kilolo District, Iringa Region, Tanzania

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**Abstract:** *Tomato is the most useful vegetables in the world and has been contributed smallholder farmers to household income. In Africa, tomato is the most useful vegetables and is produced in rural and urban areas. The aim of this study was to find out the factors influencing smallholder tomato producer's adoption to modern Agricultural technologies in Kilolo District, Iringa region, Tanzania. The data were collected through interview, focus group discussion, questionnaire, and documentary review from 60 respondent and analyzed by using SPSS version 26.0 and deductive approach method. The study found that low adoption of agricultural technology is influenced by demographic characteristics of respondents and economic factors such as low credit accessibility, unstable tomato products market due to price fluctuation and high price of modern agricultural technologies. The study recommends that efforts and resources should be directed towards enabling adoption of modern agricultural technologies and creating awareness of effectiveness of modern agricultural technologies and the government should work on reducing the cost of irrigation technologies by increasing incentives to that technology and make them easy to access.*

**Keywords—**Tomato producers; modern agricultural technology; credit accessibility; technological price; tomato market.

## 1. INTRODUCTION

Worldwide tomato has become an important and popular grown horticulture crop and by weight ranks third in global production of all horticulture China is the world's largest tomato producer (FAOSTAT, 2020). Tomato is the most useful vegetables in the world and has been contributed smallholder farmers to household income. The tomato farming like other farming use Agricultural technologies to improve production, the introduction of modern agricultural technologies in tomato farming is the one among the technologies to adopt climate change effects. Producers have been using, on farm storage system to avoid post-harvest loss, Drip Irrigation technology for inputs efficiency (monitoring of resources), and Resilient Seeds technology this is development of new crop varieties that can tolerate climate changes and Agricultural extension service that facilitate the transfer of knowledge and good practices to farmers.

In Africa, tomato is the most useful vegetables and is produced in rural and urban areas. The governments of African nation have been investing on modern agricultural technologies which are friendly to environment in order to improve tomato farming and tackle the effect of climate change and variability. There are different factors which influence farmers to adopt modern agricultural technologies for tackling the effect of weather change. Egypt is the largest producer of tomato (FAO, 2021). In Egypt Harvesting time is usually done between July, October and November to February.

Tanzania like other countries, tomato producers have been using different modern technologies to cope with climate

variability and changes for production increase. The common technologies used includes; On farm storage system, Inputs efficiency use enhancing technology, Pest Control, Resilient crops, Drip Irrigation and Extension agricultural services system. Tanzania like other developing countries where its people mostly depend on agriculture for their livelihoods, tomato has become an important horticultural economic activity due to its better market prospect as compared to other traditional crops (Sanga, 2016). Tomato crop has become an important source of income by providing employment and supplies nutrient to millions of people (Sanga and Mgimba, 2016). Tomato farming contributes much to the small householder income (Iluz, 2017). It estimated that the area planted with tomatoes in Tanzania is 26,612 acres, the country ranked forty four in the world and twelve positions in tomato farming in Africa (FAO, 2021). Tomato production is ranked higher in production than other vegetables crop, with total annual production of 129578 tons, representing 51% of total vegetable production (FAOSTAT, 2021).

A case of Tanzania the studies for assessing the technology adoption found that household head education, area of cultivation, extension services and asset ownership had impact in adoption of technology and rainfall have influence in adoption of technology example to the area where rainfall experienced for short time it influence the majority to adopt improved seeds which take short period of time so the nature of climate change and variability to some extent can act as the major cause of technological adoption (Magrini,2016).Tanzania leading tomato production areas are Iringa with 4248 acre, Tanga with 1289 acres Kilimanjaro with 900 acres, and Mbeya with 380 acres. Tomato production is higher than other vegetables crop, with total annual production of 129578 tons, representing 51% of total

vegetable production (FAOSTAT, 2021). Tomato farming contribute much to the small householder income. The factors for value change on tomato are needed to be known to improve market and production of tomato (Iluz, K, Kashenge K, and Bonsi, C, 2017).

Feed For Future Tanzania Mboga na matunda evaluation (2022) observed that growth of horticulture industry in Southern Agriculture Growth Corridor of Tanzania (Morogoro, Iringa, Mbeya, and Songwe) the majority of farmers received basic technology training were able to adopt those practices on farms by 86% of farmers adopted basic post-harvest technology, 82% of farmers adopted basic post planting technology. only 4% adopted full package of technologies that is hybrid seed, Irrigation, greenhouses, and application of chemical despite farmers being full trained in them (USAID/Tanzania, 2022). Farmers still are using some poor technologies such as flood irrigation which its efficiency to inputs is poor rather than drip Irrigation the problem was to find out the views of smallholder tomato producers to adopt Modern Agricultural Technology in tomato farming in Tanzania this will help to know why 4% only adopted full package of technologies. There are many factors including low/poor adoption of agricultural modern technologies which limit achievement of optimal yield and income by farmers

The main aim of this study was to economic factors (credit accessibility, Price of technology, and market of tomato products) contributions to smallholder tomato producer's adoption to Modern Agricultural Technology in Kilolo district, Tanzania or not.

The main contribution of this work are

- Credit accessibility contribution to adoption of modern technologies.
- Price of technologies contribution to adoption of modern technologies.
- Market of tomato products contribution to adoption of modern technologies.

## 2. MATERIALS AND METHORDS

The methodology used in this study comprised of both secondary and primary data collection methods, secondary information applied in the present research complies of journals, and internet sources. A well-structured and managed questionnaires, focus group discussion, and interview tools were prepared and distributed to the respondents from three villages of Ilula ward in Kilolo Districts that is Ikokoto, Masukanzi and Ilula-Itunda 60 smallholder tomato producers were surveyed for the determination of data collection. The collected data were analyzed through percentage and frequencies in which data presented in table format using SPSS version 26.0 (Statistical Package for Social Science version 26.0 and Deductive Approach method for qualitative data.

## 3. RESULTS AND DISCUSSIONS

In this section the results and discussion of the findings are presented, they begins with simple demographic information of respondents followed by main indicating factors which are credit accessibility, price of technologies and markets of tomato products

### 3.1 Demographic characteristics of respondents

The section discusses both social and demographic representation characteristics of smallholder farmers based on sex, age, education level and household size

#### 3.1.1 Sex of respondent

Table 1 show Sex of the respondent in the area of study. The duty of respondents is influenced by the culture of the study area that do not allow female to actively involved in farming activities or they participate in farming but the beneficiaries are male and who supposed to make decision on farming are male. The results showed that 83.3% of the respondents were male and only 16.7% were female. In this study this show that women have low participation in agricultural activities and those who are engaging are active by 50% in using modern agricultural technology. Therefore, gender equity among respondent who were participated in this study was not achieved because number of males were more than number of females.

**Table 1: Sex of respondent**

Variable	Frequency (n=60)	Percent (%)
<b>Sex of Respondent</b>		
Male	50	83.3
Female	10	16.7
<b>Total</b>	<b>60</b>	<b>100.0</b>

#### 3.1.2 Age of respondent

Table 2 show the age of the smallholder tomato producers, 70% of them fell within the middle age of 20-40 years. This show that the majority of respondents were within their economic active age and this enhances their productivity. The study is in line with most studies on adoption of modern agricultural technology such as; Mwangi and Kariuki (2015) who found that farmer's socio-economic characteristics had an influence on the adoption of technologies. However, the present study found that farmer's marital status, household size, indigenous knowledge and household assets were not significant.

The results of this study are supported by Mwangi and Kairuki (2015) who found that the active age group are characterized by less risk and are keener to try new technology than the older farmers. Younger farmers still have the potency to risk, grow more crops and search for modern agricultural technologies.

Table 2 below show that the old age group (greater than 40) had the lowest impact in farm work with 28.3% contributing to active farming among the sampled population. The results reveals that 70% of farmers who participated in the study belongs to active age group and still have strength to cultivate more and use modern agricultural technologies.

Table 2: Age of Respondent

Variables	Frequency (n=10)	Percent (%)
<20	1	1.7
20-40	42	70.0
40>	17	28.3
<b>Total</b>	<b>60</b>	<b>100.0</b>

### 3.1.3 Education Level

Table 3 show that educationally 51.7% of respondents had acquired primary education, while 33.3% had secondary education. Only 15% of respondents possessed higher education. This suggests that the respondents in the area of study obtained the basic education required for better understanding and ability to embrace new technologies especially the adoption of modern agricultural technology. In addition, it is thought that level of education enhances the ability to comprehend and adopt relevant agricultural information, which is in conformity.

The study observed that most educated people do not engage in agricultural activities this may be a cause of low adoption of modern agricultural technologies. Due to the bases of experience and most respondent have basic education.

Table 3: Education of respondents

Variables	Frequency (n=60)	Percent (%)
Primary	31	51.7
Secondary	20	33.3
Post-secondary	9	15.0
<b>Total</b>	<b>60</b>	<b>100.0</b>

### 3.1.4 Household Size

Table 4 show that the results of large household size are 1-2 member of household 23.3%. and over 2 members of household are 76.7% The study observed that most of the respondents who engage in agriculture are those with large number of family member this determining the number of working labour force and in turn labor within household of the respondents had been exposed as regarding the factors influencing the adoption of modern agricultural technology among smallholder tomato producers.

The norm in north southern highland of Tanzania guides the large families so as to provide accessible workforce. Furthermore, cultural tradition and religion allows the men to control the birth rate of the family. The use of household labour for several activities was very common in the study

area with activities such as harrowing, planting, weeding and irrigation activities and harvesting. In the same vein, large household may also help to access more agricultural information. In this study it show that most SHTPs are those with large number of people in the family, this indicate that number of family act as the labor this influence them to engage in agricultural activities. Also the size of householder influence the adoption of technology due to large number of household size in the study area it limit them to adopt modern technology such as drip irrigation because drip irrigation is the labour saving technology while the area of study labor is not a problem that is why there is low adoption of modern agricultural technology. The results are shown in the table 5 below.

Table 4: Household size of respondents

Variables	Frequency (n=60)	Percent (%)
1-2	14	23.3
>2	46	76.7
<b>Total</b>	<b>60</b>	<b>100.0</b>

## 3.2 Economic Factor Influencing Adoption of Modern Agricultural Technology

### 3.2.1 Credit accessibility

The findings show that 38.3% accessed credit and 61.7% did not accessed credit 7 source of credit is 3.3% from government and nongovernment organization, but 96.7% accessed credit from informal and self saving group credit .Credit is observed as the one among the factors that influencing SHTPs adoption to modern agricultural technologies. The study shows that SHTPs had low chance on credit accessibility, adoption of modern agricultural technology guided by capital poor credit accessibility influence the adoption of technology as seen in the table below show that few had chance to access the credit only but many STHPs adopted modern agricultural technology.

Table 5: Credit Accessibility of Respondents

Variables	Frequency (n=60)	Percent (%)
Yes	23	38.3
No	37	61.7
<b>Total</b>	<b>60</b>	<b>100.0</b>

The findings indicate financial resources was necessary to finance the uptake of new technologies. They indicated that households who had more access to formal and /or informal sources of credit significantly adopted technology. Access to credit service is the source of finance for the medium and lower income households to buy inputs for agricultural activities. Findings show that the access to credit associate with increase technology adoption. researcher find that technology adoption is greater among farmers to some technologies such as fertilizer, pesticides because they have market for tomato which increase the credit for investing in

farming ,most farmers have access to market as the source of fund table 7.

The study observed that SHTPs are many but at the time / dry season most of SHTPs who have no enough capital are not in farming process waiting for rainy season this indicate that SHTPs influenced by capital to adopt flood irrigation that is those who cannot access credit leave cultivating in dry season simply because they cannot afford the adoption of irrigation system. So credit accessibility is the one among factors that influence SHTPs on adoption of modern agricultural technology who found in the farm during the date of data collection so there are need to conduct longitudinal research design.

In this study low number of smallholder tomato producers had access to credit about 38.3% so the modern agricultural technologies adoption have the relationship with the credit accessibility that is low accessibility to credit leads to low adoption to modern agricultural technologies in the area of study. The reason for this is that the people in the study area who make the production decisions and also control on the productive resources such as land, labour and capital which are critical for the adoption of new technology which in turn help them to access credit for further investment in tomato farming due to low accessibility of credit influenced low adoption of modern agricultural technology.

In Ilula as part of Tanzania tomato farming have been suffering from low quality and production due to low use of modern technology example on farm storage system and Drip irrigation is not used by 100%. In the study it observed that the number of respondents who engage in tomato farming in dry season are those who at least has capital which is obtained from personal saving or as loan from One acre fund or district executive director office. Those who have no capital cannot afford the cost of irrigation technology. The participants reported that, most of the agricultural inputs especially pesticides are poor and cause poor yield to tomato farmers. Participants said that on other side not only tomato farmers who are affected by poor agricultural inputs but even the user who will use tomato which was produced by poor agricultural inputs. The interview done to Key informant of Kilolo district (CDO, Busnness Officer and District Extension Officer).

“...Smallholder tomato producers face problem of poor credit accessibility due to the condition made by financial institution such as business plan where it become a challenge for tomato producers to acquire credit simply because most of tomato producers are not well educated they have basic education....also smallholder tomato producers are required possess 20 acres so as to be considered in loan while most of farmers are cultivating less than 2 acres....., “....People aware on the presence of credit in the district but the

problem is that sometime people are reluctant to form groups so as to benefit from the loan without any interest from the DED office...”,

“.....There are need for government to hire as many extension officers as possible because the need of extension services is high especially in our district.....”

In FGD at Masukanzi one participant said,

... Most of the agricultural inputs which are found in this area is not in good to be used; most agricultural inputs contain low quality. The peasant can decide to spray or use in their farms and do not give up expected result. So that can lead to problems and cost to the peasants because they use a lot of money to buy those inputs...

Due to that explanations it reflects to the theory of The technology acceptance model (TAM ) by Davis, 1989 which explain Easy an Useful smallholder farmers adopt the technology due to perception of easy accessibility and reasonable cost of technology regardless to its effectiveness to their tomato farming but farmers tend to adopt the technology.

...The rainy season number of tomato farmers increase and the market also expand because traders from Dar es salaam, Kenya and nearby areas are coming, tomato product never miss the market though there is price fluctuation due to seasonal production in dry season we remain few who have capital to afford irrigation cost and the market of our products rely internal consumers such as surrounding industries and nearby areas

....  
...the credit is provided with condition most one of condition is to be in groups by which the group must have political direction in order to be given credit...of cause the credit is given with no interest rate but the difficult is for people who are not member of political part it take time to get the credit and sometime it is difficult to get credit....

### 3.2.2 Price of technology

Table 6 show that 43.3% do not meet the price of technology and 56.7% meet the price of technology. Smallholder tomato producers lack the financial resources and essentials for minimum standard of living. This suggests that an increase in income increases the probability of utilizing pure tomato value addition technology. The study had also reported price

of technology had positive impact on technology adoption. This is because income acts as an important strategy for overcoming credit constraints faced by the rural households in many developing countries. Price of technology is expected to provide farmers alternative source to balance capital for purchasing productivity enhancing inputs such as improved seed and fertilizers.

Some technology did not adopted by SHTPs such as Drip irrigation and on farm storage system also some technology had shown positive relationship between price and their adoption due to its price. Price being low due to incentives introduced by the government and some private sectors such as One Acre Fund influenced adoption of technology.

Table 6: Price of Technology

Variables	Frequency (n=60)	Percent (%)
Meet	34	56.7
Not meet	26	43.3
<b>Total</b>	<b>60</b>	<b>100.0</b>

The result shown that the probability of years of processing experience increases with increase in income. It suggest that household expenditure is a more consistent measure than household income. Hence, this expenditure of the household limits the type of technology to adopt without considering the accuracy of the technology.

Key informant interview. “...There is high price of technology and the government provide incentives for only fertilizers...did not consider other agricultural inputs such as pesticides, sim Tank and Irrigation machine....”

...the price of technology sometime hinder the peasant to adopt the technology fore example drip irrigation is so complicated pipes and sim tank and water pump require capital and at Ilula there are water source near so they prefer to use flood irrigation due to availability of water and the use of local technology such as water can....

“...Price of tomato product is dynamic it depends the season during rainy season tomato price rise due to the increase of tomato farmers who influence traders from Kenya, Dar es salaam and Morogoro to come Kilolo to buy tomato so the demand of tomato become high and the producers increased...”

Also reasonable price lead some SHTPs to afford price such as the price of seeds, pesticides and Irrigation machine in focus group discussion respondent said that

...I prepare early before starting cultivation by making some calculation before farming so to as to afford cost...due to My low income I fail to afford the cost of improved modern

technology. The changes in price of technology especially during rainy season is the challenge....

...Due to needs of agricultural inputs in rainy season most agricultural inputs such as fertilizer and pesticide its price become high also in dry season most smallholder tomato producers fail to accommodate the price of irrigation that is why we remain few who can afford cultivation while others are waiting rain season....’

“...’price of technology make me to opt to use simple technology such as manure when the price of fertilizers become high also sometime the price of technology decreases due to government incentives this influence us to adopt the technology though not meet the need of all framers hence local technology such as manure is inevitable for me...”

Table 6 that the price of technology have direct impact to the choice of SHTPs on adoption of the technology though the necessity of technology also have a vital role 56.67% said that they did not meet the price of technology and 43.33% they meet the price of technology. Adoption of modern technology that is Fertilizer 81.7% of respondent adopted due to its efficiency .The low price influence adoption of technology that is why some technology such as Pesticides 100% of SHTPs adopted fertilizer 81.7% and seeds 76.7% adopted by SHTPs but in real sense they did not meet the price of Drip irrigation and on farm storage system that is why they did not adopt at all in the study area. .

In this study lack the financial resources and essentials for minimum standard of living suggested by respondent as factor to hinder adoption of some of technology and the increase probability of utilizing technology to tomato farming.Income has also been reported to have positive impact on technology adoption. This is strategy for overcoming credit constraints faced by the rural households in the study area. Off- farm income is expected to provide farmers alternative source of liquid capital for purchasing productivity enhancing inputs such as improved seed and fertilizers. However not all technologies has shown positive relationship between off-farm income and their adoption.

The study findings show that price and quality is the fact that many producers are unable to value their own tomato in the same way that buyers and consumers do. This make difficult to both improve farming methods or technology and negotiable with buyers. In focus group discussion one tomato farmer explained that, smallholder producers who primarily focused on their basic needs from tomato in order to survive from day to day life.

### 3.2.3 Market of Tomato Products

Market of the product is not an issue to the respondent of the study. There are various factors for smallholder tomato producers (SHTP) to adoption of modern agricultural technologies in farming. The factors are different from one smallholder to another according to economic situation and geographical location of tomato producers. But in this study the focus was to know the factors that influence SHTP to adoption of modern agricultural technology on their farming and make their choice on technology to use for their production. The various factors that influencing SHTP to adoption of modern technology were outlined according to the findings such as Fair trade is among of the factor which reported by participant as one which influence to adoption of modern technology which increases their production and quality of tomato hence to sustain its value in the market. The quality of product determines the price of the products and the quality of technology and its efficiency determine the price of technology. The image of SHTPs or small-scale farmers facing up price fluctuation of the internal and external market access.

The SHTP are powerless against any slight shake of the market forces which can bring the fall down crashing him and his/he family. The most obstacles to SHTP are price fluctuation. The researcher found large number of participants explained that the government is not serious to SHTP on controlling price fluctuation of both tomato products and technology so the market of tomato products and technologies is controlled by nature the government have introduced agricultural incentive to fertilizers only.

Table 7 show that market of the tomato products is not an issue 96.67% smallholder tomato producers agreed the presence of tomato market internally and externally only 3.33% face the problem of market so only the challenge is the price fluctuation in the market which depend the quality of tomato this show that due to fair trade which increase the quality of products so failure to compete leads some farmers to face problem in the market so adoption of modern technology is influenced by nature of market that is fair trade once the products is poor the price become poor too.

The weak farmers is fail to sustain the cost of technology hence they waiting until rain season so as to minimize the cost of production thus lead the decrease of SHTP during dry season to only 60 who can afford the cost of irrigation.

Table 7: Market of Tomato Products

Variables	Frequency (n=60)	Percent (%)
Yes	58	96.7
No	2	3.3
<b>Total</b>	<b>60</b>	<b>100.0</b>

The study relates with the study of Gebresilassie and Bekele (2015) found that distance to market centers was negatively and significantly related to adoption of fertilizer. Decreasing

of the distance from the market led to the decrease of the transportation cost of agricultural inputs. Hence market distance and use of inorganic fertilizer had a negative relationship. Limited access to alternative management methods due to high price such as Tanks and fertilizers hinder farmers to use modern technologies to increase their benefits from farming as output have low price to meet with the price of inputs. Access to credit, information, and market and services noted to influence and encourage agriculture technology adoption and Kafle, (2011).

Market distance of the respondents is important for the producers to get attractive market price through reduction of transportation cost. The increase in market distance makes farmers to get out-dates market information and becoming out of adopting agricultural modern technologies. The findings showed that technology package adoption improved as the households' residences became closer to market while the reverse held true for wheat technology package adoption. An interview of Key informants show

*...Market of tomato at Kilolo District is not a problem there is market called TASAF market, and processing industry which consume more tomato products but also there is network with other market from other countries like Kenya but the problem is price fluctuation because during dry season tomato producers decreased which lead to more traders to find another parts like Morogoro to find more tomato products this resulted to price fluctuation...*

During the data collection in dry season is where now the price of tomato increase due to the decrease of tomato producers and incidence of tomato diseases. Fair trade lead those who can afford application of modern technology to earn income which in turn re invested to modern technology and adopt the new invented technology. The government have action plan aimed to help the SHTPs on how to maintain the price to tomato products which can help SHTP to get capital for adoption of technology so the only way for farmers to improve their production to survival to the need of fair trade is to adopt modern technology. Some participants said", challenge is price fluctuation during rainy season "One participant reported that in the issue of market of price influence on technological adoption.

One of respondent in FGD said "...Challenge of price during rainy season.... The rise of insect pesticide...during rainy season the price rise due to increase of tomato diseases...." .”Due to that the study observed that Market of tomato products affects adoption of modern agricultural technology because price fluctuation make the tomato producers sometime to fail to get income for further investment in technology”

#### 4. CONCLUSION

Economic activities conducted by the people in the study area is agriculture, mostly tomato farming. Specifically the study aimed to identify economic factors that influence smallholder tomato producers adoption to modern agricultural technology these factors included low credit accessibility, market of tomato products due to price fluctuation and price of modern agricultural technologies these influence smallholder tomato producers to adopt modern agricultural technologies. The findings observed that economic factors have a great impacts on adoption of modern agricultural technologies

#### 5. RECOMMENDATION AND FUTURE STUDY

- ✓ Basing on the findings from this study, it is suggested that more efforts and resources should be directed towards enabling adoption of modern agricultural technologies and creating awareness of effective modern agricultural technologies. Resources should also be directed by the nation government towards breeding of new varieties that are fast maturing, tolerant and resistant to diseases this will show efficiency of technology which at the end will influence SHTPs to adopt technology.
- ✓ The government should work on reducing the cost of irrigation technologies by increasing incentives to that technology and make them easily to accommodate. The government is moving in this direction but more needs to be done to improve SHTPs access to irrigation. Lending institutions such as commercial banks and micro-finance institutions should work towards availing affordable credit to farmers in order to improve their ability to cover costs associated with practicing off-season production. These costs could arise from irrigation facilities that must be put in place during dry season.
- ✓ Government policy should improve incentives to other technologies that are less privileged and women should be helped to engage in agricultural activities, insurance scheme regarding to new technology can also boost the adoption, to connect the people with technology and financial institution to help them to access credit. Lowering of interest rate and simplifying application and disbursement procedures of loans should be prioritized.
- ✓ Further study should be done on factors that cause low engagement of educated people in tomato farming to investigate the factors that cause poor involvement of people with high education on farming. Who in the area of study the increase of education show the decrease of participation in tomato farming.

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