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In Tharaka South, Eastern Kenya, Socio-Economic Variables Influence the Use of Rainwater Collecting and Conservation Methods

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ABSTRACT- Rainwater harvesting and conserving technologies are essential interventions for water supply and food production in Kenya's dry and semi-arid regions due to low soil moisture levels. Despite extensive study on the subject, variables influencing farmer acceptance and adaptation of these helpful technologies remain unknown, and low adoption and adaption levels of these beneficial technologies remain a problem. This study expands on this feature, focusing on the Tharaka South sub-county, where family food insecurity is exacerbated by water shortage, unpredictable rainfall, and soil water stress. A cross-sectional survey methodology was used to gather farm and social data from 351 household heads. Descriptive statistics and logistic regression were used to analyze the data. Trashlines (73 percent) used in situ rainwater collecting and saving methods more than micro-catchments (26 percent), Zai pits (26 percent), and Negarims (13 percent). Household size (p 0.01) and Zai pit training (p 0.002) were positively and substantially related with Zai pit usage, whereas overall farm size (p 0.01) and land tenure (p 0.01) had negative co-efficients. Rainwater collection and conservation technologies were disseminated using both official and informal teaching methods. Farmers' age, family size, farm size, farming history, training, and formal education were shown to be significant variables influencing the adoption of rainwater collecting and saving technology in Tharaka sub-county, according to the research. In contrast to less resource-intensive technologies, specific methods are required to increase the efficiency of asset technology.

KEYWORDS- Agriculture Climate Change, Dry Land, Economic, Rain Water Harvesting, Resource-Intensive.

I. INTRODUCTION

Farming is the main significant economic industry in several nations in Sub-Saharan African, with significant amplification impacts and around 60% to 70% of the overall inhabitants living in outlying areas and reliant on small-scale sustenance farming for a subsistence[1]. Furthermore, rainfall is insufficient and has a lot of geographical and temporal variability, which leads to lengthy dry spells throughout the growing season. Several scientific studies have shown that Author who communicates with you. Found that rainwater collecting skills are essential in improving creative liquid usage while increasing crop yield levels in semi-arid agro-ecosystems [2].

Tharaka South Sub-seasonal county's rainfall varies widely about the mean, featuring spells of below rains[3]. The continuation of below-average rainfall in Tharaka poses a threat to livelihoods, exacerbating the semi-arid region's susceptibility to hunger and famine. Government and nonprofit organizations have successfully tested and promoted a variety of water harvesting and conservation methods. Several rainwater collecting and conservation methods have been developed in Kenya since the 1950s[4]. Although the biophysical and economical benefits of rainfall collection and storing technology, soil and groundwater preservation approaches have remained underutilized, especially in Kenya's semi-arid zones[5]. Few of these programs have succeeded in combining technology efficiency with farmer acceptability in their respective communities. Rainfall gathering and conservation methods are critical in attaining the objectives of socioeconomic growth, climate change resilience, and sustainability, according to the Nationwide Climate Change Act Strategy However, combinations between biophysical and socioeconomic variables have influenced the acceptance and use of these technologies in Kenya, which have not been well explored[6]. There is a paucity of scientific data on smallholder farmers' development and usage of both asset and resource-light technologies rainwater collecting and conservation methods. As a result, the purpose of this research is to determine the socioeconomic variables that influence their usage (or non-use) in Tharaka Sub-County [7].

A. Rainwater harvesting and conservation techniques

Six different kinds of in situ rainwater collecting The land and freshwater preservation strategies employed in Tharaka South are described. Three very resource demanding technologies and three less resource intensive technologies were chosen[8].

Although they were imposed on a large scale under colonial authority the origins of. Back-slope bench terraces known as Fanya juu are created by excavating

and tossing dirt up the slope to build an embankment following the contour. Conferring terraces are created by excavating a trench approximately 60 cm wide following the contour to decrease the slope and velocity of overland flow. This has a substantial impact on slope length reduction, resulting in enhanced From steep croplands, rainfall penetration and soil degradation and flow were decreased [9].

Closed micro catchments, also known as negarims, are bund-encircled gemstone creek. Negarims are widely used for fruit tree cultivation in the)[10]. They're used to plant Fruits bushes are recommended for dry and semi-arid environments with annual precipitation as little as 150 mm and elevations of up to 5%. They are intended to resemble conventional square earth bunds that have were tilted 45 degrees off the curve to focus surface runoff at the bottom corner of the rectangle[11].

Zai pits are a outdated West African method that has just lately been brought to Kenya They are, nevertheless, Currently, it is growing popular in Uganda, particularly in dry land regions. Multiple Zai pit design variants have been utilized in various Kenyan locations. The Zai plant four to eight seeds of a crop, such as maize, in shallow, broad holes of 0.6 meters in circumference and 0.3 meters in depths. The method may be used on slopes ranging from 1% to 15%. To enhance soil fertility, manure is typically put to the pit. It functions as a water collecting structure in the pit, preserving together soil wetness and richness. The trenches may be used to grow more water-intensive crops or trees than are typically present in the region, or to decrease the risk of crop failure during dry periods. Zaipits are often used in conjunction with other rainwater collecting and conservation methods to get the best results [12].

Vegetative grass strips are made up of live plant strips seeded along the contour. Plant growth strip are quasi obstacles that grow down the slopes of the soil, limiting water flow and absorbing silt, and eventually forming terraces. Trashlines are identical to vegetation strip, with the distinction that grass strips employ freshly planted living grasses. Trash lines comprise of agricultural leftovers, cereal, and/or legume russel spread in strips along the hillside to restrict subsurface flow. Trash lines range in width from 30 to 50 cm and in height from 35 to 70 cm [13].

Logs from fallen forests and similar natural farm biological resources might be included into the lines. The makeshift construction catches silt in runoff and decreases overland flow velocity. Making garbage lines is a traditional method used in many regions of Kenya that requires little expertise, agricultural labor, or cash. The correlation between training and usage was strong (89%), whereas There was a strong relationship between training and the use of rainwater collecting and saving systems (Chi-square = 35.075, The primary issue restricting agricultural production in arid and semiarid areas is a lack of water and soil fertility deterioration. Semi-arid regions This necessitates widespread use of suitable technologies. Rainwater collection and conservation methods are critical for semi-arid agricultural growth [14].

In agriculture, the quantity of water required is measured in gallons. These findings are consistent with those of observed a high frequency of in situ technology being used as comparable to the research area's micro and macro-catchments The When compared to newer The use of older and original forms of stormwater collecting and saving technology was just as prevalent as the use of newer and native kinds of rainfall gathering and conserving technology. Negarim pits, for example, are a more recently adopted soil technology. and Zai pits, which agree with There was a strong connection between training and usage. (89%), indicating that rainwater collection and conservation training is beneficial. The use of these technologies was strongly linked to technology. Technologies. As a consequence, farmers in semi-arid regions must be educated, trained, and equipped in order to improve their productivity [15].

Extension was one of the primary sources of According to Negarim pits, up to 38% of farmers rely on farmers' markets. Field schools are a kind of educational institution. The major trainers in the use of grass strips wereFarmer field schools (27%) and other farmers (29%) are the most common sources of information. from family members (44%), and from other farmers Field days, farmer training schools, and school agriculture are all examples of this. Rainwater collecting instruction was provided by a few small providers.

The use of relevant rain water collecting and saving technologies was linked to the sources of training for such technologies. Technologies. The sources for further information and training technologies that need a lot of resources, particularly physical soil structures Field Schools are a kind of school where students are taught in Grass strips, stone terraces, and trashiness, on the other hand, need less expertise and resources. Mostly reliant on community-based and indigenous sources Informal sources of information, such as family and other sources

II. DISCUSSION

Knowledge and abilities may be handed down from generation to generation, making technology a cultural heritage over time. and guaranteeing long-term viability, there were institutional initiatives to encourage adoption. in the study of micro- and macro-catchment methods as shown by the large number of farmers who have received training Agents from the government and other farmers acted as trainers. both found that there was a substantial difference between the two groups.an increase in the likelihood of rainwater use and adoptionAs a consequence of increasing interaction, new harvesting and saving technologies have emerged.with the use of extension agents The capacity of individuals to share with one another was strongly linked to a greater degree of community connectedness.strengthening their exchange connections.These local interpersonal training channels are native to the area [16].

Because stone line technology is a long-standing neighborhood exercise in the research area, and neighborhood references of knowledge are better suited to interacting these technologies than cosmopolitan and exterior outlets of understanding, which are better suited to asset and expertise technologies, formal instructional credentials might not have played a significant role. Farmers who worked primarily as agriculturalists were also more likely to use stone lines than farmers who worked in more formal jobs.

The trashiness regression model described 26% of the total variation, including an 81 percent correct predictions rate of occurrences in the model (including economic factors), up from 77% in the zero models. Location, household size, labor source, and land area under agricultural production were all significant predictors of trash line usage.

The usage of garbage lines was strongly correlated with the size of the household and the amount of land under crops. The probability of utilizing trash lines increased by 1.2 times as the size of the household increased (B = 0.198, Odds = 1.2). Farmers who employed hired labor in their agricultural operations were 2.9 times more likely than farmers who used family labor to construct stone lines (B = 0.318, Odds = 1.374). A 1.4 times greater probability of using trash lines was related to a bigger farm area under crops by 1 ha (B = 0.318, Odds = 1.374).

Trash line method is a local communal custom that entails laying farming wastes including plant leftovers on the soil layer to reduce surface movement and soil runoff. Farmer who cultivate more farmland are greater prone to generate bioenergy from food and non-crop leftovers, which may be used as trash line materials. Because the technique does not need the construction and maintenance of permanent or complicated soil structures, it may be used by farmers with little or no advanced expertise, land tenure, money, or training. This explains why training was essential in a number of rainwater harvesting and conservation systems, but not in trash lines. As a result, farmers of all socioeconomic backgrounds, genders, and resource endowments may use this technique. Organic materials from farms and non-farms, particularly those that can't be used as feed, fuel, or absorbed directly into the soil as green manures, may be used as surface materials to prevent soil erosion caused by wind and water [17].

As for Hosmer and Wilk test ($p > 0.05$) and the % correct forecasts (>60%) , the regression model met statistical criteria, The Wald Statistic was used to construct model interpretations, whereas important variables in the Wald Statistics ($p > 0.05$) were used to generate models understandings. Significant factors in the Negarims, grass strips, and garbage lines regression models were shown to be significant in all 6 econometric methods for rainwater gathering and saving. Except for Negarims, which had a negative coefficient (indicating a greater probability of use in Nkarini, Negarims, grass strips, and garbage lines all had positive coefficients, indicating a higher likelihood of use in Tunyai.

Teklehaimanot (2006) found that the location of structures was positively and significantly correlated with the usages of rainwater harvesting systems water harvesting and saver innovations, with the odds proportion in favor of placing soil constructions rising by a component of 2.588 when farm location circumstances in Egypt were suitable.

Occupation had a major impact on the usage of stone lines, while house-hold size had a big impact on the use of Negarims and garbage lines. Farmers with off-farm sources of income were less likely than full-time farmers to construct stone-lines, according to the results. This may be explained by the fact that full-time farmers chose to install the technologies employing family labor, which could have been adequate given the availability of stones on or near the fields. provided reasons for how the household head's profession may influence the adoption of rainwater collecting and saving systems. One argument is that the opportunity cost of doing off-farm activities may be significant; another is that once a farmer sells off-farm labor or enters formal employment, they are no longer accessible to use and maintain rainwater collecting and saving systems on the farm. According to there is a link between off-farm work and the use of rainwater collecting and conservation technology. The usage of stone lines was influenced by the size of the household in a favorable and substantial way. This may be linked to the claimed increased food security connected with the use of Zai pits and the success stories around the use of Negarims for fruit tree cultivation.

The use of Fanya juju, Negarims, and trash lines was positively and substantially related with the source of labor. When it came to labor, Growers who hired labor were greater inclined than those who utilized family workers to use Fanya juu, Negarims, and rubbish lines. To satisfy the high work needs of Fanya and Negarims, farmers may require hired labor or organised farming collective labor arrangements. Whole digging takes 30 to 70 people hours per acre, whereas fertilization takes 20 people weeks per acre (ADB, 2008). The high labor costs of installation Negarims explain the link amongst ingroup and Negarim use, since pooled labor may make Negarim installation easier [18].

The use of grass strips was strongly linked with title deed ownership, which indicates security of tenure[19]. This result is consistent with the findings of numerous researches on the connection between land tenure and farmer adoption of technology, such as rainwater collection and conservation technologies. Farmers need security of tenure in order to carry out agricultural investments. According to Testate, land security was a significant factor in the adoption of rainwater collecting and conservation technology. In the Philippines and Kenya, the use of rainwater collecting and conservation technology was similarly significantly related to land ownership Terracing, vegetative strips, and trashlines were among the Kenyan technologies studied in this research[20]. According to land rights security has a statistically significant beneficial impact on the use and acceptance of rainwater collecting and conservation technology. This may indicate that farmers who are confident in their land rights are more inclined to use rainwater collecting technology.

III. CONCLUSION

In the research locations, the most often utilized technologies wereTrashlines and Fanya juu technologies were among them, whereas Negarims andZai pits were utilized in a limited capacity. Negarims and Zai pits are increasingly common. In terms of installation and maintenance, they are resource-intensive. Although the technology has just lately been developed, all of which contribute Farmers in Tharaka are using their land at a reduced rate. According to the findings of the research that resource-intensive technology training was mostly based on formal and cosmopolitan sources of information, whereas Farmers in the study regions relied

on local sources of information for the methods they employed to preserve soils in the past.as well as information To grow and scale-up more, other methods are required.technologies that use a lot of resources Grass strips, stone lines, and trash lines, on the other hand, are less reliant on knowledge There are both official and informal sources of information. In the development and scaling up of technology, training in rainwater collection and saving technologies is critical. Formal education is the study of a subject. To improve the acceptance and usage techniques that use a lot of resources and need a lot of understanding, field training activities should be utilized. Localized types of information, on the other hand, are more suited to soil techniques that are less energy and native. such as garbage cans. The use of indigenous technology may be beneficial.

When there is a need to innovate, formal training may help. indigenous technology to be modified, modernized, and adapted The findings of the research showed various use patterns forTharaka uses both resource-intensive and less resource-intensive rainwater collecting and conservation methods. The aspect of location was important. Which showed a greater chance of being installed in Tunyai, and a higher chance of being installed in Tunisian terms of rainfall, potential agro-ecozone compared to Nkarinidistribution. The adaptability of a crop is influenced to a larger degree by agro-ecological factors such as slope, rainfall, and soil types. as well as the application of various methods of rainwater collecting technologies that save money In terms of employment, more people are working off-farm. Installing stone lines is a less wealth process, was adversely linked with many occupations, including employment. Technology. When comparing the use of rain water collecting and saving technology with the presence of hired labor, the use of rain water harvesting and saving technologies was positively related. Group membership was a favorable influencing element for rain water collecting and saving technology, whereas it was a negative influencing factor for family labor. For increasingly resource-intensive technology, training was essential. Compared to technologies that use less resources. Access to credit was adversely linked to the establishment of grass strips, which is Farmers who did not have access to financing were more likely to deploy the equipment than those who did since it was a less resource-intensive technology. Having access to credit generally, initiatives such as education, training, capacity development, and resource mobilization are appropriate approaches. when used to semiarid rainwater collecting and conservation methods that need a lot of resources and expertise agricultural systems The use of grass-strips was favorably related to the amount of land under pasture in Tharaka.

Those who have a smaller percentage of their land under cultivation, because they were in a better position to produce enough agricultural product and Biomass from non-crop sources to be used as trash line materials. Rainwater harvesting is being developed and disseminated via farmer organizations and finance access mechanisms. And energy-saving technologies, both of which should be promoted. In this case, Participation in farmer groups was linked to Negarims in a research. Installation, which is to be anticipated given the labor and resource constraints the technological needs as a result, farmer organizations are formed. Key entrance sites for academics and policymakers in efforts to scale up rainwater collecting and conservation technology in the United StatesZones that are semi-arid. Farmer organizations should be formed to provide access to finance, labor, and rainwater harvesting training. as well as energy-saving technologies.

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