Tsavo Trust initiative towards up-scaling Climate Smart Crop Technologies in Kamungi and Shirango Community Conservancies

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1 Background information

Tsavo Trust (TT) is an action-oriented Kenyan non-profit conservation organization providing support in securing wildlife, preserving habitats, and supporting key communities on the borders of the Protected Areas (PAs) within Kenya's Tsavo Conservation Area (TCA). Our primary strategic partners are the Kenya Wildlife Service (KWS), and The National and County Governments, with whom we have had a close partnership over the past 11 years through a Memorandum of Understanding (MoU). Our three primary goals outlined in our 5-Year Strategic Plan 2023-2027 (attached):

- Support effective management and protection of protected areas under KWS
- Establish strong and effective community-led conservation and development initiatives
- Develop a more resilient and robust long- term financing framework for TCA

Goal Two emphasizes two pivotal communities acting as buffers to the PAs: Kamungi Conservancy (KC) on the northern side of Tsavo West NP (TWNP) and Shirango Community Conservancy (SCC) on the southeastern boundary of Tsavo East NP (TENP). Partnerships with KC date back to 2014, and SCC in 2017. The aim is to create secure buffers and economic opportunities for these marginalized communities. Both conservancies are registered CBOs owned by community landowners, relying on partnerships with TT, donor funding, County Government, KWS, and KWCA.

In line with these efforts, TT forged a collaboration effort with the Kenya Agricultural and Livestock Research Organization (KALRO) to address livelihoods challenges faced by these communities. The primary objective of this partnership was to enhance the well-being of marginalized communities through specialized training, fostering the adoption of climate-smart agriculture practices for increased productivity. Some of the interventions encompassed utilization of drought resistant crop varieties designed to withstand erratic

rainfall patterns and prolonged dry spells, which are becoming more prevalent in the recent years. In addition, KALRO was to ensure the accessibility and availability of resilient improved crop technologies. Those technologies that exhibit resilience to drought, pests and diseases, while also offering higher yield potential in the arid and semi-arid regions. If embraced, the adoption of proven climate-smart technologies would empower farmers to mitigate the adverse effects of climate change thereby fortifying resilience in these communities.

1.1.1 Main objective

The primary objective of these activities was to raise awareness and promote the adoption of improved climate-smart crop technologies within the two conservancies including the surrounding communities for improved livelihoods. This initiative was to serve as a sustainable approach for adapting to, and building resilience against climate fluctuations while increasing income, food and nutrition security.

1.1.2 Specific Objectives

- Train farmers on adoption of climate-smart technologies including post-harvest management
- Disseminate sustainable agricultural practices through participatory learning
- Collect feedback information from the participants

1.1.3 Expected outcomes

- Increased farmer awareness on the production and utilization of improved cowpea varieties in the project target area.
- Increased accessibility and availability of improved cowpea varieties in the project target area.

1.2 Study Sites

KC and SCC conservancies lies in agro ecological zones Lower midland (LM) zone 5. The conservancies, experiences a hot and dry climate throughout most of the year with an average temperature ranging between 25^{o}C to 35^{o}C. The areas receives two rainy seasons from March through June and short rain from October through December with driest months being from July to September and January to February the following year. The average annual rainfall ranges between 200 to 700 mm and can even receive less rainfall depending on weather changes. The distribution of rainfall is be patchy and very unpredictable which is not evenly distributed. The soils here are diverse in nature and vary in different sub-regions including red sandy soils, volcanic soils, loamy soils and

black cotton soils especially in Kamungi while Shirango the soils are generally volcanic soils. The trainings were conducted during the 2022 and 2023 short rains season in Kamungi and Shirango conservancies.

1.3 ACHIEVEMENTS

1.3.1 Activity 1: Capacity building through training to farmers on adoption of improved technologies

This activity was implemented in KC primarily Ngiuluni and Kamunyu villages while SCC included Ndarako and Shirango villages. The approach employed was participatory learning, providing participants with initial overview of climate-smart agriculture. The overarching goal was to address the challenges posed by the effects of climate adverse effects.

Farmers underwent sensitization sessions emphasizing the significance of adopting sound agronomic practices encompassing the use of improved variety technologies, adherence of recommended spacing, appropriate seed rates tailored for specific crop technologies as well as timely planting, weeding, soil and water conservation technologies. The training also covered pest and disease control along with post-harvest management. Participants were also enlightened on the importance of clearly selecting crop species and varieties well-suited to their region. They were encouraged to embrace farming systems that are both economically viable and environmentally friendly, serving as a means to protect crops against abiotic and biotic stresses including extreme weather and upsurges of pests and diseases.

1.3.2 Crop/Varietal Selection

Farmers were reminded to make informed decisions on when selecting varieties for planting Successful crop production and a good harvest always begin with the right planting materials. As mentioned above, it was very significant to emphasize the key factors that influence decision making at the household level regarding selection of crops and type of cropping system suitable before planting. Some of the factors to be considered inluded:-

a) **Water availability:** The amount of rainfall received on average basis was crucial consideration. Participants were tasked with assessing rainfall availability in their localities to determine whether it would support the growth
b) **Climatic conditions:** Emphasis were made concerning the suitability of the crop selection in relation to the prevailing weather parameters such as temperature and their soil fertility

1.3.3 Land Preparation

Emphasis on the importance of ensuring early land preparation before the onset of rains were made. A well prepared field not only facilitates production of good yield but also helps controls weeds and recycle plant nutrients, preventing them from going to waste. Without adequate land preparation, growers cannot expect to generate good profits, and the likelihood of crop failures at the end of cropping season is high.

Farmers were introduced to three techniques of land preparations including conservation tillage, conventional tillage and Zero tillage. The trainers elaborated on these methods, discussing their advantages and disadvantages enabling farmers to make informed decisions on the method to adopt. Some of the highlighted advantages entailed (i) improvement of the soil and water conservation: Providing and ideal environment for crop growth (ii) loosening compacted soils to allow good aeration and (iii) protecting the land from weeds and pests by reducing the weed competition for light and nutrients

1.4 Soil Fertility

1.4.1 Organic Fertilizers

Participants were further educated on the significance of utilizing locally available farmyard manure at the household level to enhance soil fertility. This emphasized the necessity of diversifying both crops and animals at farm level. Diversification is crucial for replacing nutrients extracted by crops from the fields thereby restoring the soils crop production potential. This practice was emphasized as being essential for improving overall soil productivity and enhancing crop production.

1.5 Field Operations

1.5.1 Planting

Farmers were advised to plant their crop at the onset of rains to minimize the risk of crop failure and equally use the early maturing climate-smart crop technologies. This strategic timing allows the sensitive stages of the crops to avoid the peak activity of insect pests and also other emerging issues.

1.5.2 Spacing

The spacing intervals for different varieties of crops are determined by the farming systems adopted by the farmers, taking into account the varied growth habits and patterns of the crops. Overcrowding of crops not only diminishes yield due to the nutrient competition and light. The recommended spacing also influences plant populations thereby affecting the ultimate desired yields and overall quality production.

Figure 1 Training at Shirango and farmers planting Kamungi

1.5.3 Seed Rates

Farmers underwent training on diverse seed rates tailored to different available crop technologies. Various aspects were explored concerning the seed rates of different crops in relation to farmers practices. The quantity of seeds needed depends on factors such as the variety, cropping system, seed size and viability. Crops with erect growth habit requires higher seed rate as compared with the spreading varieties. Similarly fewer seeds will be required in the intercropping system. The seed size also determines the quantity of seeds to be used. Therefore larger seeds implies higher seed rate

1.5.4 Crop Rotation

Farmers were advised to practice crop rotations based on nutrient requirements, which entailed planting legumes first followed by heavy feeders such as sorghum or maize. They were reminded that this vise is recommended to reduce the build-up of pests and disease. In addition it enhances water use efficiency by increasing the amount of organic matter in the soil, thereby improving soil structure and water holding capacity.

1.5.5 Weed Management

Weeding being a crucial element for successful crop production farmers were advised to ensure fields are free from weeds. Various methods of weed control such as mechanical methods, tilling and hoeing were explained as being effective at removing weeds from field. Weed managment improves crop health and increases yield potential

1.6 Crop Protection

1.6.1 Pest and Disease Management

Biotic stresses contribute to low crop productivity. Farmers were guided on incorporating integrated pest and disease management as both a practice and as strategy for ecological safety. They were reminded that combinations of cultural, physical, biological and chemical and exclusion approaches had proven to be effective in lowering the need for synthetic pesticides. These strategies aid in preserve ecosystems, enhancing biodiversity and protecting beneficial organisms in the soils.

Equally, the discussion delved into the significance of indigenous technical knowledge serving as repository of skills and techniques for managing farming system. This interactive exchange allowed farmers to share their diverse experience, knowledge and techniques. The emphasis was not only on controlling field pests but also addressing common storage pest like weevils and bruchids. Farmers encouraged to leverage local knowledge and utilize locally available resources make use of it not only to tap the local knowledge but also to make use of locally available resources such as neem trees, red pepper, aloe Vera, dusting of ash on crops, use of cow dung as a seed protector among others.

1.7 Post-Harvest Management

1.7.1 Drying

This was a crucial subject, aiming to reduce the moisture content of grains before storage to mitigate infestation by primary storage pests and prevent contamination. Farmers were

advised to carry out this activity on a clean surface such as mats, plastic sheets or tarpaulin or a raised platform.

1.7.2 Threshing and Winnowing

Various methods of threshing the dried crops were covered. Farmers were encouraged to manually perform the activity by using sticks or beating bagged pods with sticks once they are dry enough. Other methods included use of threshing machines available in different sizes powered by petrol engine or diesel or electricity, for small, medium and large-scale threshing. Emphasis were placed on this aspect to ensure that the quality of seed was not compromised...

1.7.3 Assessing Moisture Content before storage

Farmers were advised to sun dry their produce by spreading it thinly on the drying surface in order to allow air to pass through it and turn it regularly to avoid overheating. Several methods of testing the dryness of grains were also highlighted and participants advised on applicable methods to use:-

(i) Grain Testing by biting or pinching the grain

When the seed is dry enough, it should break or rather than bend or stick between teeth or fingernails. They were also reminded should be undertaken before threshing by using biting or pressing the seed between fore fingers and thumb.

(ii) Salt Method

The participants were advised to use locally available materials such as salt and transparent bottle. This was a good way to determine the moisture of threshed grains. For this test farmers required to have a clean dry jar with a lid, salt and a handful of grain. The seed should be taken from the middle of each bag using a sampling spike. They were advised to observe dampness of the salt after 10 minutes on the sides of the jar after shaking which implied the seeds were moist. It also implied the moisture was above the required 12-13%. If the jar fails to show some salt sticking on the jar, it implied the seeds were dry and moisture content was approximately 10-11%.

1.7.4 Storage

Due to destructive nature of storage pests, it was observed farmers faced difficulties in managing storage pests leading them to dispose of their produce shortly after harvesting. Farmers were advised to make use of hermetic bags such as PICS which are more cost effective as a means of minimizing the yield losses. Alternatively, they were recommended to use actellic dust.

1.7.5 Value Addition and Utilization

Various methods of value addition were highlighted on different crops ranging from legumes, cereals, root and tubers. This was done in a participatory manner where farmer were allowed to share their experiences and acted as entry point for business development at household level. They were taken through several benefits of adding value to agricultural produce such as increased income, employment creation, enhanced food safety, food security and nutritional benefits.

2 Disseminating Sustainable Agricultural Practices Through Learning Participatory Learning

2.1 **Activity 2.** Setting-up On-farm demonstration plots in the farmers' fields

Farmers will only adopt a technology they are aware of or have heard about it. Access to information reduces the uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time (Bilaliib et al 2017). In this regard it was imperative after training and discussion in class to setup a demo farm where farmers will use it as platform for learning by doing.

Three on-farm demonstration plots were established in both Kamungi and Shirango communities in collaboration with farmers, KALRO officers and area administrators. Three lead farmers were participatorily selected by group members to serve as host farmers for their demo plots Annex 1-3. Farmers were allowed to suggest the crop technologies they would like to plant in their demo plots among them being the legume crop varieties, cereals and root and tuber crops as indicated in Table 1. In Kamungi two on-farm demo plots were raised and three were established in Shirango, during the short rains of year 2022. During planting, considerations were given to various treatments including soil types, soil fertility and the presence of trees in the field.

Use of Randomized complete block design was adopted in allocating plots of 3 m x 5 m for each of variety crop technologies identified. Uniform treatment were applied for each variety across all the technologies selected. These demonstrations plots was to serve as potent and efficient mechanism for showcasing the climate smart crop technologies. The plots were meant to provide an interactive environment for members serve as an active discussion platform and also a farmer to farmer learning platform.

Table 1. Crop Technologies introduced and planted in on-farm demonstration plots

Legumes	Root and Tuber	CEREALS
Cowpeas	**Cassava**	**Maize**
(i) Kunde Soko	(i) KME-2	(ii) KDV1
(i) Kunde Tamu	(iii) Mygyera	
(ii) Kunde Faulu	(iv) Ex-Mariakani	**Sorghum**
(iii) Kat Kunde		(i) Kamani
(iv) Kunde Tumaini	**Sweet Potato**	(ii) Seredo
	(i) Irene	(iii) Gadam
Green gram	(ii) Kabode	
(i) Ndengu Tosha		**Millets**
(ii) Ndengu Karembo		(i) Pearl Millet
(iii) Ndengu Biashara		(ii) Finger millet
(iv) N26		
(v) KS20		**Amaranth**
		(i) Terere Smart
Pigeon pea		
Mituki		
Mbaazi 60/8		
Mbaazi II		
Dolichos Lab ab		
DL 1002		

2.2 Procurement of Improved crop Varieties

Economic impacts have been observed lately in the two conservancies, particularly in the increased adoption of new technologies by farmers, expansion of acreage dedicated to specific crop technologies at household level. This impacts are well illustrated in the quantities of improved planting materials procured in previous seasons since the inception of the trainings. Seeds worth KES 80,000 was purchased alone during the current short rain season of 2023 (Table 2)..

Table 2.. **Improved seeds purchased by Shirango and Kamungi farmers during the short rain season of 2023**

Crop	Kilogram (kg)	Unit cost/ 2Kg pack	Total Budget (KES)

Cowpea	78	400	31,200
Green gram	40	560	22,400
Pigeon pea	12	560	6,720
Maize	42	340	14,280
Sorghum	4	340	1,360
Dolichos lab lab	4	280	1,120
Cassava	302	5	1,510
Sweet potato	785	2	1,570
Total (KES)			**80,160**

Figure 2; Shirango farmers inspecting their cowpea, green gram and maize fields

2.2 Constraints

Major challenges encountered by the farmers included:-

(i) Moisture Stress: Farmers in Kamungi reported that although the crops initially emerged well, moisture stress caused the crops to wilt and eventually dried-up due to insufficient rains.

(ii) Wildlife invasion: Both Kamungi and Shirango communities faced challenges with wildlife invasion. Although the demo plots in Kamungi were put-up in 10% porcupine electric fence farmers still faced crop invasion by impala, dik dik and monkeys The Shirango community, where there was not 10% fence at the time, the crop was destroyed by elephants, impala and the dik.

(iii) Financial constraints: farmers encountered financial constraints which hindered their ability to access essential supplies for their crop especially for the pest and disease control management. This was noted in Shirango.

3 Feed Back Information from the Participants

3.1 Crop technologies adopted by farmers

The collection of feedback information involved farmers from Kamungi and Nthuguuni, .both whom had undergone initial training. Subsequent assessments revealed that a majority of the farmers visited, adopted varied cropping patterns with prevalent cultivation of cowpeas, green grams, maize (KDV1 variety) which was either mono-cropped or intercropped with other crops. These crops demonstrated resilience to the harsh weather conditions, and it appeared that majority of the farmers have experienced the benefits of these crops and have finally embraced them. In addition, several farmers cultivated vegetables, the “sukuma wiki” around their home gardens, especially those with small water pans. Perennials crops like castor trees and mango trees were also observed in these localities.

Regarding crop diversification, farmers in this region were found to grow several crops as earlier mentioned. This practice serves as beneficial strategy to cushion farmers against unfavorable weather changes that might lead to crop failures.

3.2 Information gathering from farmers: A few Question and Answers

3.3 *Where do you buy seeds from* and which seeds did you buy if any?

When asked about the seed procurement, several farmers mentioned obtaining them from market which they referred to as “seeds” but in reality these were “grains”. They explained that the improved varieties purchased from the agro-dealers were more

expensive as compared to their local. Some mentioned relying on farmer saved seeds as their source of planting material

A few farmers eluded that they bought improved varieties from KALRO including cowpeas, green grams, sorghum, pearl millet and the maize KDV1.

How has Tsavo Trust assisted you to avoid crop invasion

Farmers mentioned they are grateful to the organization for installing the 10% porcupine fence as they are assured of harvesting their crops as compared to the previous years. Those farms where the fence have not been installed they suggested the organization always assist them in retrieving the elephants them back to the National park. Other animals which invade their crop included gazelles, impala, monkeys and dikdik

Overall experience with improved seeds

Farmers expressed overall satisfaction with KALRO varieties. They were pleased with variety performance noting significance improvement compared to the previous seasons, with KALRO varieties which consistently out-yielding the local varieties. Specifically farmers highlighted the appeal of certain cowpea notably Kunde Soko due to its large grained attributes which fetches high prices market at the market compared to the medium grained. Moreover, they appreciated the sweet taste of the variety and expressed intentions to grow them again in the future.

Did you face any challenges with improved varieties?

Farmers mentioned there were no major challenges though the rains were short and poorly distributed but the production of the improved varieties were exemplary good the previous season. They also noted that some of the varieties were early maturing and were able to escape drought

Did you make any adjustments to your usual cultivation of improved climate smart crops?

Majority of the farms visited have adopted the sole cropping system. They mentioned they are using the good agronomic practices as advised, early planting before the onset of rains, correct spacing, and pest and disease management and using the triple bags to store their crop.

Did improved varieties exhibit any resilience?

According to the farmers, legumes particularly cowpea and green grams demonstrated remarkable resilience throughout the season when compared to beans. Farmers noted that, despite their enduring affection for maize, they were compelled to forego due to its susceptibility to moisture stress. They also deduced that maize variety KDV1 was early and though the harvest did not meet their expectations, at least provided a harvest, given its early maturation.

3.4 Opportunities

Farmers were reminded that adoption of climate smart agricultural practices holds the promise of heightened productivity. By incorporating improved crop varieties, sustainable soil management and efficient water-use practices, farmers can achieve increased yields and improved outcomes, This not only ensure food security but also contributes to the economic well-being of communities dependent on agriculture

Farmers Success Stories

Story No 1-**Kamungi Conservancy**

Phillip Quote *". The* ***S****ecret to enhanced production on my farm has always been timely land preparation, acquisition of the right planting materials and planting at the onset of rains. My neighbors consistently always keep an eye on my seasonal calendar to make well-informed decision for their farms".*

Mr. Phillip Muli, a small-scale farmer based at AEZ 5 at Ngiluni village, used to practice traditional farming methods in the past relying entirely on farmer- saved seeds of maize, cowpea and green gram fo planting. Through participating in on-farm demonstration plots, Phillip has acquired knowledge and information on the benefits of utilizing improved climate smart crop varieties. Consequently, he has successfully adopted improved technologies in his three acre farm.

In recent seasons, Phillip has observed significant improvement in his farm income, quantities and quality of his farm produce for his family. He illustrates his farming as having changed, to a more commercial like enterprise. He characterizes his farming transformation as a shift toward a more commercial enterprise. Previously the production on his farm was very low of 0.5 bags (1bag = 90Kg) of pigeon pea, green gram and cowpea per acre. He now produces 3 bags per acre for every crop enterprise and anticipates higher production in future

.. Phillip also highlighted that the improved varieties exhibited more market-preferred characteristics by the consumers including color, large grained size and good quality seeds in terms of uniformity compared to previously grown landraces. He asserts that food and nutritional security are now guaranteed for his family a notable shift from two

years ago when he relied on the market for sustenance. Looking ahead Phillip plans to expand his three- acre plot to at least four acres.

Success Story No 2- **From Mr. James Kithuku**

James Kithuku is a small holder farmer in Nthunguni village, Mtito Andei sub county, has emerged as a proactive adopter of improved farming practices . Exposed to advancements through on farm demonstation plots and various agricultural practices in his location, james has gained a profound understanding of the benefits associated with improved crop technologies a realization that, for him outweighs the initial investiment costs.

'I was determined by all means to ensure I used improved crop technologies" says James. To realize this commitment, he consistently invests in certified seeds from agro-dealers a decision he asserts has never failed him even during periods of low rainfall, in contrast to grains obtained from grain stores in the local market. " Remarkably, James dedication to implementing these improved practices has attracted attention.prompting inquiries from both neighbors and group memmbers curious about the performance of crops on his farm.

Having been exposed to the improved crop technologies suitable for his region, he mentioned that his production level has increased from 1.5bags to 4.0 bags of either cowpea or green grams per acre. With the increased income from his farm, he successfully educated his children. From the income he used a portion of his earnings to pruchase beans, acrop that tradidtionally do not performa well in his farm.

Highlighting the importance of diversification, James aemphasized that both crop and livestokc are cruciall for enhancing farm productivity. This strategic approach not only contributes to increased yields but alos ensures amore resilient and sustainalbel farming model.

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Annex 1 Capacity building at Shirango and Kamungi Conservancies

Conservancy/CBO	Farmer Group	Host Farmer	Date trained	Planting Demo Date
Kamungi	(i)Kamunyu	Margret Ngina	18-10-2022	19-10-2022
	(ii)Ngiluni	Kyalo Ndeto	20-10-2022	21-10-2022
	(iii)	Kirimbai Barisa		
Shirango	(i)Ndaragu	Lai Saidi	16-11-2022	17-11-2022
	(ii)Shirango	Barisa Haiyesa	14-11-2022	15-11-2022
	(iii) Shirango	Kanze	18-11-2022	19-11-2022

Annex 2..

Conservancy	Farmer Group	Host Farmer	Date trained	Planting Demo Date
Kamungi	(ii)Shirango		2-10-2023	3-10-2023
Nthuunguni	(iii)Nthuguuni		4-10-2023	5-10-2023
Kamungi	(iii)Ngiluni	Mutunga	6-10-2023	7-10-2023

Annex 3..

Conservancy	Farmer Group	Host Farmer	Date trained	Planting Demo Date
Kamungi	(i) Ngiluni		27-11-2023	28-11-2023
	(ii)Kamunyu		29-11-2023	30-11-2023
Nthuunguni	(iii)Nthuuguuni	James Githuku	30-11-20	7-10-2023
