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Demographic Factors Influencing Adoption of Modern Technologies among Tomato Smallholder Farmers: A Case of Mboga Na Matunda Project in Iringa District

Asheri Mwaipungu [a*], Frank Philipo [a] and Agnes Nzali [a]

[a] Department of Community Development, University of Iringa (UoI), Iringa, Tanzania.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Tomato (Solanum lycopersicum) is one the most useful vegetables in Africa and the world as it has contributed to income level of smallholder farmers. This study therefore assessed factors influencing the adoption of modern technologies among Tomato smallholder farmers in iringa District, Tanzania. The data were collected through interview, focus group discussion, and questionnaire from 60 respondents and analyzed by using SPSS version 20, and deductive approach method. The findings show that 83.3% of respondents were male. Age of the smallholder tomato producers, 21-40 were 70% active age group. The educational level of respondents are; primary education 51.7%, secondary education 33.3%, and post secondary education 15%. Household size 1-2 members is about 23.3%,3-4 members is 66.7%, and above 4 is 10% of respondents. The study confirm that, demographic factors including sex,age,education and

**Corresponding author: E-mail: asherimwaipungu@gmail.com;*

household size influenced the decision making process of smallholder tomato producers of adopting technologies.

Keywords: Technological Adoption; Modern Agricultural Technologies; Smallholder farmers; Mboga na Matunda; Iringa District.

1. INTRODUCTION

The global context highlights the significant role of tomato(Solanum lycopersicum) farming in horticulture. Tomatoes being the third most produced horticultural crop worldwide by weight [1]. China leads in tomato production, followed by India and Turkey. Tomato farming contributes to household incomes and employs smallholder farmers, with various modern agricultural technologies being introduced to improve production and address climate change impacts [2].

The tomato (Solanum lycopersicum) farming like other farming use Agricultural technologies to improve production, the introduction of modern agricultural technologies in tomato farming is one the technologies designed to adapt to 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 Improved Seeds technology of new crop varieties that can tolerate climate changes and agricultural extension service that facilitate the transfer of knowledge and good practices to farmers [2-5].

In Africa, tomato farming is vital both in rural and urban areas, with governments investing in eco-friendly agricultural technologies to enhance tomato farming and mitigate climate change effects. Factors influencing the adoption of these technologies include local climate variability (Egypt being a leading producer in Africa, [6] and the potential for poverty reduction and employment generation [7].

In Tanzania, tomato production is vital for smallholder farmers income and food security. The country ranks 31st in tomato farming in Africa [6] Diverse agricultural technologies such as on-farm storage, efficient resource use, pest control, resilient crop varieties, drip irrigation, and extension services are utilized to adapt to climate variability and increase production [8]. Despite the importance of tomato farming, there's a need to explore why advanced technologies are not widely adopted by smallholder farmers [9].

In Tanzania, Iringa, Tanga, Kilimanjaro, and Mbeya are leading tomato production areas, contributing significantly to smallholder incomes. Understanding factors affecting tomato value chain development is essential for improving both production and market access [10]. The Southern Agriculture Growth Corridor of Tanzania (Morogoro, Iringa, Mbeya, and Songwe) has witnessed horticultural industry growth, with farmers adopting basic post-harvest and planting technologies. However, the adoption of a full technology package remains low [11].

USAID's Feed the Future project Mboga and Matunda at Ilula was a four year project initiated 2017 and ended 2021 in Iringa, Mbeya, Morogoro and Songwe region and targeted to medium and smallholder farmers.The beneficiaries were smallholder farmers and medium enterprises. The activities of the project were to provide technical assistance, to identify agricultural technology based on cost and likelihood of adoption, use of demonstrations plots for training, capacity building to private and public sector service providers, assist loan application, and link farmers with financial institution such as SACCOS, and Farmer groups [12-15].

Despite the commendable efforts of the project during its life cycle, adoption of technology was reported during evaluation was 4% project. "Feed for Future Mboga and Matunda" project's conclusion indicated that, while the majority of farmers had received basic technological training, the adoption of a full technology package remained notably low [11,16,17]. The repercussions of this low adoption are far-reaching, as evidenced by the persistently low adoption rates of modern agricultural technologies among tomato producers in Tanzania, standing less than 6%, according to the Comprehensive Africa Agriculture Development Program [18-21]. This research therefore intends to delve into the factors contributing to this low adoption of modern agricultural technologies.

2. LITERATURE REVIEW

2.1 Theroretical Framework

The Diffusion of Innovation Theory (DIT), developed by Everett Rogers in 1962, seeks to explain how, why, and at what rate new ideas and technologies spread within a population or social system. This theory originated in the field of communication but has been widely applied to various domains, including agriculture and technology adoption. The theory posits that the adoption of innovations is influenced by five key elements: the innovation itself, adopters, communication channels, time, and the social system. Innovations are typically adopted by individuals who have a certain degree of social capital and who are exposed to information about the innovation through various communication channels over time.

DIT is highly applicable to the study of factors leading to low adoption of modern agricultural technologies among smallholder tomato producers. It provides a framework for understanding how and why these farmers may or may not adopt new farming practices and technologies. The theory allows researchers to analyze the role of demographics, social networks, communication channels, economic factors, and institutional influences on technology adoption within this specific context. Several scholars have applied the Diffusion of Innovation Theory in their research. For instance, [22] used the theory to analyze the dynamics of innovation networks in agriculture, emphasizing the role of social networks and knowledge exchange in technology adoption. Jones (2015) applied it to analyze the spread of sustainable farming technologies. Wang [23] employed the theory to investigate the adoption of precision agriculture tools. Patel [24] utilized the theory to understand the adoption of biotechnology in agriculture.

Literature review shows that researchers explored mixed-method approaches that combined quantitative and qualitative data to provide a comprehensive view of technology adoption among smallholder farmers. In the study of demographic factors influencing adoption of modern agricultural technologies among smallholder tomato producers, the Diffusion of Innovation Theory was employed by considering demographic factors and individual influences adoption decisions. The theory help researcher to get better understanding and address the challenges faced by smallholder farmers in adopting modern agricultural technologies. This comprehensive approach helped better understand the low adoption of modern agricultural technologies among specifics and contribute to addressing the challenges they face in adopting innovations

2.2 Emperical Results

Meinzen *et al*., [25] found that gender led to the empowerment of rural farmers for adoption of modern agricultural technologies and increasing food supply for overall economic development. Gender influences adoption decisions through differential access to resources and information [26] According to Abdulai & Huffman [27] Gender differences in agricultural sector arising from cultural and institutional factors impose real costs on society in terms of untapped potential in increasing agricultural productivity financial and adoption of agricultural modern technology.

Mwangi and Kairuki [28] 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. Age is the factor related to willingness to adopt technology that could be impacted by age. The study of Berkowsky [29] hypothesized that the perceived value of technology involved older adults would be a strong predictor of adoption. Sharit, [30] foundage to be the factor that is believed to influence the willingness of farmers to adopt technology. Type of future rewards increased discounting with age, which is consistent with economic perspectives on aging and discounting found that older adults discounted less with increasing age when rewards consisted of attaining greater skills on technologies. Melenhorst [31] found thatthe reduction of age in meta-cognitive beliefs concerning cognitive capability. Older adult learn new material more slowly than young adults. The possible requirement for a greater investment of mental effort for older adults to learn the technology inhibit their willingness to learn new things which is related to the trait and construct technology readiness influence the willingness to adopt technology .

Adenuga *et al*., [7] identified education to be a critical social factor that play a great role in determining one's ability to comprehend and analyze issues before taking any action. Education level is useful in technology adoption

for crop production increment. An increase in educational status of farmers positively influence the adoption of modern technologies and practices. Farmers with better education equipped for making more informed decision for lives and for their communities as well as becoming active participant in economic, social, and cultural dimensions of development In a study by Sosina *et al* [31] which focused on factors affecting adoption of improved varieties in Somalia Region of Ethiopia the study found that, more educated farmers are more likely to adopt improved sorghum varieties in the study area. Other studies, found household heads level of education enhance awareness and decision making, which was likely to increase the probability of adoption. Abdulai & Huffman [27] Good education increases adoption through a better ability to interpret technical knowledge and allocate resources. Household size is a proxy for labor availability studies show larger households are more likely to adopt improved agricultural technologies.

Grabowski *et al*. [21] found household size to be considered as a proxy for labour availability, it is suggested that adoption of labour-intensive technologies to some extent, improved varieties. The use quantitative and qualitative data from Zambian smallholders to show that labour availability is the primary constraint in adoption of labour-intensive hand-hoe planting basins, while capital constraints limit the use of the more expensive ox-ripper.

Balana *et al* [34] found that limited access to credit and financing options remain significant challenges to agricultural technologies' adoption among rural farmers. Demographic factors influence access to credit and were unique determinants for adoption because, the acquisition was not open to negotiated arrangements. Kreyling, [35] Credit access in some countries where female-headed households are discriminated against by credit institutions, prevent women who are into agriculture from adopting yield-raising technologies. Kafle, [36] confirmed that farmers' who have access to credit services had more probability to adopt the new agricultural technologies than otherwise confirmed. Access to credit can increase the probability of adoption of agricultural new technologies by offsetting the financial shortfall of the households.

Adebayo *et al.,* [37] used the concept of poverty, which denotes a state in which individuals or households lack the financial resources and essentials necessary for a minimum standard of living, to play a significant role in the adoption of agricultural technology, particularly in the context of pure tomato value addition technology. When the price of technology increases, it can have a profound effect on the probability of smallholder farmers utilizing this technology.

Bekele, [38] establishes the negative relationship between distance of residence from an all-weather road and fertilizer adoption. The study found that distance to market centers was negatively and significantly related to adoption of fertilizer and due to culture of the study area male are more likely to meet the market due to social cognition of the society about the possession of resources. Decreasing of the distance from the market decreased the transportation cost of agricultural inputs. Hence market distance and use of inorganic fertilizer had a negative relationship.

A study by Qaim and Kouser [39] investigated the awareness and adoption of digital agriculture technologies among smallholder farmers in developing countries. They found that lack of awareness was a significant barrier to technology adoption, highlighting the need for targeted awareness campaigns and training. Ali *et al.* [40] explored the impact of agricultural extension services on farmers' awareness and adoption of modern technologies. The study found that well-designed extension programs significantly improved technology awareness among farmers. Arora *et al.,* (2015) [41] examined the use of mobile technology for agricultural information dissemination and its impact on farmers' awareness and decision-making in Nigeria. The findings demonstrated the effectiveness of mobile-based approaches in increasing technology awareness among farmers. Kiconco [42] Different sources of information (family/friends and media) available to individuals separately affect their decision to adopt technology the network of family and friends, as well as other sources of information such as media and mobile, increases the probability of adoption and use of technology in Uganda. Mukong, [43] The source of awareness or social ties is an important determinant of technological adoption. Sseguya et al [44].

Farmer groups are important sources of credit and technology access. Some groups organize around the village-based community banking model. Others operate informal rotating savings

and credit accounts and are platforms for farmer learning and consolidated inputs acquisition, which might encourage the adoption of technologies on a case-to-case basis.

Wachira,[45] considered institutional factors influencing extension services, credit and market management. Abdulai & Huffman, [27] found extension contact to increase farm productivity by directly adopting high-yielding grain seed and a new variety of chemical fertilizers or indirectly by contactingfarmers spread knowledge to non-contact farmers enhancing farmers' application ability. Other farm and system-level factors, including experience of production shocks, and contact with extension.

Sanga, [8] identified agricultural extension services in Tanzania to still remain entirely financed by the public sector represented by the government through the Ministry of Agriculture Food Security and Cooperatives (MAFC). Prior to decentralization, MAFC had the mandate to provide extension services to the whole country. Agricultural extension service facilitates the transfer of knowledge and good practices to farmers. The traditional agricultural extension is mainly done by an extension officer visiting a farmer or farmer field schools.

Sofoluwe, (2015) talked about the provision and availability of technological innovations to be as important as adoption of such innovations by the expected people. The Study examined the drivers of technological innovations in rural areas. Institutional factors include access to credit, land ownership and acquisition in addition to government and non-governmental influence in the life of the rural people. Smith *et al*., [46] explains insurance regulations, to address risks and uncertainty. This regulation provide guide for peasant or farmers to join insurance scheme. The institution develops mechanism that ensures farmers have insurance against extreme events. Farmers tend to under subscribed to insurance scheme.

3. RESEARCH METHODOLOGY

3.1 Research Study Approach

The study was cross-sectional in nature and used qualitative approach in collecting, analyzing and interpreting data related to the factors influencing tomato smallholder producers to adopt modern agricultural technologies.

This study used Interview, Focus Group Discussion and observation to collect qualitative data. This approachenabled the researcher to collect views/opinion from smallholder tomato producers on factors influencing them to adopt modern agricultural technology. The quantitative approach was used to simplify analysis by using cross tabulation this involves numbers and calculation such as percentage [47] The quantitative data in this study collected by using questionnaires.

3.2 The Study Design

3.2.1 Data collection methods

In this study data was collected by using interviews, documentary review, questionnaire and focus group discussion.

3.2.2 Questionnaire

The questions or items were used to gather data from respondents about their attitudes, experiences, or opinions. Questionnaires were used to collect quantitative and/or qualitative information. Questionnaires helped since it was cheap, did not require much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data

3.2.3 Interview

In this study, the open-ended questions used in interview. Interviews were conducted to eight key informants included one district agricultural extension service officer, one district business officer, one district community development officer, one ward executive officer, three village executive officers and one ward agricultural extension service officer. The researcher used diary to record data from key informants

3.2.4 Focus Group Discussion (FGDs)

FGDs used one group consist 9 respondents three (3) from each villages. Herman [48] defined FGD as the very essence of the group a technique lies in tapping the unexpected findings that result from the interaction session between the members of the group. Focus group should usually compose homogeneous member for the targeted population. In this study FGDs were formed by picking randomly members from villages that is Ikokoto, Ilula -Itunda, and Masukanzi for the discussions. The methods that

were used to get participant is purposive methods because the researcher intended to have sample depending on their knowledge and experiences about tomato and adoption of modern agricultural technologies.

3.3 Data Analysis

SPSS was used to analyze the data and results presented in frequencies percentages, cross tabulations . For quantitative data Microsoft Excel and Statistical Product for Social Solutions (SPSS) version 20 was used for descriptive analysis.

4. RESULTS AND DISCUSSION

4.1 Respondents' General Characteristics

The section presents general characteristics of representations that include sex, age, education level and household size. These variables were analyzed and discussed in sub section as follows;

4.2 Sex of Respondents

Respondents' sex involved in this study is shown in Table 1. The results show that 83.3% of the respondents were male and only 16.7% were female. In the study it shows 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 who are engaging in tomato farming were more than number of females. In the study area it shows that the culture has influence on in the distribution of work on the basis of sex that led to low involvement of female to tomato farming or female who are in marriage have no right to make decision on adoption of technologies or in any kind of any talk about the farming or activities that leadfemale to not participate in providing opinion concerning agriculture in this study.

In order to find relationship between sex and adoption of technology cross tabulation applied in Table 2 the findings show that the male respondents more likely to adopt improved seeds by 80% but female are likely to adopt improved seeds by 70% also in chemical fertilizer male adopted by 84% and female adopted chemical fertilizer by 70%. The results are show that male are more likely to adopt modern technology compared to female.

4.3 Age of Respondents

The findings in Table 1 show the age of the smallholder tomato producers,1.7% of respondent fell within 18-20 respondents,70% of them fell within the middle age of 21-40 years. This show that the majority of respondents were within their economic active age and this enhances their productivity.

Table 1. Demographic characteristics of respondents

Variables	Frequency (n=60)	Percent (%)
Sex of respondents		
Male	50	83.3
Female	10	16.7
Total	**60**	**100.0**
Household size		
1-2	14	23.3
3-4	40	66.7
4>	6	10
Total	**60**	**100.0**
Education of Respondent		
Primary	31	51.7
Secondary	20	33.3
Post secondary	9	15.0
Total	**60**	**100.0**
Age of Respondent		
18-20	1	1.7
21-40	42	70.0
40>	17	28.3
Total	**60**	**100.0**

In order to find relationship between age and adoption of technology cross tabulation applied in Table 3 which show that the respondents with active age 21-40 are more likely to adopt improved seeds by 78.6% also the aged above 40 are likely to adopt improved seeds by 82.4% also in chemical fertilizer it show that the respondents aged 21-40 adopted by 81% and aged above 40 adopted by 88.2% this is because of the characteristics of late majority that is they adopted technology due to experience of many years so they fail to adopt new invented technology. The results are shown in the Table 3 below But On farm storage system and drip irrigation did not adopt at all by the respondents in the area of the study and pesticides technology adopted by all respondents in the area of the study.

Table 2.The relationship between Sex and technological adoption

Sex of Respondent		**Improved Seeds Technology**		**Total**
		Yes	No	
Male	Frequency (n=50)	40	10	50
	Percent within Sex of Respondent	80.0	20.0	100.0%
Female	Frequency (n=10)	7	3	10
	Percent within Sex of Respondents	70.0	30.0	100.0
	Frequency (n=60)	47	13	60
Percent within Sex of Respondents		78.3	21.7	100.0
Chemical Fertilizer Technology				
Male	Frequency (n=50)	42	8	50
	Percent within Sex of Respondents	84.0	16.0	100.0
Female	Frequency (n=10)	7	3	10
	Percent within Sex of Respondents	70.0	30.0	100.0
	Frequency (n=60)	49	11	60
Total (%)		**81.7**	**18.3**	**100.0**

Table 3. Age against adoption

Age of Respondent		**Improved Seeds Technology**		**Total**
		Yes	**No**	
18-20	Frequency (n=1)	0	1	1
	Percent within Age of Respondents	0.0	100.0	100.0
21-40	Frequency (n=42)	33	9	42
	Percent within Age of Respondents	78.6	21.4	100.0
40>	Frequency (n=17)	14	3	17
	Percent within Age of Respondents	82.4	17.6	100.0
	Frequency (n=60)	47	13	60
Total % of respondents		**78.3**	**21.7**	**100.0**
Chemical Fertilizer Technology				
18-20	Frequency (n=1)	0	1	1
	Percent within Age of Respondents	0.0	100.0	100.0
21-40	Frequency (n=42)	34	8	42
	Percent within Age of Respondents	81.0	19.0	100.0
40>	Frequency (n=17	15	2	17
	Percent within Age of Respondents	88.2	11.8	100.0
	Frequency (n=60)	49	11	60
Total (%)		**81.7**	**18.3**	**100.0**

The study is in line with most studies on adoption of modern agricultural technology such as Keelan (2014);[49] Mwangi and Kariuki (2015) [28] who found that farmers socio-economic characteristics had an influence on the adoption of technologies. However, the present study found that farmers household size, indigenous knowledge and household assets were not significant. The results of this study are supported by Mwangi and Kairuki (2015) [28] 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. The findings in Table 1 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.

4.4 Education Level

The findings in Table 1 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.Due to data from the field the study observed that only 15% of post educated respondent engaged in agriculture this can be concluded that in the area of study either educated people do not engage in agricultural activities or there is low number of people who attained post education this may be a cause of low adoption of modern agricultural technologies. Due to the bases of experience and most respondent have basic education.

In order to find relationship between education and adoption of technology cross tabulation applied the findings in Table 4 show education against adoption of technology, it show that education have influence on adoption of technology example in improved seeds and chemical fertilizer Table 4 show that the increased level of education increased with rate of adoption as shown in Table 4 primary education adopted chemical fertilizers by 74.2% and Improved seeds technology by 74.2% respondents while secondary education by 75% respondents with post secondary education by 100% all adopted improved seeds this can be concluded that education influence adoption of technology but respondents without considering their level of education all adopted pesticides but all respondents did not adopted drip irrigation technology and on farm storage system due to other factors.

4.5 Household Size

Findings in Table 1 show that 1-2 members of household size is 23.3%, household size 3-4 members is 66.7% of respondents, and 10% of respondents above 4 household size members.. 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 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 shows 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 influences the adoption of technology due to large number of household size in the study area it limits 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.

In order to find relationship between household size and adoption of technology cross tabulation applied in Table 5 show that family member have influence on adoption of modern technology and willing to adopt modern technology example the in chemical fertilizer technology family with 1-2 member are willing to adopt chemical fertilizer by 85.7%,3-4 by 77.5% and more than 4 by 100%. In the improved seed technology 1-2 by

Table 4. Education against adoptions

Education of Respondent		**Improved Seeds Technology**		**Total**
		Yes	**No**	
Primary	Frequency (n=31)	23	8	31
	Percent within Education of Respondents	74.2	25.8	100.0
Secondary	Frequency (n=20)	15	5	20
	Percent within Education of Respondent	75.0	25.0	100.0
Collage/University	Frequency (n=9)	9	0	9
	Percent within Education of Respondents	100.0	0.0	100.0
	Frequency (n=60	47	13	60
	Percent **of Total**	**78.3**	**21.7**	**100.0**
Chemical Fertilizer Technology				
Primary	Frequency (n=31)	23	8	31
	Percent within Education of Respondents	74.2	25.8	100.0
Secondary	Frequency (n=20)	17	3	20
	Percent within Education of Respondents	85.0	15.0	100.0
Post secondary	Frequency (n=9)	9	0	9
	Percent within Education of Respondents	100.0	0.0	100.0
	Frequency (n=60)	49	11	60
Total (%)		**81.7%**	**18.3%**	**100.0%**

Table 5. Household size against technologies

Household size		**Improved Seeds Technology**		**Total**
		Yes	**No**	
1-2	Frequency (n=14)	10	4	14
	Percent within Household size	71.4	28.6	100.0
3-4	Frequency (n=40)	33	7	40
	Percent within Household size	82.5	17.5	100.0
4>	Frequency (n=6)	4	2	6
	Percent within Household size	66.7	33.3	100.0
	Frequency (n=60)	47	13	60
Total (%)		**78.3**	**21.7**	**100.0**
Chemical Fertilizer Technology				
1-2	Frequency (n=14)	12	2	14
	Percent within Household size	85.7	14.3	100.0
3-4	Frequency (n=40)	31	9	40
	Percent within Household size	77.5	22.5	100.0
4>	Frequency (n=6)	6	0	6
	Percent within Household size	100.0	0.0	100.0
Total Frequency (n=60)		49	11	60
Total (%)		**81.7%**	**18.3%**	**100.0%**

71.4% ,3-4 adopted improved seeds by 82.5% and the family with more than 4 members adopted improved seeds 66.7%. On farm storage system and drip irrigation did not adopt at all by the respondents in the area of the study pesticides technology adopted by all respondents in the area of the study. Due to that finding, there are no relationship between household size and adoption of technology.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The study confirms that demographic factors, including age, education, and household size, significantly influence the decision-making process of smallholder tomato producers regarding the adoption of modern agricultural technology education provide experience about technologies, sex influence the decision making in the area of study due to culture which affected the participation of female on the decision concerning technologies or even to participate in agriculture, household size influence adoption of technologies since the size of family act as proxy indicator of family income the large family size the low adoption of technology unless other factors influencing. Understanding these demographic characteristics is crucial for designing targeted interventions to enhance technology adoption rates.

5.2 Recommendations for Actions

The researcher recommend that programs and awareness campaigns on modern agricultural technologies should be specified to demographics factors of smallholder tomato producers in the study area. These programs should consider the varying needs and preferences of different sex, age groups, educational backgrounds, and household sizes. Establish mentoring or peer-to-peer support networks that connect experienced adopters of technology with those who are less inclined to adopt, encouraging knowledge sharing and mutual assistance

CONSENT

As per international standards or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. FAOSTAT. Statistical Database. Food and Agriculture Organization of the United Nations, Rome; 2020
2. FAO .Fruit and vegetables become UN's centerpiece for ;2019. Available:http://www.fao.org/newyork/news/detail/en/c/125632
3. Kothar CR. Research methodology:Methods and techniques.2nd Edition, New Age International Publishers. New Delhi; 2004
4. Osuagwu.L.Research Methods: Issues and Research Direction: American university of Nigeria; 2020
5. Peter,Shedrack, John . First Mile Transport Challenges for Smallholder Tomato Farmers along Ihimbo - Itimbo Road, Kilolo District Tanzania. AFCAP Project Reference Number TAN2015C; 2015.
6. FAO. Food and Agricultural Organization of the United Nations, Statistics; 2021.
7. Adenuga AH., Muhammad-Lawal A, Rotimi OA. Economics and technical efficiency of dry season tomato production in selected areas in Kwara State, Nigeria. Agris on-line Papers in Economics and Informatics; 2013.
8. Sanga A, Mgimba C. An Analysis of constraints that affect smallholder farmers in the marketing of tomatoes in Mbeya Urban and Peri-Urban, Tanzania. Imperial Journal of Interdisciplinary Research. 2016;2(3):603-611.
9. Mngumi. Perceptions of climate change, environmental variability and the role of agricultural adaptation strategies by small-scale farmers in africa: The case of Mwanga District in Northern Tanzania; 2016.
10. ILuzi-K, Kashenge-K, Bonsi C,. A Review of Maize, Rice, Tomato and Banana Research in Tanzania; 2017.
11. USAID/Tanzania. Feed For Future Tanzania Mboga na matunda evaluation; 2022.
12. Borden and Abbott. Research Design and Methods: A Process Approach 9th; 2015.
13. FAO,(2021). World Food and Agriculture - Statistical Yearbook Rome; 2021. Available:https://doi.org/10.4060/cb4477en
14. FAOSTAT. The Food and Agricultural Organization of the United Nations Production Databases; 2020.
15. Jones A. The spread of sustainable farming technologies: An Analysis Using the Innovation Diffusion Framework. Sustainable Agriculture Research. 2015;4(3):72-84.
16. Rogers EM. Diffusion of innovations 3rd Edition. New York: The Free Press; 1962.
17. Sanga VJ, Kalungwizi CP. Msuya. Building an agricultural extension services system

supported by ICTs in Tanzania. Sokoine University of Agriculture, Tanzania; 2013.
18. United Nations Development Programme (UNDP); United Republic of Tanzania (URT). Tanzania Human Development Report 2017. Social Policy in the Context of Economic Transformation; Economic and Social Research Foundation: Dar es Salaam, Tanzania; 2017.
19. Sofoluwe,Tijani1 & Kareem.Socio-Economic Factors Influencing the Use of Botanicals in Cocoa Pest Management Department of Agricultural Economics, Obafemi Awolowo University, Osun state, Nigeria; 2013.
20. USAID. The U.S. Government Global Hunger and Food Security Initiatives; 2018.
21. Yamane. Determining Sample Size.University of Frorida; 1967.
22. Klerkx L, Leeuwis C. Analyzing innovation networks in agriculture: Theoretical and methodological challenges. Agriculture and Human Values. 2018;35(2):259-267.
23. Wang S. Investigating precision agriculture adoption: A study using the innovation diffusion theory. Journal of Agricultural Technology. 2018;45(1):32-45.
24. Patel R. Understanding biotechnology adoption in agriculture: An application of the innovation diffusion theory. Biotechnology Journal. 2019;14(7):e1800223.
25. Meinzen R,Quisumbing R, BehrmanJ, Jenzano P, Ragasa C, Beintema. Engendering agricultural research.Environment and production technology; 2010
26. Fischer Kotu, Mutungi. Sustainable and equitable agricultural mechanization? A gendered perspective on maize shelling. Renewable Agriculture and Food Systems; 2021.
27. Abdulai A, Huffman W. The adoption and impact of soil and water conservation technology: An endogenous switching regression application. Land Economics; 2014.
28. Mwangi M, Kariuki S. Factors determining the adoption of new agricultural technology by small scale farmers in developing Countries; 2015.
29. Berkowsky Sharit, Czaja, Factors predicting decisions about technology adoption among older adults; 2018
30. Sharit J, Moxley J, Czaja S. Investigating older adults' willingness to invest time to acquire technology skills using a discounting approach; 2021.
31. Melenhorst A. Adopting Communication Technology in Later Life : The Decisive Role of Benefits. Eindhoven: Technische Universiteit Eindhoven;2022
32. Sosina B,Girma.Shiferaw B, Obare G, Muricho G. Rural institutions and producer organizations in imperfect markets: Experiences from Producer Marketing Groups in semi-arid eastern Kenya; ICRISAT Socioeconomics and Policy Working Paper Series*.* 2014*;23*.
33. Grabowski M. Kerr S. Haggblade S. Kabwe .Determinants of adoption and dis adoption; *2016*
34. Balana B, Mekonnen DK, Haile B, Hagos F, Yiman S, Ringler C. Are smallholder farmers credit constrained? Evidence on demand and supply constraints of credit in Ethiopia and Tanzania. IFPRI Discussion Paper 1974. Washington, DC: International Food Policy Research Institute; 2020.
35. Kreyling J. Winter climate change*:* A critical factor for temperate vegetation performance, Ecology. 2010;91
36. Kafle B . Factors affecting adoption of organic vegetable farming in Chitwan District, Nepal. World Journal of Agricultural Sciences. 2011;7:604-606.
37. Adebayo AG, Akintoye HA, Adeoye BO .Socio- Economic analysis of okra (*Abelmoscus esculentus* (L.) Moench) under different live mulches in southwest Nigeria. Nigerian Journal of Horticultural Science. 2018;23:98-203
38. Bekele A, Gebresilassie L. Factors determining allocation of land for improved wheat variety by smallholder farmers of northern Ethiopia. Journal of Development and Agricultural Economics 2015;7:105-112.
39. Qaim M, Kouser S. Genetically modified crops and food security. PLoS ONE. 2013;8(6): e64879.
40. Ali A, Abdulai A, Owusu V. The impacts of agricultural extension services in the context of diverse cropping systems and gendered farm productivity in northern Ghana. World Development. 2019;114:25-42.
41. Arora A, Banerjee S, Imai KS, Matous P. Using mobile phones for nutrition and consumption choices in rural India. Journal of Political Economy. 2015;123(5):1239-1270.
42. Kiconco RI, Rooks G, Snijders C. Learning mobile money in social networks: Comparing a rural and urban region in

Uganda. Computers in Human Behavior; 2020
43. Mukong AK. Peer networks and tobacco consumption in South Africa. South African Journal of Economics; 2017.
44. Sseguya, Robinson, Mwango, Flock, Manda, Abed, & Mruma. The impact of demonstration plots on improved agricultural input purchase in Tanzania: Implications for policy and practice; 2021
45. Wachira J, Mshenga P, Saidi M. Comparison of the profitability of small-scale greenhouse and open-field tomato production systems in Nakuru-North District, Kenya. Asian Journal of Agricultural Sciences. 2014;6(2):54-61.
46. Smith, Vincent H. and Barry K. Goodwin. The environmental consequences of subsidized risk management and disaster assistance programs. Annual Review of Resource Economics. 2013;5 .
47. Bhattacherjee A. Social Science Research: Principles, Methods, and Practices: University of Florida; 2012.
48. Herman,G.(2018),Educational Research Methods. A Practical Guide. Mahelo Book Centre, Mwanza Tanzania. 2016;77-105.
49. Keelan C, Thorne F, Flanagan P, Newman C. Predicted Willingness of Irish Farmers to Adopt GM Technology. The journal of Agrobiotechnology Management and Economics. 2014;12(3).

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