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CONTRIBUTION AND CHALLENGES OF ADOPTION OF DRIP IRRIGATION KIT TECHNOLOGY TO CROP DIVERSIFICATION AMONG COMMUNITIES IN KAJIADO COUNTY, KENYA

ABSTRACT

Embracing crop diversification contributes to sustainable agriculture, resilient communities, a healthier environment. The adoption of drip irrigation kit technology has not only improved water efficiency, but has also played a pivotal role in encouraging crop diversification and enabling farmers to explore a wider range of crops in a sustainable and resource-efficient manner. Despite the benefits, the adoption of drip irrigation kit technology faces several challenges in promoting crop diversification. This study was carried out to establish the contribution and challenges of adoption of drip irrigation kit technology to crop diversification in Kajiado County, Kenya. The target population for the study was 155 small-scale drip kit irrigation farmers in three wards (Namanga, Mashuru, and Isinya) in Kajiado County. It also involved ten key informants sourced from community local leaders, ward agricultural extension officers (WAO) and Kenya Agricultural and Livestock Research Organization (KALRO) Scientists who have been coordinating the donor funds and the government of Kenya funded farming technologies in the area. Data from the questionnaires were coded to open data kit (ODK) software, then imported to excel and SPSS software for analysis. Results showed that 30% of the respondents diversified their crops to increase crop yields and reduce losses while 22.5% diversified to introduce new crop varieties. Results also showed that 35% of the respondents rated the contribution of drip irrigation kit technology on influencing crop diversification as high. Further, blocking of drip irrigation pipes was a major challenge for 35.3% of the respondents. The study concludes that drip irrigation kit technology is an approach that will go a long way in positively affecting the livelihoods of the community in the study area and therefore need for strengthening measures to promote the technology for economic use and utilize the available water.

Keywords: Crop diversification, drip irrigation kit technology, Kajiado County, Kenya.

1.0 INTRODUCTION

Crop diversification is a strategy that involves cultivating a variety of crops which offers numerous economic, social and environmental benefits. It helps communities reduce their dependency on a single crop, minimizing the risk of crop failure due to pests, diseases, or adverse weather conditions (Abro and Sadaqat, 2010). By diversifying crops, communities can enhance food security and therefore gin more power to meet other household needs (Dalal and Shankar, 2022) contributes to soil health and biodiversity. Different crops have varied nutrient requirements, and rotating them helps maintain soil fertility and structure and also reduces the likelihood of pest and disease buildup since specific pests often target particular crops (Samberg, Shennan and Zavaleta, 2010). In addition to the ecological advantages, crop diversification can foster social and cultural

resilience. It allows communities to preserve traditional farming practices and heritage crops, promoting local biodiversity and cultural identity (Joglekar, 2010).

Drip irrigation also referred to as trickle irrigation is a system of irrigation that allows controlled water application alongside the rooting zone of the plants or localized water application (Simonne *et al.*, 2012). The system can be used by subsistence farmers with a small acreage of about 0.5ha or less, the case of many African farms. Drip irrigation after a study on field performance evaluation was done in Ghana was reported to have water use efficiency of more than 90 percent making it more preferable to areas of low rainfall and cost-effective method for the farmers who buy water for irrigation (Darimani *et al.*, 2021) making it a transformational technology for smallholder producers. In Sub-Saharan Africa, Kenya is a country with potential adoption of small-scale drip irrigation with increased market actors across the supply chain and progressive development of small-scale drip irrigation which has been noted since the late 1990s (Hornum and Bolwig, 2020). More than 80% of the Kenyan farmers depend on rain-fed production despite the rainfall variability that does not meet crop water requirements exposing the country to chronic food insecurity. In 2014, the government of Kenya in collaboration with the stakeholders of both private and public Institutions, launched its water master plan 2030 intending to increase irrigated areas from approximately 100,000ha to 972000ha by 2030(USAID, 2016).

The adoption of drip irrigation kit technology has significantly contributed to crop diversification by revolutionizing the way water is delivered to crops (Kulecho and Weatherhead, 2006). This technology has enabled farmers to cultivate a broader range of crops, promoting crop diversification in several ways. Drip irrigation allows for the cultivation of crops with varying water requirements in the same field. This flexibility in water management facilitates the simultaneous growth of crops that thrive in different moisture conditions, thus encouraging diversification (Shanono, 2022). Further, the controlled and localized water supply of drip irrigation is especially beneficial in regions with water scarcity. Farmers can efficiently use limited water resources to cultivate a variety of crops, promoting sustainable agriculture practices and crop diversification. Moreover, the precise control over water and nutrient delivery provided by drip irrigation enhances the adaptability of farmers to different soil types and climatic conditions. This adaptability is crucial for experimenting with and introducing new crops, leading to increased diversity in agricultural production (Chandran and Surendran, 2016).

The adoption of drip irrigation kit technology faces several challenges in promoting crop diversification and one major obstacle is the initial cost associated with purchasing and installing drip irrigation systems. Many small-scale farmers may find it financially burdensome to invest in this technology, limiting their ability to diversify crops (Shanono, 2022). Additionally, the lack of awareness and technical know-how poses a significant challenge since farmers need proper training to understand the installation, operation, and maintenance of drip irrigation systems (Kulkarni, 2011). Water quality is another concern since drip irrigation systems are sensitive to water impurities, such as sediments and contaminants, which can clog the pipes and emitters. In areas where water sources are not adequately treated or filtered, the adoption of drip irrigation may be compromised, affecting its effectiveness in promoting crop diversification (Ismai'il et al., 2014).

Arid and Semi-Arid Lands (ASALs) are mostly affected due to the dominance of pastoralism and reliance on rain-fed agriculture. It is assumed that the introduction of small-scale irrigation technologies has been instrumental in changing the crop diversity in a semi-arid region of Kenya, Kajiado and the introduction of high-value crops such as tomatoes, capsicums, onions, egg-plants sweet-potatoes have been because of drip irrigation technology. This is part of a strategy by the government for food and nutrition security. The increased adoption of big scales drips irrigation kits have enhanced the production of drought-tolerant crops which were originally being grown at the onset of rainy seasons such as green grams, finger millet, and fruits such as Pawpaw, melons(Sijali, 2017). Small scale irrigation is critically important as an innovative practice in smallholder agriculture to improve crop productivity for enhanced food security and the farming systems' resilience to climate variability (Mango *et al.*, 2018) and thus the need for this study.

2.0 METHODOLOGY

The study was carried out in Kajiado County which is a large pastoralists area characterized by nomadic life with many in search of pasture due to prolonged dry spells and unpredictable rainfall seasons exacerbated by climate change(Mutua and Boitt, 2017). Due to increased support by the government in the region, the study identified sites that has received immense support on irrigation technologies looking at the impact of small-scale drip irrigation on crop diversification in Kajiado Central in Mashuru, Isinya and Namanga. Irrigation is possible in the areas due to the main river crossing the sub- county coupled with other seasonal streams that enables the community to

harvest water in ponds and shallow dams to supplement irrigation. The target population for the study was 155 small-scale drip kit irrigation farmers in three wards (Namanga, Mashuru, and Isinya) in Kajiado County and 10 key informants sourced from community local leaders, ward agricultural extension officers and scientists who have been coordinating the donor funds and government of Kenya funded farming technologies in the area. The three wards were specifically selected since they have benefited from training by various organizations facilitating small-scale drip kit irrigation technology. The majority of the farmers were originally trained by KARI in collaboration with other agricultural-oriented stakeholders which have been instrumental in the changing farming pattern in the three wards. Out of the 155, 63 farms were the most productive household farms and were prioritized over the farms that drip irrigation was in use on and off during the cropping season who formed the study's respondents. Questionnaires and documented information were the tools used for data collection. Sampled respondents were interviewed at their farms. Data from the questionnaires were coded to open data kit (ODK) software. Cleaning of the data was first done by checking the completeness of the questionnaire, then data was imported to excel and SPSS software for analysis.

3.0 RESULTS

3.1 Crop diversification

The understanding of the respondents on the crop diversification, reasons for crop diversification, rating of the contribution of the drip irrigation technology influencing crop diversification and contributions of crop diversity under the drip irrigation technology to household livelihood was evaluated as shown below.

3.1.1 Understanding of the term crop diversification

The respondents were asked to define what they understood by the term crop diversification (Table 1). 60% of the respondents termed crop diversification as growing of different varieties of crops while 20% defined it as planting of different types of crops in different seasons. Other respondents understood crop diversification as changing of crops/ farming (10%), different methods of farming (5%), planting of different crops in the same season (2.5%) and crop rotation (2.5%).

Table 1: Definition of crop diversification

Crop diversification	Frequency	Percent
Growing different varieties of crops	24	60
Planting of different types of crops in different seasons	8	20
Changing of crops/ farming	3	10
Planting of different crops in the same season	1	2.5
Crop rotation	1	2.5
Different methods of farming	2	5.0
Total	40	100

3.1.2 Reasons for crop diversification

The reasons for crop diversification by the respondents was sought and results shown in Table 2 show that 30% of the respondents diversified their crops to increase crop yields and reduce losses, 22.5% to introduce new crop varieties, 12.5% to change and diversification in diet while another 12.5% of the respondents diversified their crops to ensure availability of food throughout the year. To increase income, crop rotation, payment of school fees and to increase food for marketing were also reasons for crop diversification.

Table 2: Reasons for crop diversification

Reasons for crop diversification	Frequency	Percent
Change and diversification in diet	9	12.5
Availability of food throughout the year	9	12.5
Increase crop yields and reduce losses	12	30.0
Increase income	6	15
Crop rotation	1	2.5
Payment of school fees	1	2.5
Increase food for marketing	1	2.5
Introduction of new crop varieties	1	22.5
Total	40	100

3.1.3 Rating of the contribution of the drip irrigation technology influencing crop diversification

Respondents were to rate the contribution of drip irrigation technology influencing crop diversification and the results are shown in Figure 1. Results show that 35% of the respondents rated the contribution as high, 25% as very high while average/normal and moderate were each rated by 20% of the respondents.

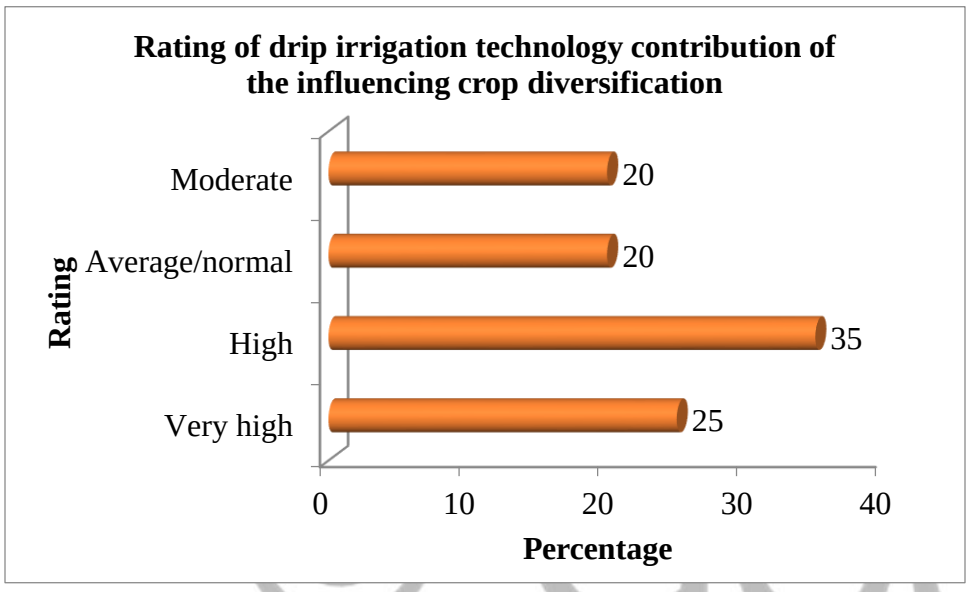

Figure 1: Rate of drip irrigation technology contribution to crop diversification

3.1.4 Crop diversity contribution to household livelihood

Crop diversity under the drip irrigation technology contribution to household livelihood was evaluated and the results shown in Table 3. Consumption of different food types and production of different crop types for sale were the main contributions of crop diversity under the drip irrigation technology to household livelihood with 34.0% and 31.9% of the respondents respectively. Increased income from sale of crop produce (26.6%) and general well-being of the family (7.5%) were also crop diversity contributions to household livelihood as cited by the respondents.

Table 3: Crop diversity contribution to household livelihood

Contribution to household livelihood	Frequency	Percent
Consumption of different food types	32	34.0
Production of different crop types for sale	30	31.9
Increased income from sale of crop produce	25	26.6
General well-being of my family	7	7.5
Total	94	100

3.1.5 Challenges in using the drip irrigation technology in crop diversification

Some of the major challenges the respondents have faced in using the drip irrigation kit technology were evaluated and are shown in Table 4 below. Blocking of drip irrigation pipes was a major challenge for 35.3% of the respondents which is caused by lack of regular flushing of the soil sediments. Lack of enough water and high cost of installation and maintenance was cited as a major challenge by 32.4% and 29.4% of the respondents respectively.

Table 4: Major challenges faced in using the drip irrigation kit technology

Major challenges	Frequency	Percent
Lack of enough water	22	32.4
Blocking of drip irrigation pipes	24	35.3
High cost of installation and maintenance	20	29.4
Culture and beliefs	2	2.9
Total	68	100

3.1.6 Strategies used to cope with the challenges

Three strategies that the household used to cope with the above-mentioned challenges in order of priority were sought. Lack of enough water being the first major challenge was coped by roof water harvesting (74%) of the respondents, run-off water harvesting (17.4%), digging water pans (4.3%) and planting early maturing crops (4.3%) of the respondents. Blocking of drip irrigation pipes was coped through roof water harvesting (50%), run-off water harvesting (16.7%), digging water pans (16.7%), planting early maturing crops (8.3%) and planting different types of crops next season (8.3%) of the respondents while looking for alternative source of income e.g., Off-

farm employment (casual labour) was used in coping with the challenge of lack of enough land for farming.

4.0 DISCUSSION

Studies by (Kumar and Palanisami, 2020)in India have shown that drip irrigation technology has a significant effect on water use efficiency and yield of crops thus encouraging farmers to diversify their crops. Crop yields have been increased and new crops introduced which corroborates the findings of this study since 30% of the respondents diversified their crops to increase crop yields and reduce losses while 22.5% diversified to introduce new crop varieties (B. K. Jha, S. S. Mali, 2017) carried out a study in India and found out that irrigation of vegetables using drip irrigation increased yields from 38 to 65 %. They further noted that there was increased water efficiency, water productivity, reduced labour costs and increased economic returns. This is supported by the key informants who denoted that increased water use efficiency was one of the contributions of drip irrigation kit technology.

Due to the high cost of drip irrigation installation, repair and maintenance, potential high outcomes and the high possibility of failure, there is need of integrating concerns that regard to environmental sustainability, resource use efficiency, nutrition and health impacts which is important to the small-scale household farmers. The contributions of drip irrigation on communities and households are higher crop yields and planting of crops off-season. Irrigation has also been found to affect time used in farming, nutrition and health of the households (Domenech and Ringler, 2013). This is achieved through growing of different crops thus consuming different diets providing varied nutrients to the households.

5.0 CONCLUSION AND RECOMMENDATIONS

The study showed that there are contributions of the drip irrigation kit technology to crop diversification both at the household and community level. Moreover, there are challenges that are being experienced by the farmers in using the technology; key among them being blocking of the drip irrigation pipes. The study concludes that drip irrigation drip technology is an approach that will go a long way in positively affecting the lives of the community in Arid and Semi-Arid Areas especially where the study was carried out. There is, therefore, need for strengthening measures to boost the technology to promote economic and social stability of the area. Capacity building on

technologies by the research institutions is paramount to maintain the sustainability of the benefits accrued and reducing problems of drip pipes maintenance by periodical flushing to avoid clogging. There is also need for a policy that should focus on the promotion of drip irrigation kit technology in the arid and semi-arid regions of Kenya, where water scarcity and the effect of climate change and variability is alarming. This will ensure food security for the communities and their social and economic welfare improved through the government led and supported initiatives.

6.0 REFERENCES

B. K. Jha, S. S. Mali, S. K. N. & T. S. (2017) 'Yield, Water Productivity and Economics of Vegetable Production Under Drip and Furrow Irrigation in Eastern Plateau and Hill Region of India', *International Journal of Agricultural Science and Research*, 7(3), pp. 43–50. Available at: http://www.tjprc.org/view-archives.php.

Dalal, S. and Shankar, T. (2022) 'Crop Diversification and its Importance in Agriculture: A review', *Indian Journal of Natural Science*, 13(72), pp. 44540–44548.

Darimani, H. S. *et al.* (2021) 'Field Performance Evaluation of a Small-Scale Drip Irrigation System Installed in the Upper West Region of Ghana', *Computational Water, Energy, and Environmental Engineering*, 10(02), pp. 82–94. doi: 10.4236/cweee.2021.102006.

Domenech, L. and Ringler, C. (2013) 'The Impact of Irrigation on Nutrition, Health, and Gender: A Review Paper With Insights for Africa South of the Sahara', *SSRN Electronic Journal*, (April). doi: 10.2139/ssrn.2249812.

Hornum, S. T. and Bolwig, S. (2020) *The Growth of Small-Scale Irrigation in Kenya: The Role of Private Firms in Technology Diffusion*.

Kulecho, I. K. and Weatherhead, E. K. (2006) 'Adoption and experience of low-cost drip irrigation in Kenya', *Irrigation and Drainage*, 55(4), pp. 435–444. doi: 10.1002/ird.261.

Kumar, D. S. and Palanisami, K. (2020) '- Impact of Drip Irrigation on Farming System: Evidence From Southern India', *Management, Performance, and Applications of Micro Irrigation Systems*, 23(December), pp. 54–67. doi: 10.1201/b17303-12.

Mango, N. *et al.* (2018) 'Adoption of small-scale irrigation farming as a climate-smart agriculture practice and its influence on household income in the Chinyanja Triangle, Southern

Africa', *Land*, 7(2), pp. 1–19. doi: 10.3390/land7020049.

Mutua, C. and Boitt, M. (2017) 'Suitability Analysis of Water Pan Sites for Pastoralists : A Case Study of Kajiado Suitability Analysis of Water Pan Sites for Pastoralists : A Case Study of Kajiado County in Kenya', 2017(June). doi: 10.13189/ujg.2017.050303.

Sijali, I. (2017) 'Isaya Sijali', *Conference paper*.

Simonne, E. *et al.* (2012) 'Drip-Irrigation Systems for Small Conventional Vegetable Farms and Organic Vegetable Farms', *IFAS Extension*, (January 2012), pp. 1–23.

USAID (2016) 'The Market for Small-Scale Drip Irrigation in East and Southern Africa Partnering for Innovation'. Available at: https://s3.amazonaws.com/www.dripplus.org/Resources_The_Market_for_Small_Scale_Drip_Irrigation.pdf.