Final Project Report:

Sorghum Value Chain Business Case Development

Development of a Sorghum Smallholder Pilot Financing Scheme in Kitui and Makueni Counties

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Alliance

Bioversity International

CIAT

International Center for Tropical Agriculture

Financial Access

CGIAR

AICCRA

Accelerating Impacts of CGIAR Climate Research for Africa

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List of Abbreviations and Acronyms

ASAL	Arid and Semi-Arid Lands
CBO	Community Based Organization
CGA	Cereal Growers Association
CIAT	International Center for Tropical Agriculture
CSA	Climate Smart Agriculture
EABL	East African Breweries Limited
FAO	Food and Agriculture Organization
FI	Financial Institution
GAP	Good Agricultural Practices
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ILRI	International Livestock Research Institute
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KES	Kenya Shillings
MFI	Microfinance Institute
MoALF	Ministry of Agriculture Livestock Fisheries and Cooperatives
MT	Metric Tons
SACCOs	Savings and Credit Cooperative Societies
SASRA	SACCO Societies Regulatory Authority

Executive Summary

Sorghum production is vital to the country's food security and can play a major role in improving the livelihoods of farmers in arid and semi-arid lands (ASAL). Being a drought resistant crop that can tolerate extreme temperatures and flooding conditions, it offers farmers in ASAL regions a better alternative to generate higher incomes compared to other staples such as maize and wheat. Despite this, uptake of sorghum farming has been slow with production lagging demand nationally. Most farmers have yet to adopt the good agricultural practices (GAP) necessary to boost production. 84.4% of sorghum farmers in Makueni utilize uncertified seeds from their own stored sources while 30.9% of them grow the crop without any fertilizer. The AICCRA project seeks to remedy this by developing a climate-smart lending business case that will encourage financial institutions to lend to these farmers. The business case shall facilitate the formulation of a pilot lending scheme involving a Partner Financial Institution (PFI) covering the semi-arid counties of Kitui and Makueni in Lower Eastern Kenya. This will be done in close cooperation with the Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Livestock Research Institute (ILRI) among other project partners.

In the targeted counties of Kitui and Makueni, the sorghum value chain is less structured compared to other value chains such as mangos and oranges where farmers are organized into cooperatives and marketing of their produce is not a challenge. The value chain begins with input suppliers who supply farmers with mineral fertilizers and seeds mainly. After production and successful harvest, the grain is offtaken by aggregators who work with between 500 to 2,000 farmers per ward before selling it to larger scale off takers. Farmers at times sell it directly to these off takers through purchase agreements. Some of the commodity trickles down to the local market. The main market for the grain, especially white sorghum is the brewing industry led by East African Breweries Limited (EABL). Other end market participants include flour millers and animal feed manufacturers. The value chain would not be complete without support service providers who enhance the flow of the commodity from one level of the value chain to the next alongside providing other essential services. These include transporters, financial institutions, County Agricultural Officers, and the Cereals Growers Association.

The success of sorghum smallholder farmers is imperative to the growth and sustainability of the value chain. Most of these farmers in the targeted counties hold between one to five acres of land with sorghum taking up on average one acre. They prefer to cultivate white sorghum varies such as Gadam, Advanta ADV 23012, KARI Mtama 1 & 2, and Sila seed varieties as they are more marketable compared to the other varieties. The smallholders are usually organized into savings groups and Community Based Organizations (CBOs) through which they access farming inputs, training on GAP practices and markets for their harvest. Up to 80% of these producers are women with youth taking up a paltry 5%. Lack of farming land and interest in farming compared to other fast earning jobs is a major contributor to their low participation. These farmers face several challenges that hinder optimal production of sorghum key among them being the high cost of quality farm inputs without which, they experience low yields. Lack of well-established and structured offtake markets is also a pain point for most farmers. Without structured markets, sorghum smallholders run the risk of unfair pricing by grain brokers. Finally, the negative effects of climate change and bird infestations have a significant bearing on sorghum yield per acre.

To remedy the challenges above and enhance the productivity of sorghum smallholder farmers located in these two counties, the study proposes the implementation of a pilot financing scheme. This will enhance access to climate smart inputs such as certified drought resistant seeds, organic and mineral fertilizers, and climate risk insurance to enhance farmers' climate resilience. The scheme will also facilitate access to mechanized services by farmers such as the use of rippers for land preparation, winnowing and threshing machines for grain preparation after harvesting. This will improve the quality of life of farmers who are mostly women by reducing the time, labor, and exertion of manual sorghum production. The study also proposes several measures to mitigate bird infestations namely, planting sorghum alongside trap crops such as biofortified millet, use of seed varieties adapted to combat bird infestations such as Advanta ADV 23012 or synchronizing their planting periods to spread the losses from bird infestations across multiple farms.

To facilitate the implementation of the measures proposed above, farmers will receive input loans from Family Bank, the selected partner financial institution (PFI). The scheme estimates the total input cost to be KES 26,188 per acre. With this in place, the farmers stand to harvest approximately 1,000 kgs of sorghum per acre to be sold at KES 40 bringing their revenues to KES 40,000. Their profitability is therefore estimated to be KES 11,455 after netting off the loan financing expenses. The study proposes a channeled lending approach where the loan funds will be channeled through the off taker, Tegemeo Cereals Enterprises Ltd. who will bulk the necessary inputs and distribute them to approved smallholders at a discount. This will mitigate against the risk of diversion of the disbursed funds by the smallholders. After harvesting and aggregation of the grain, the off taker will transfer the farmers' revenues to the PFI for loan settlement with the remainder being allocated to the farmers by the PFI. This approach mitigates the risk of diversion of funds to be used for loan repayment if they were to be paid directly to the sorghum smallholders.

The paper recommends running the pilot with 1,000 smallholder farmers in both Kitui and Makueni. If implemented in the long rain season, the offseason for sorghum, farmers will need to be concentrated in one region e.g., 1,000 smallholders from two neighboring wards in one county. This will spread potential losses from bird infestations across multiple nearby farms. Incorporation of climate risk insurance through soil moisture index and picture based monitoring to be offered by ACRE Africa will be key in mitigating the risk of adverse climatic events. The study also recommends the provision of a loan portfolio guarantee cover for the group of smallholders selected in the pilot scheme. This will cover the PFI in case of pervasive non-climatic related losses in production by the farmers. In preparation for phase two of the project, it is recommended that the project partners and the selected pilot implementation partners plan a workshop after validation of the results of the report to design the roadmap for the pilot implementation.

1 Introduction

1.1 Sorghum Production in Kenya

Like in most African countries, sorghum production in Kenya is essential to food security. This is due to its ability to flourish in severe and unpredictable climatic conditions prevalent in significant parts of the country. It is the fifth most important grain crop after maize, wheat, rice, and barley due to its short harvest cycles and little maintenance. The drought resistant crop can tolerate extreme temperatures on one hand and withstand flooding conditions on the other[1]. Compared to other staples such as maize and wheat, sorghum offers farmers a better alternative to combat global warming and climate change due to its hardiness. The grain is usually cultivated in marginal and semi-arid regions marked by unpredictable rainfall patterns and spells of extreme temperatures[2]. These include Western, Northern Rift Valley, Eastern and some parts of Central Kenya.

The country's sorghum output has witnessed progressive gradual increase in Arid and Semi-Arid Lands (ASALs) as per MoALF 2015[1]. Production has almost doubled from 164,066 MT in 2010 to 315,000 MT in 2020[3]. However, production levels have been on a decline in 2019 and 2020 despite the harvested area increasing for the same period due to constraints such as lack of quality inputs and the grain's susceptibility to damage by birds which has resulted in low yields. Irregular rainfall patterns have also reduced yields as most farmers rely on rain fed farming[1]. Below is chart illustrating the growth in the country's sorghum production quantities

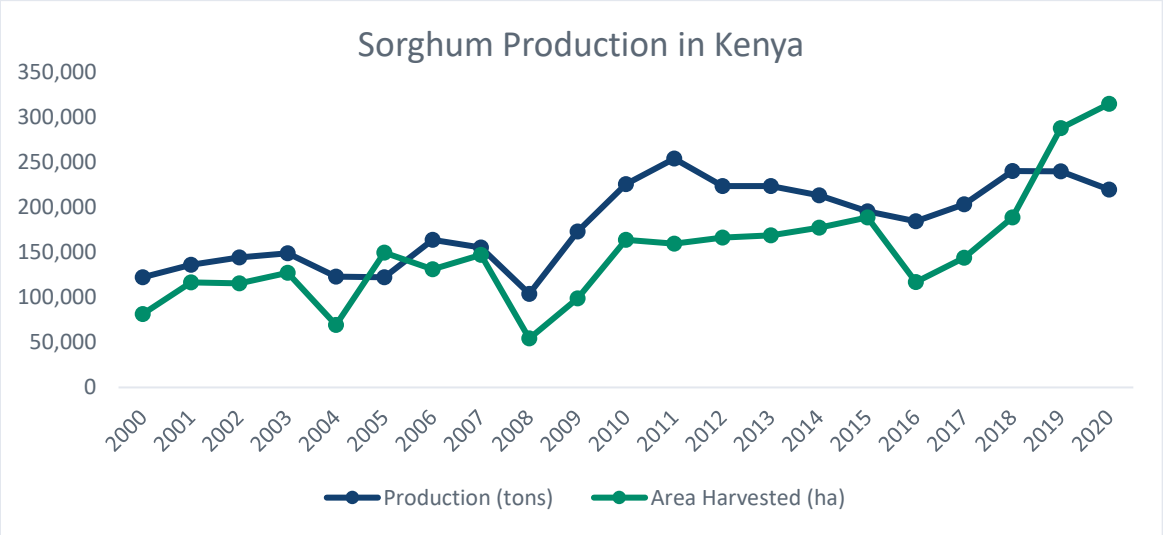


Figure 1.1: Sorghum Production in Kenya

[1] Tim Njagi et al., "Sorghum Production in Kenya: Farm-Level Characteristics, Constraints and Opportunities" (George Padmore Road, Nairobi Kenya: Tegemeo Institute of Agricultural Policy & Development, March 2019).
[2] Orr A., Mwema C., and Mulinge W., "The Value Chain for Sorghum Beer in Kenya" (International Crops Research Institute for the Semi-Arid Tropics, April 16, 2013).
[3] Food and Agriculture Organization of the United Nations, "FAOSTAT," www.fao.org, accessed May 5, 2022, https://www.fao.org/faostat/en/#data/QCL

Close to 90% of the Kenya's Sorghum production is accounted for by smallholder farmers who cultivate it mainly for subsistence[1]. Its demand has also been on the rise in the cities as the middle class become more health-conscious substituting maize flour for sorghum in the making of the popular meal "ugali". In the recent past, there has been a significant increase in the demand for sorghum by industrial consumers driven mainly by the emergence of sorghum beer. Beer processors such as East Africa Breweries Limited (EABL) have increased local sourcing of the crop through contract farming arrangements to secure demand. Despite this, EABL still faces a shortage of approximately 24,000 MT of sorghum annually. Prior to the growth of the sorghum beer market, industrial use for sorghum was mainly as animal feed, for bio-industrial products and blending of food products.

Despite expected significant increases in the production of sorghum, Kenya still imports up to one-third of its total consumption and lags most of its neighboring countries in production. In 2019 the country imported 141,609 tons of sorghum with most of it coming from Sudan (82,000 tons) and the USA (42,911 tons)[4]. Tanzania is the major supplier of sorghum to Kenya in East Africa, in 2021 Kenya imported sorghum worth USD 2.06 million from Tanzania[5]. Tanzania produced 750,000 MT of the grain in the same year, this was more than double Kenya's output. Ethiopia's output of 5,058,043 MT, on the other hand topped Kenya's by more than ten time and was the highest in the East African region[3].

1.2 Sorghum Production in Makueni and Kitui Counties

In Makueni county, approximately 84.4% of the producers utilize uncertified seeds from their own stored sources[6]. Additionally, 30.9% of the farmers grow the crop without any fertilizer. Such agronomical practices stifle sorghum yields making it difficult for farmers to achieve maximum production. Insufficient rainfall is stated as the biggest hurdle in the production of sorghum in the region[6]. Damage by birds is also cited as a major constraint faced by most farmers in the targeted counties. Gadam sorghum is the most preferred variety by farmers due to its offtake demand by the brewing industry; it is however the most susceptible to bird infestations causing the farmers huge losses. In 2021 Egerton University developed a variety that was less prone to damage by birds and considered highly nutritious (known as Egerton University Sorghum 1)[7]. It brought relief to the farmers hoping to minimize losses.

Sorghum is also among the very few crops that do well in Kitui county. It is particularly known to be a very dry area hence preference for sorghum seed varieties that have higher yields and shorter maturation times. These varieties are highly promoted in the region, by both the private and the public sector actors. In 2014, the county government of Kitui came up with Kitui County Sorghum Act, 2014, whose aim was to

[4] "Kenya Cereals; Grain Sorghum Imports by Country | 2019 | Data," wits.worldbank.org, accessed June 28, 2022, https://wits.worldbank.org/trade/comtrade/en/country/KEN/year/2019/tradeflow/Imports/partner/ALL/product/100700

[5] "Kenya Imports from Tanzania of Grain Sorghum - 2022 Data 2023 Forecast 1997-2021 Historical," tradingeconomics.com, n.d., https://tradingeconomics.com/kenya/imports/tanzania/grain-sorghum

[6] Dorcas Kagwira et al., "Sorghum Production Practices in an Integrated Crop-Livestock Production System in Makueni County, Eastern Kenya," Tropical and Subtropical Agroecosystems 22 (2019): 13–23.

[7] Gerald Andae, "Makueni Farmers back to Contract Sorghum Farming on New Seed Variety," Business Daily, August 23, 2021, https://www.businessdailyafrica.com/bd/news/counties/makueni-farmers-back-to-contract-sorghum-new-seed-variety-3521284.

promote the growth of the sorghum industry in the region[8]. Some of the objectives include promoting its competitiveness, attracting private investments to the industry, and advancing the efficiency of the institutions enhancing sorghum uptake in the region. Such initiatives have enhanced Kitui's sorghum production levels compared to its counterpart Makueni county. Production of sorghum however, decreased in 2016 to 2017 in the two counties due to drought in the country that begun in October to December 2016 which led to the declaration of a national emergency by the government. The chart below illustrates the significant difference in sorghum production between the two counties.

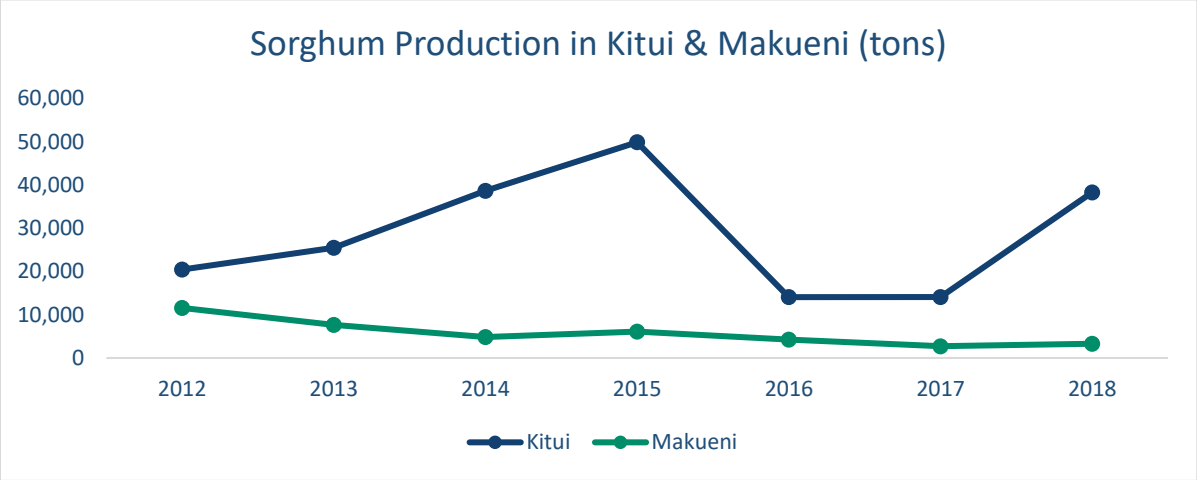


Figure 1.2: Sorghum Production in Kitui and Makueni Counties

The sorghum industry in Kenya has huge potential for growth but is held back by several factors. For example, most farmers recycle their seeds as opposed to buying high-quality certified seeds. They also cannot afford the labor costs necessary to enhance production of the grain. One of the biggest contributors to these challenges is the smallholders' lack of access to credit[1]. They are perceived as risky borrowers by financial institutions since most of them lack the necessary collateral to secure their loans. Additionally, the seasonality of their incomes as well as the challenges posed by unpredictable rainfall patterns add to their risk perception. The purpose of this study is this to develop a climate-smart lending business case that will motivate financial institutions to lend to these farmers. The scalable business case shall be implemented through a pilot lending scheme involving a Partner Financial Institution (PFI) covering the semi-arid counties of Kitui and Makueni in Lower Eastern Kenya. The success and scalability of the pilot is key to enhancing climate resilience of farmers in ASAL regions, an important goal for the Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) project. The AICCRA project seeks to make climate information services (CIS) and climate-smart agriculture (CSA) more accessible to millions of smallholder farmers across Africa.

[8] "The Kitui County Sorghum Act, 2014," September 5, 2014, https://www.fao.org/faolex/results/details/en/c/LEX-FAOC149454.

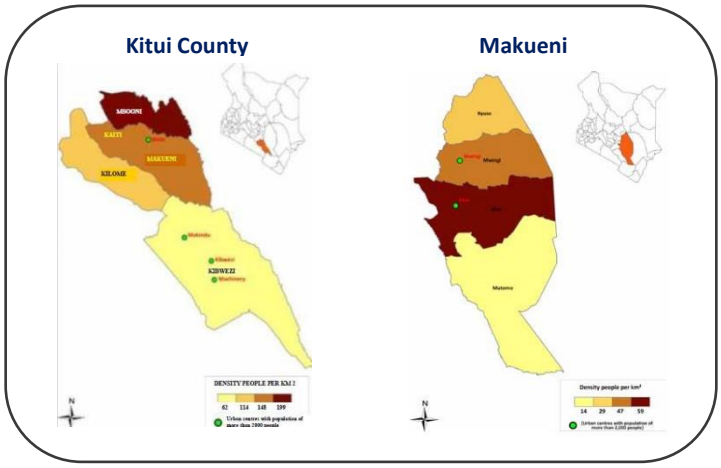
2 Methodology

This report presents the findings of a desktop research, a four day field visit to Makueni and Kitui, offsite discussions with key project stakeholders and the presentation of the business case to financial institutions. The study selected key value chain actors based in the two counties for interviews. The actors interviewed in Makueni in the first two days of the field visit included input providers (agrovets and wholesale agro-dealers), farmers, aggregators, county agriculture representatives, and a financial institution (Inuka Africa Microfinance). In Kitui, the research covered input providers (agrovets), farmers, aggregators, and a financial institution (Equity Bank – Mwingi branch). A mix of semi-structured interviews and focus group discussions was employed to collect data from selected sorghum farmers and aggregators. Semi-structured interviews were employed to collect data from an off taker, wholesale agro-dealers, agrovets, a farmers' association organization and financial institutions. The data collected facilitated the development of a business case which was presented to three financial institutions i.e., Trans Nation Sacco, Inuka Africa Microfinance and Family Bank.

2.1 Study area

As indicated above, the study covered actors operating in Lower Eastern counties of Kitui and Makueni. In Kitui county, the study looked at sorghum production and off taking activities in the following sub-counties: Kitui Central, Kitui Rural, Kitui South, Kitui East, Kitui West, Mwingi Central, Mwingi North, Mwingi West. In Makueni County the sub-counties covered included: Mbooni, Kilome, Kaiti, Makueni, Kibwezi West and Kibwezi East.

Figure 2.1: Map of the Study Area



Source: Open County portal, Kenya (https://opencounty.org/county-about.php?com=8&cid=17 and https://opencounty.org/county-about.php?com=8&cid=15).

3 Key Value Chain Actors and Their Roles

The sorghum value chain encompasses a wide array of interconnected actors who play different roles but face the knock-on effects of challenges encountered at different levels of the value chain. These participants are either part of the primary value chain or they offer supportive services to facilitate the flow of sorghum and its by-products from one actor to the next. Agrovets and agro dealers are the main initiators in this value chain as they supply farmers with inputs required in the production process. The main flow of the harvested sorghum by the smallholders passes through the aggregators first, then to off takers who avail it to the market. There are alternative routes whereby the produce goes through the brokers or local market before reaching other markets such as brewers, millers, and animal feed manufacturers. Below is an illustration of the studied value chain:

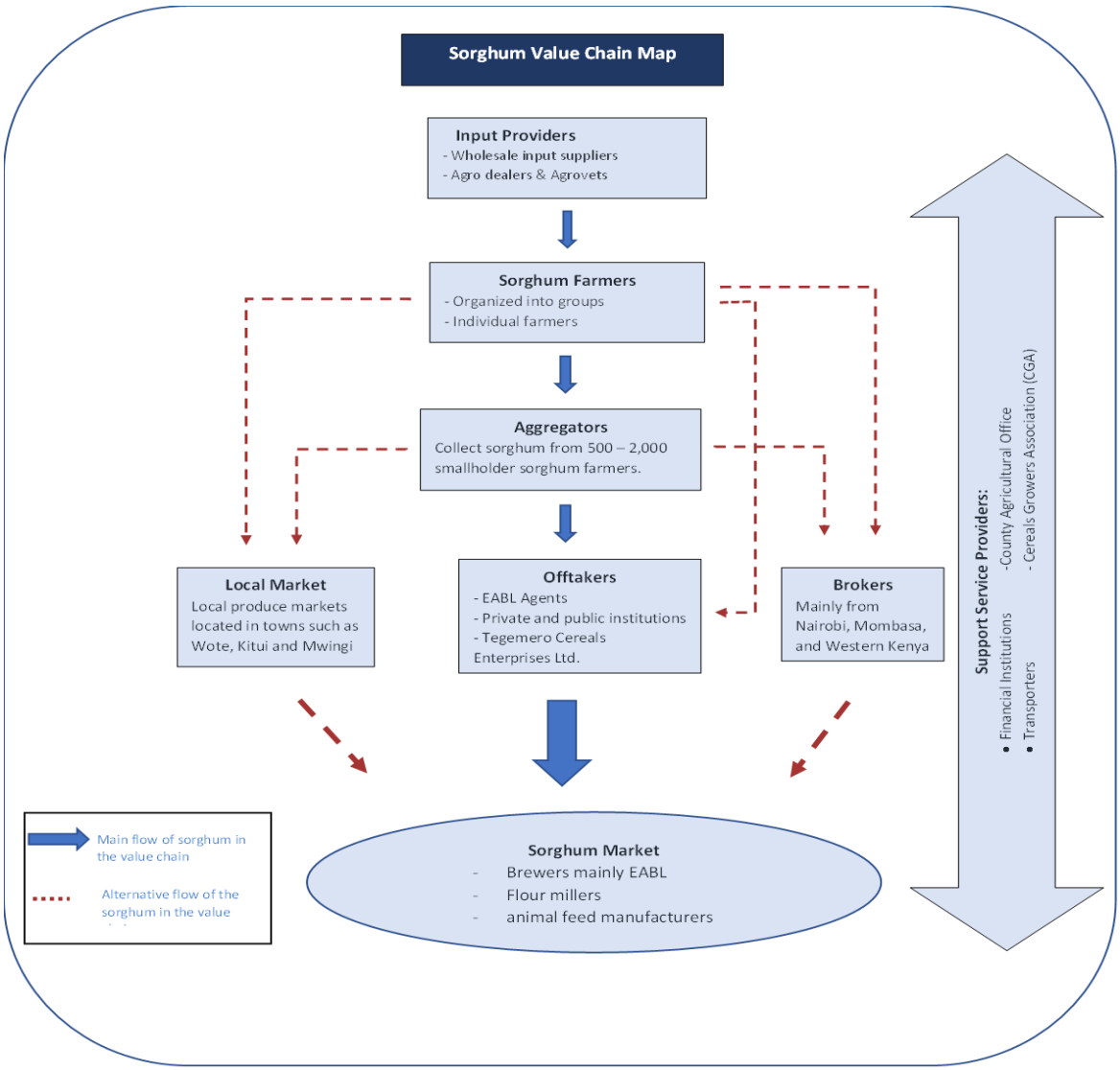


Figure 3.1: Sorghum Value Chain Map in Kitui and Makueni Counties

The table below summarizes the challenges experienced by each actor in the value chain and the recommended solutions:

Table 3 - A: Challenges Experienced by Key Value Chain Actors and the Prospective Solution

Actor	Main Challenges	Prospective solutions
Input providers	1. Low demand of sorghum inputs by smallholder farmers especially certified seeds and chemical fertilizers.	1. Sensitize farmers on the importance of using quality inputs to enhance production. This will in turn drive up demand of these inputs.
Sorghum farmers	1. Access to market and fair price. 2. Poor agronomical practices and bird infestations. 3. Lack of access to finance for purchasing quality inputs.	1. Partnership with consistent off takers operating in the region such as Tegemeo Cereals Enterprises. 2. Enhancing capacity building on GAP and CSA farming practices amongst farmers. 3. Enabling access to finance under the pilot financing scheme.
Aggregators and off takers	1. High transportation costs involved in shipping the aggregate grains to their main markets such as EABL. 2. Access to working capital.	1. Dedicated revolving loan facility for the aggregators and especially off takers to access during their off taking season.
Financial institutions	1. Farmer credit risk and the impact of climate risk on their repayment capability.	1. Detailed climate based credit scoring and cash flow analysis of the smallholder farmers before loan approval. 2. Incorporation of climate risk insurance in the loan product.

3.1 Input Providers

They can be divided into two categories i.e., wholesale input suppliers and retail agro dealers and agrovets. The wholesale input suppliers not only supply farm inputs to their retailing counterparts, but also deal with individual farmers occasionally. The main inputs supplied to sorghum farmers include certified seeds, fertilizers, and pesticides. The retail agro dealers and agrovets alluded to selling Gadam seed variety the most compared to the others. The wholesale agro dealers purchase certified seeds from KALRO, Kenya Seed Company Limited and other seed producers in bulk before disaggregating them to farmers through stockists. The agro dealers interviewed offer purchases on credit to some of their customers. This is determined by their loyalty, the value of goods they purchase as well as their credit history.

During the interviews, most of the input providers stated that the demand for sorghum inputs has been on a downward trend. In the recent past, one of the agrovets based in Makueni county used to easily sell more than 5 bags of sorghum seeds per season, a bag weighs 24kgs. Currently, orders from sorghum farmers are not enough to finish 4 bags. One wholesale input supplier asserted that they do not stock sorghum seeds due to lack of demand from the retailers. This is the case as most farmers are fast

abandoning sorghum farming due to lack of market and other challenges encountered in its production as illustrated in the section bellow covering sorghum farmers. To combat the low demand by farmers, they emphasized the importance of sensitizing farmers on the benefits of sorghum farming especially in the semi-arid locations as it is a highly drought tolerant crops compared to favorites like maize.

3.2 Sorghum Farmers

In the two targeted semi-arid counties of Kitui and Makueni, farmers prefer to plant the grain during the "short rains" season from October to December. They mostly plant Gadam, KARI Mtama 1, Advanta ADV 23012, Sila and Seredo sorghum varieties. These farmers are usually organized into farmer groups and Community Based Organizations (CBOs) with some such as the Kaka CBO in Waita ward, Kitui county accommodating as many as 1,700 farmers. As per the interviews held onsite, approximately more than 80% of sorghum production in the two counties is done by women with the youth (below 35 years) taking up an estimated 5%. During periods of drought most smallholders don't produce enough to sell and opt to keep the little they produce for their own consumption. The surplus produce that is not consumed by the household is either sold at the local market or to brokers from different parts of the country.

Figure 3.2: Grain store constructed by the Kaka CBO based in Waita Ward, Kitui County

Sorghum production in the targeted region is not without its challenges – one of the major challenges is the lack of structured markets to offtake the farmers' produce. According to one of the farmers based in Kitui, the last time they sold the grain through an offtake arrangement was in 2019 when Smart Logistics Ltd. was actively aggregating sorghum in the region for EABL. Without a ready market the smallholders are forced to sell the commodity at throw away prices (KES 18-20/kg) unlike during the offtake arrangements which could fetch them as much as KES 40/kg. This has driven many farmers to cut down on sorghum production shifting to fruit farming of mangos and oranges where farmers are organized into cooperatives and marketing of their produce is not a challenge. Losses resulting from bird infestations was also cited as a major challenge. This is mainly the case for specific varieties of white sorghum such as

Gadam which has a sweet taste compared to the other varieties. If unable to take the necessary preventative measures, a farmer can lose as much as 70% of their produce in a season.

Most of the sorghum farmers also cited the high cost of inputs such as certified seeds, labor, and fertilizer as a major barrier to optimum sorghum production. In the targeted counties, most of the farmers interviewed confirmed using seeds recycled from previous harvest or sourced from neighboring farmers. Many of them are also unable to afford paying for laborers to assist in planting, weeding and especially harvesting and threshing which are labor intensive. They are also unable to afford fertilizers especially chemical fertilizers which are currently retailing at approximately KES 6,000 – 7,500 per 50kg bag. The farmers also cited climate change, especially erratic rainfall patterns as another hinderance to their activities. Some of the farmers engaged are not well versed with GAP and CSA practices.

Ensuring that there is a ready market for the farmers' produce is key in ensuring the pilot financing scheme is successful. This can be done by structuring formal offtake arrangements with large-scale off takers. Currently, the main structured market for the produce is the sorghum brewing industry led by EABL. However, the targeted counties especially Makueni county, are still not producing enough quantities to warrant logistically cost-effective off taking operations by the brewer. They thus contract large-scale off takers with operations in the sorghum producing regions to offtake the produce on their behalf. Integrating these off takers into the envisioned pilot financing scheme is imperative to its success and full roll out in the region.

Introduction of measures to curb against loss of produce resulting from bird infestation is also key to the success of the pilot financing scheme. This is especially the case because the targeted market, EABL, prefers white sorghum varieties which are the most prone to bird infestations. One of the key measures would be to sensitize the sorghum smallholders on the importance of planting sorghum alongside trap crops such as biofortified millet. In a study conducted by Mutisya et al. (2015) in Eastern Kenya, they found that where sorghum and millet matured at the same time, birds fed mostly on millet than on sorghum giving enough time for the latter to harden and be ready for harvest. In one of the study locations i.e., Ithookwe in Kitui county, farmers were able to salvage as much as 90% of the grain when they utilized millet as a trap crop. Other measures could include use of seed varieties adapted to combat bird infestations such as Advanta ADV 23012 which has spikes that prevent birds from perching on the panicle to eat the grains. Though an expensive affair, farmers can contract laborers to scare away the swarms of birds. As part of the scheme, the farmers could also be sensitized on the importance of synchronizing their planting periods to spread the losses from bird infestations across multiple farms.

Finally, facilitating access to finance to enable the sorghum farmers purchase certified seeds, fertilizers and afford farm laborers is crucial. Most farmers, however, are hesitant to taking up loans due to the risk that production might fail because of climatic factors beyond their control such as droughts. In such a scenario, they will end up losing valuables they placed as collateral for the loans. For this reason, the financing scheme needs to incorporate affordable climate risk insurance for smallholder farmers to indemnify them against the loss of produce due to an assortment of climate related calamities. Moreover, the smallholders will need to be trained on climate smart agricultural practices, to ensure they are better equipped to deal with the negative effects of climate change on their production capacity.

3.3 Aggregators

They are an integral part of the value chain as they collect sorghum from the smallholder farmers and supply it to large-scale off takers, and public and private institutions within their catchment area. Well established aggregators have the capacity and capability to mobilize and aggregate sorghum from as many as 2,000 smallholder farmers. To minimize costs, some aggregators have set up grain collection points where farmers drop off their produce instead of going to the farms for them. In a bid to promote farmer loyalty, most aggregators provide farmers with certified seeds at a subsidized price. Well trained aggregators usually provide farmers with pre-and post-harvest training services to enhance productivity and loyalty.

As intimated in the paragraph above, one of the major challenges experienced by aggregators is the significant transportation costs involved in collecting sorghum from farmers who are widely dispersed. Lack of working capital to ensure timely offtake of the grain is also a significant challenge. This arises from the fact that their purchases are in cash while a significant portion of their sales are on credit. This mismatch creates a liquidity gap thus exacerbating the need for short-term working capital funding. Delays in off taking by their clients may at times lead to additional storage expenses for the aggregators. Finally, low sorghum production quantities by farmers in recent seasons due to reasons mentioned earlier has led to a downturn business.

To mitigate against the challenge of working capital, the aggregators selected for the financing scheme can be facilitated to access short-term working capital from the partner financial institutions. The pilot financing scheme can also utilize aggregators as farmer trainers and organize a training of trainers workshop for them. This will equip the aggregators with the skills and knowledge necessary to train farmers on GAP and CSA practices to maximize production quality and quantity. To minimize storage and transportation expenses, the financing scheme can facilitate capital contributions by each aggregator geared towards renting out centralized storage facilities for sorghum aggregated from the different county wards before being sold to off takers. Cost sharing will make it more affordable and ensure proper utilization of resources as opposed to the current practice whereby each aggregator caters for their own storage costs while awaiting off taking of the grain.

3.4 Off takers – with a focus on Tegemeo Cereals Enterprises

In the formalized offtake arrangements, EABL is the primary market for the aggregated sorghum especially the white sorghum varieties. The brewer receives the bulked white sorghum grains from the two counties through contracted off takers such as Smart Logistics and Tegemeo Cereals Enterprises (Tegemeo). Smart Logistics was one of the biggest off takers in both regions before they ceased active operations in Makueni in 2019 and Kitui in 2018. They contracted aggregators to collect the grains from their wards before delivering them to their store in a central location. They at times also bought directly from the farmers and would offer very good prices which the aggregators couldn't compete with. Smart Logistics initially bought the grain at KES 17/kg when they joined the market and increased it to KES 35/kg by the fourth season and just before they exited. This made sorghum farming a very profitable venture for most farmers thus encouraging its cultivation in the region.

Tegemeo on the other hand have recently ventured into the two regions commencing their operations there in 2021. Their main offtake market is Tharaka Nithi county, the largest sorghum producing county in Kenya. Tegemeo's preferred variety is KARI Mtama 1, however, they also offtake other varieties of white sorghum. They sell to their contracted farmers KARI Mtama 1 seeds and proceed to train them on regenerative agriculture and post-harvest handling of the produce through their extension officers. They are currently testing the production market through contracted aggregators who collect sorghum from specific wards in the targeted region. Their sorghum off taking season is February – March.

One of the major challenges experienced by Tegemeo while off taking the commodity in the two counties is the lack of sufficient production quantities by farmers. This has been caused by mainly by little to no rainfall during the planting season in the last two seasons which reduces production. Poor agronomical practices by farmers and bird infestations as mentioned earlier also contribute to the insufficient quantities. The transportation costs involved in shipping the aggregated grains to EABL, their main client is quite significant and adds to the challenges faced by the off taker. Finally, lack of sufficient working capital is a major impediment to the efficient running of Tegemeo's off taking activities. This is caused by the difference in the timing of cash receipts from EABL and cash payments made to farmers while off taking the grain. They have the capacity to offtake 3,000 MT of sorghum from the two counties but would require working capital funding worth KES 105 million as most of their cash is spent off taking the commodity from Tharaka Nithi county. Receiving loans from financial institutions is also difficult for the off taker due to the stringent collateral requirements by most banks.

To mitigate the challenge of working capital, it would be prudent for the financing scheme to also include a dedicated revolving loan facility for the off taker to access funding during their off taking season. This will fill the cash short fall and enable them to offtake the quantities of sorghum targeted during the pilot. In addition, the financing scheme can work to enhance the level mechanization in the value chain through reapers that ensure minimum tillage in line with Tegemeo's regenerative agriculture practice.

3.5 Financial Institutions

The financial ecosystem in Kitui and Makueni is served mainly by commercial banks, microfinance institutions (MFIs) and Savings and Credit Cooperative Societies (SACCOs). Commercial banks that mainly operate in the region include tier 1 banks such as Equity Bank, Kenya Commercial Bank, Co-operative Bank of Kenya, and tier 2 banks such as National Bank of Kenya and Family Bank. Microfinance institutions within the two counties are of two types i.e., deposit taking MFBs such as Kenya Women Microfinance Bank PLC (KWFT), Rafiki Microfinance Bank, Faulu Microfinance Bank and non-deposit taking MFIs such as Inuka Africa Microfinance. Examples of agricultural SACCOs operating in the region include Kilimo SACCO, Capital SACCO, Boresha SACCO etc.

Each type of financial institution has its merits and demerits, for example, SACCOs rarely require collateral, but borrowers, who must be SACCO members, are limited to borrowing only three times their savings and the loan must be guaranteed by other SACCO members. Banks on the other hand have fewer limits on loan amounts but often require collateral or a guaranteed source of income for most loans. On the other hand, microfinance institutions enhance credit access especially for rural based micro borrowers, but this comes at a price i.e., high interest rates charged compared to the other institutions. Below is a table

illustrating the services offered by the different institutions and the estimated interest rate ranges for their loan products:

Table 3 - B: Services and Loan Products Offered by Financial Institutions and their Estimated Interest Rate Ranges

Type of Financial Institution	Relevant Services Offered	Estimated Interest Rates (%)
Commercial Banks	Savings mobilization, deposit facilities, loans and advances, bank guarantees, transaction processing, insurance services	12- 13
Non-Deposit Taking MFIs and Deposit Taking MFBs	Loans and advances, and in some cases savings mobilization, deposit facilities, transaction processing, insurance services.	18 – 30
SACCOs	Savings mobilization, deposit facilities, loans, and advances, SACCO share capital ownership	8 – 15

Most of these institutions would like to engage with smallholder farmers, but the risks and challenges involved in the sector often limit them. One of the key challenges brought up during the interviews was the adverse effect of climate related calamities on a famer's ability to repay their loans. The nature of a smallholder's activities means that they are prone to climatic risk factors beyond their control such as erratic rainfall patterns which could negatively impact production hence their capacity to repay their loans. For this reason, financial institutions end up charging higher interest rates or having stringent collateral and loan guarantee requirements that most farmers cannot meet. In other cases, the financial institutions limit their exposure only to more established large-scale farmers or experienced smallholder borrowers with verifiable credit histories. This is usually the case when the financial institutions do not have the credit assessment tools needed to analyze and quantify the risks involved in lending to first time smallholder borrowers. Other challenges included the risk of fund diversion by smallholders. This is mostly the case for non-deposit taking MFIs as the borrowers do not operate banking accounts with the institution.

To reduce the risk involved in lending to smallholder farmers, certain arrangements may need to be structured into the pilot financing scheme and the loan product. In a discussion held with Inuka Africa Microfinance, organizing the sorghum farmers into groups to co-guarantee each other's loans could be a key mitigative measure. This has successfully worked for the MFI in the dairy value chain. Both financial institutions interviewed advocated for the inclusion of a climate risk insurance element into the proposed loan product to protect both the farmer and the financial institutions from losses caused by unforeseen climatic catastrophes.

Another key mitigative measure especially when dealing with less experienced and first-time borrowers is the use of climate enhanced credit scoring technology to assess and quantify the risk posed by each individual farmer under the scheme. This could act as a qualifying measure when determining the farmers to incorporate into the pilot. Finally, the pilot financing scheme could be structured in a way that minimizes the smallholders' interaction with the loan funds by channeling it directly to the input suppliers where the smallholders can collect their farm inputs once their loan application is approved. For loan

repayments, the proceeds from the sale of sorghum can be deposited directly to the smallholder's bank account by the offftaker. This will allow the bank to recover their funds before the smallholder gets their share of the proceeds. Such strategies could help minimize the risk of diversion of funds by the smallholders.

3.6 Other Supporting Actors and Their Roles

These are tertiary actors who play a supporting role by ensuring the main actors can conduct their activities effectively. They include the Cereal Growers Association (CGA), the County Agricultural Department, and transporters of the commodity.

3.6.1 Cereal Growers Association

It is a national non-profit member-based farmer organization that brings together cereal farmers to help them improve their farming practices and to solve some of their challenges. Their role includes farmer representation to the National government by participating in agricultural policy formulation and raising farmer concerns to the government. They also provide research, training, and advisory services to the sorghum farmers. They do this through workshops, trade fairs and field days where they train them on efficient methods to maximize their outputs. In addition to this, they also provide soil testing services. Furthermore, they provide linkage services to the sorghum farmers by connecting them to financial institutions for credit facilities, they also link them to the market by aggregating them to increase their bargaining power.

3.6.2 County Agricultural Department

They are responsible for disseminating the National government's agricultural agenda at the county level. They promote cultivation of the hardy crop in the counties to enhance food security. They provide agricultural extension services on best practices to improve sorghum quantity and quality. They are also responsible for the collecting and maintenance of data on the sorghum sector at the county level. Records of the farmers and their production levels can be found in their databases. In addition, they are responsible for the development, implementation, and coordination of public programs and projects targeting the agricultural sector.

3.6.3 Transporters

They work across the value chain with farmers, aggregators, EABL agents, and grain brokers. They facilitate the shipment of inputs to the farmers and the delivery of their produce to the market. Their main mode of transportation from the farms to aggregation points or the market are motorcycles and carts which can access harsh terrains that other means of transport cannot and are cheaper. The large-scale transporters concentrate on the other end of the commodity shipment chain which involves transporting it from the aggregation centers to the main off takers and other markets in different regions.

3.7 Gender and Youth Inclusion in the Value Chain

As earlier indicated, women constitute close to 80% of sorghum farmers within the two regions while the youth account for only 5%. Women play almost all roles at the production level such as land preparation, planting, weeding, harvesting and post-harvest grain processing. Most of these activities are performed manually which leads to exertion while also taking much of their time away from other more value adding activities at both the household and farm level. Women are usually organized into formal savings groups which are used as sorghum aggregating platforms by aggregators. Access to mechanized agricultural services such as the use of rippers and tractor mounted planters for land preparation, planting and fertilizer application could greatly benefit them. This and other mechanized services in post-harvest grain preparation will reduce the time, labor, and exertion of manual sorghum production thus enabling them to focus on farm and household management while also improving their quality of life.

Lack of farming land by most of the youth is the major contributor to their low participation in sorghum farming. Also, a lack of interest in farming compared to other fast earning jobs is another significant factor. To enhance their participation, the best bet would be to boost their involvement in the offering of value chain support services earlier mentioned. Equipment utilized in offering these services usually require significant capital contributions thus facilitating access to finance would be key. The financing pilot can be tailored to include an equipment financing scheme to the youth especially those organized in savings groups. This will enable them to acquire motorbikes or auto rickshaws popularly known as ‘tuk-tuks’ to facilitate transportation of the grain. They could also be financed to acquire grain threshing and winnowing equipment to facilitate the post-harvest grain preparation process or acquire grain milling equipment for value addition purposes.

4 Sorghum Smallholder Farmers Business Case

4.1 Sorghum Smallholders Funding Needs

Funding is essential to sorghum farmers as it enables them to purchase quality farm inputs necessary to boost their production capacity. According to research done by Omanga and Rossiter (2014), more than 90% of farmers in ASALs use informal seeds in their cultivation[9]. These are seeds that have been recycled after harvest, seeds purchased from local markets or obtained from other farmers. A grain study undertaken in Makueni revealed that very few farmers use certified seeds in sorghum production as most smallholders find it expensive[6]. The practice of recycling seeds interferes with the quality and quantity of the produce. Pests and diseases from previous harvests are carried forward hence low viability of attaining maximum produce. Proper storage of the seeds after harvesting also plays a huge part in the success of the next harvest should the seeds be recycled. Therefore, if the farmers are not well trained on proper storage techniques there ends up being a negative ripple effect on their future outputs. Certified sorghum seeds are therefore one of the farmers' biggest funding needs.

Figure 4.1: Sorghum Farmer Pauses with Her Value-added Products

Many of the farmers still use outdated technology in sorghum production. There is very little to no mechanization especially when preparing the harvested grains through manual threshing and winnowing which is labor intensive. They lack funds to invest in modern technology hence continue using such outdated methods that negatively affects their productivity and timely operations[10]. Fertilizers too, are quite expensive for most smallholder grain farmers. A study conducted in Makueni showed that most sorghum farmers do not use chemical fertilizers in the production process hence attaining low yields during harvest[6].

Farmers in general are regarded as risky borrowers hence the difficulty in accessing formal credit facilities. These funds would also be useful in enabling them to invest in expanding the farm size as demand for sorghum increases. As indicated earlier, brewers and flour millers still face a huge shortage of the grain due to insufficient quantities produced by farmers despite engaging them in contract farming. Some sorghum smallholders may also need funding for

[9] Paul Omanga and Paul Rossiter, "Towards Effective and Sustainable Seed Relief Activities," www.fao.org, 2004, https://www.fao.org/3/y5703e/y5703e07.htm#bm07.1.

[10] County Government of Kitui, "Kitui County Sorghum Policy 2013," 2013, https://repository.kippra.or.ke/handle/123456789/1904.

value addition purposes as they seek to boost their income levels.

4.2 Farmer Profitability Analysis

The farmers' estimated profits are calculated per acre of land holding. On average, sorghum farmers in the targeted regions who do not implement the recommended GAP and CSA practices attain yields of approximately 323 kgs per acre as illustrated in the figure below[11]. Through the CSA and CIS interventions to be piloted in the proposed financing scheme, these farmers stand to earn more as the yield per acre is estimated to increase to 1,000 kgs (10 bags each weighing 100 kgs). Each kg fetches approximately KES 40 according to the current offtake prices bring the total earnings to KES 40,000 per acre compared to KES 12,920 initially. To attain the stated higher yields, smallholders will need to fund the proposed CSA inputs which amount to KES 26,188. For the loan to fund these inputs, they will need to pay interest expenses worth KES 2,357 estimated at 18% annually. This nonetheless increases their profitability to KES 11,455 from a paltry KES 740 without the proposed interventions. The improvement in earnings ascertains the potential of sorghum to enhance the smallholders' income levels provided all the risks and challenges involved in cultivating the crop are dealt with. The figure below presents a representation of the sorghum farmers' revenues, costs, and net earnings before and after the proposed CSA and CIS interventions.

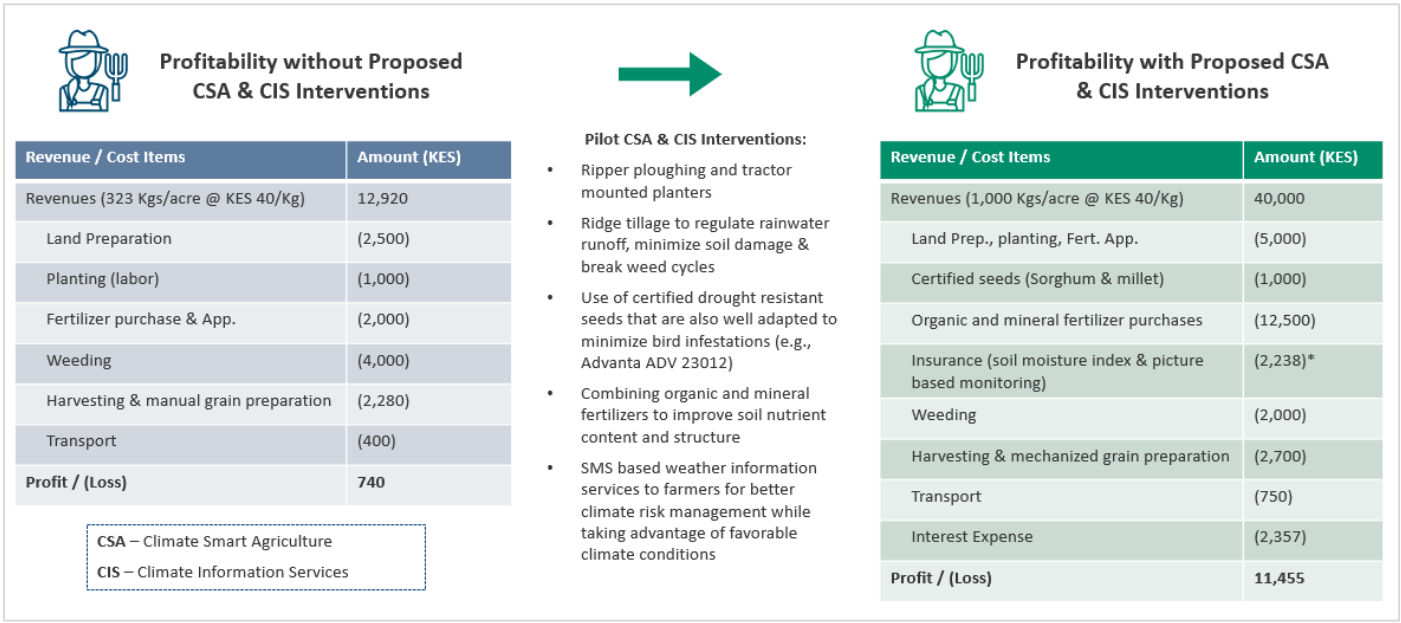


Figure 4.2: Sorghum Smallholder Farmer Net Earnings with and without Proposed Interventions

[11] Africa Harvest Biotechnology Foundation International, "Unblocking Challenges Related to Access to Quality Sorghum Seeds," Africaharvest.org, accessed September 20, 2022, https://africaharvest.org/unblocking-challenges-related-to-access-to-quality-sorghum-seeds/.

From the earnings table with proposed CSA and CIS interventions on the right in the figure above, organic, and mineral fertilizer purchases are the highest cost drivers taking up 44% of the estimated total costs. Based on the insights gathered during discussions with key stakeholders and agricultural specialists from the county offices in Makueni, one acre of land requires 50 kgs of planting fertilizer preferably DAP (18-46-0) and 25 kgs of top-dressing fertilizer preferably CAN 27 to achieve the recommended 16 kgs of Nitrogen per acre. Land preparation, planting, and fertilizer application, which involves the use of both mechanized inputs and manual labor, is the next most significant cost item taking up 18% of the total cost of sorghum production.

4.2.1 Sorghum Smallholder Monthly Cash Flows

The table below presents an illustration of the timing of sorghum farmers' monthly cash inflows in green and cash out flows in orange. It also includes the cash flows from loan disbursements and repayments at the beginning and end of the farming season respectively. Being a seasonal crop, sorghum can be planted in both the long rain season takes place from March to June and the short rain season from October to December as illustrated below.

Table 4 - A: Sorghum Smallholder Monthly Cash Flows

Short Rains/Long Rains →	Sept/Feb (KES)	Oct/March (KES)	Nov/April (KES)	Dec/May (KES)	Jan/June (KES)	Feb/July (KES)
Loan Disbursement	26,188					
Input Related Cash Flows						
Climate risk insurance	(2,238)					
Seeds (sorghum and millet)		(1,000)				
Organic and mineral fertilizers		(12,500)				
Land prep, planting & fertilizer application		(5,000)				
Weeding				(1,000)	(1,000)	
Harvesting						(2,700)
Transportation						(750)
Sorghum Sales						40,000
Loan Repayment						
Principal						(26,188)
Interest (18% annually)						(2,357)

5 Smallholder Pilot Funding Scheme

5.1 Proposed Loan Product - Working capital loan

As sorghum is a seasonal crop, the study recommends an input finance facility for sorghum smallholders that will cover the cost of climate smart inputs necessary to generate higher yields. These include certified seeds, both organic and inorganic fertilizer, hiring of machines for land preparation, planting and harvest preparation, labor for weeding, and harvesting. The study also recommends the addition of climate risk insurance to the proposed working capital finance facility. ACRE Africa, a key player in the agriculture insurance sector in the continent recommended the utilization of soil moisture index insurance combined with picture based monitoring of the farms. The risk-based premiums to be paid by the sorghum smallholder shall be part of the inputs to be financed through the loans disbursed to farmers. As stipulated earlier in the report, this will indemnify smallholder farmers against the loss of produce due to unforeseen climate related calamities. Below are the recommended general terms of the loan product to be negotiated with the selected Partner Financial Institution:

Table 5 - A: Pilot Financing Scheme General Term Sheet

Item	Details
1. Borrower	1,000 qualified and trained sorghum smallholder farmers based in Kitui and Makueni counties. The selection of the wards for the pilot with the PFI will be agreed upon in the planned internal project workshop.
2. Facility	Input finance loan to cover the purchase of farm inputs and labor costs.
3. Loan Amount	The PFI can finance the whole input cost or a minimum of 80% of it with the farmers covering the rest i.e.: i. Full input cost – KES 26,188 ii. Minimum 80% of the input cost – KES 20,950
4. Interest rate	1% – 1.5% per month reducing balance (12% – 18% per annum)
5. Loan Tenor	1 loan tenor will run for 5 – 6 months beginning before the planting season in September/February to the harvest period in February/July.
6. Loan Repayment Structure	To be negotiated with the selected PFI. The two most likely options however include: i. Bullet payment of both interest and principal after harvest and sale of the produce. ii. A principal only moratorium until harvest and sale of produce with interest being paid monthly.
7. Other Loan Charges	Loan application fees – approximately 2% of approved loan amount. Climate risk insurance premium – to be negotiated with the selected insurance provider. The premium rate ranges could be between 6 – 8% of the sum insured depending on the number and probability of occurrence of the insured perils.

5.2 Potential Smallholder Financing Scheme Structure – Channeled Lending

Based on the findings of the desktop reviews, the onsite and offsite discussions with several key value chain actors, the study proposes a channeled lending approach. The financing will be done through an off taker who will disburse the necessary farm inputs to approved farmers. The main aim of this option is to mitigate against the risk of diversion of the disbursed loan funds by the smallholders. This is especially important in the context of this financing scheme since the purpose of the loan is specifically to finance the purchase of quality inputs. The funds are thus channeled through the selected off taker where approved farmers will have to present their input vouchers to redeem their farm inputs. The off taker will purchase the inputs in bulk transferring the cost savings to the farmers. Produce payments will be channeled through the partner financial institution to mitigate against the risk of diversion of funds to be used in repaying the loans. Below is an illustration of the loan disbursement and repayment scheme:

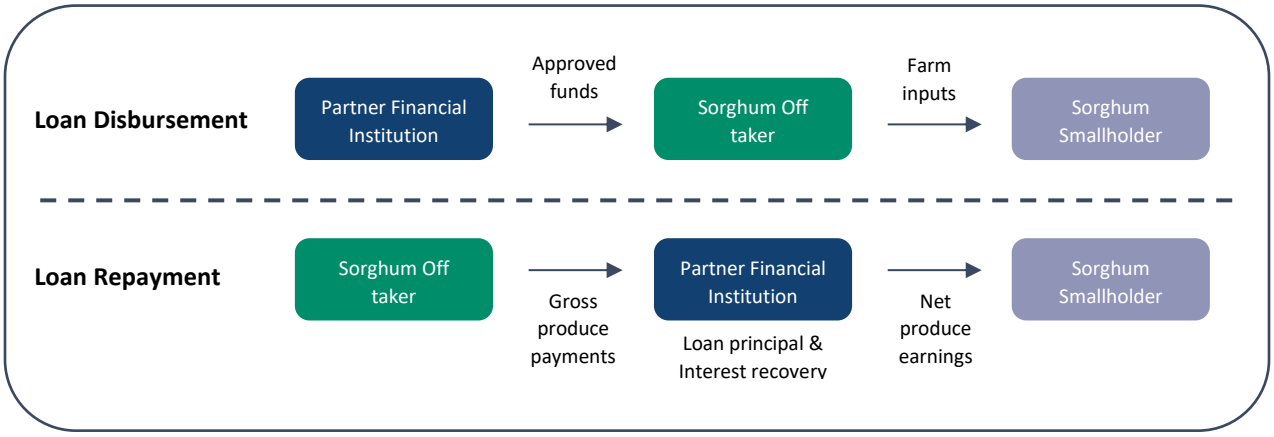


Figure 5.1: Channeled Loan Disbursements and Loan Repayment Schemes

The financing structure above could mean that farmers only access funding for the inputs provided or paid for by the selected off taker i.e., land preparation and planting tractors, certified seeds, fertilizer, and harvest preparation machines. For labor, a key input especially during the preparation or ridges and weeding, the farmers will require cash disbursements to source this input for themselves. A major risk that could arise from the scheme proposed above is the risk that the off taker could divert the farmers' input funds to other more pressing needs within their business such as working capital. The mitigation strategy is discussed in the project risks and mitigation section below.

5.3 Analysis of Potential Partner Financial Institutions

This section analyzes the suitability of the three financial intermediaries interested in becoming the partner financial institution of choice for the pilot lending scheme. The team conducted business case presentation meetings with these institutions to disseminate specific details regarding the envisioned pilot financing scheme as well as collect data on their suitability to the scheme. The three institutions include a commercial lender (Family Bank), a microfinance institution (Inuka Africa MFI) and a SACCO

(Trans Nation SACCO). The main criteria utilized to assess the suitability of the three institutions were accessibility by farmers, speed of project and loan approval, prior experience in similar projects or value chains, product flexibility, interest rate charges, finding requirements, collateral requirements, and stability through Portfolio at Risk (PAR). The table below illustrates the institutions' suitability per criteria.

Table 5 - B: Analysis of Potential Partner Financial Institutions

	Commercial Bank Family Bank	Microfinance Institution Inuka Africa MFI	SACCO Trans Nation SACCO
Accessibility	Operates branches in both Makueni and Kitui. Offers mobile banking. Has a strong agent network in Kitui and Makueni	Operates a branch in Mwingi, Kitui county. No physical presence in Makueni. Has no agent network only loan officers available	Operates a branch in Mwingi, Kitui county. No physical presence in Makueni. Utilizes field agents to reach out to farmers
Speed	Project approval can take approximately 1 month depending on how fast partners submit data. Targeted loans can be approved within 1 day	Project approval can take 2 weeks depending on how fast project related data is availed. Targeted loans can be approved within 1 day	Dependent on whether the project and loan product fits within the existing loan policies and procedures. If not, they will have to develop the loan product and seek approval from SASRA.
Experience	Has experience undertaking similar value chain financing scheme pilots	No prior experience in a similar project but have experience lending to the livestock, dairy and horticulture sector.	No prior experience in a similar project
Repayment Flexibility	Flexible on the loan repayments. They can be through a balloon, bullet or monthly payments of both interest and principal depending on the seasonality of the crop.	Prefer to have the farmers make monthly interest payments at the very minimum instead of bullet or balloon payments which are not part of their current loan repayment offering.	Not flexible on loan repayments. They must be within the SACCO's current policies and procedures otherwise they require approval by SASRA.
Interest Rate	13% p.a.	As this is a new value chain, the rate will be guided by data collected during the pilot preparation.	13% p.a.
Funding Requirements	Can only fund up to 80% of the total input cost. Prefer to channel the funds to input suppliers than funding the farmers directly.	Farmers must contribute between 10% to 25% of the loan and have other sources of income. Prefer to channel the funds to input suppliers than funding the farmers directly.	The targeted farmers must be members of the SACCO. Provide financing from 3 to 5 times members' savings.
Collateral Requirements	Require borrowers to provide chattels or household and farm items as collateral.	Prefer borrowers to provide cash collateral covering a small percent of the loan amount but can also work with chattels or household and farm items as collateral	Borrowers at the very minimum are required to have their loans guaranteed by other members.

Family Bank is the only FI with physical operations in both Kitui and Makueni counties. Inuka Africa MFI has the quickest project approval turnaround time at two weeks while Trans Nation SACCO requires approval from their regulatory body SASRA for any new project beyond their current policies and procedures which could take long. Of the three, Family Bank is the only FI with experience in similar financing schemes with development partners. They are also the most flexible when it comes to tailoring the loan repayments to match the seasonality of sorghum. This stems from their vast experience lending to the agriculture sector since inception in 1985. Both Family Bank and Inuka Africa MFI require farmers to make part contributions to the total loan amount. Trans Nation SACCO on the other hand can provide funds for the full loan amount requested, however, it must be between three to five times their savings. All the three FIs require some form of collateral or guarantee to secure their loans. Inuka Africa's preference for cash collateral to secure the loan could be prohibitive for many smallholders.

From the above analysis, the least suited FI for the pilot lending scheme is Trans Nation SACCO. Being a SACCO, they require borrowers to be members of the institution. Also, any new loan product or project will require approval by their regulatory authority SASRA which adds complexity to the scheme. Family Bank is the most suited FI for the scheme especially due to their experience in similar projects, loan repayment flexibility and less stringent collateral requirements. Being a commercial bank, they have a vast network of branches and banking agents spread out across the two counties that can be easily accessed by farmers. They however have stricter requirements when it comes to project approval as they must conduct due diligence on potential project partners especially those who will play a major role in the scheme such as off takers. This is a plus for the financing scheme as it will help to mitigate the risk of non-performance by the pilot implementing partners selected.

5.4 Funding Scheme Risks and Mitigants

For the pilot financing scheme to be successful, it is critical to ensure that the smallholder farmers are well equipped to attain maximum results as well as have ready market for their produce. This will ensure that they generate enough income to repay their loans and sustain their livelihoods. Below are the main risks identified by the study and the proposed measures to mitigate them. The risks have been categorized into three main phases i.e., sorghum production phase, input financing and loan repayment phase and finally sorghum marketing phase.

5.4.1 Sorghum Production Phase

Table 5 - C: Sorghum Production Risks and Mitigants

Risk	Likelihood and potential cost	Description	Mitigation
Climate and weather risk (drought, flooding, etc.)	Likelihood: high Cost: high	Negative impact of adverse weather conditions and climate change i.e., drought, flooding, heat waves etc. Measure: regular soil moisture index measurement of pilot farms.	**Loan pre-appraisal stage:** the farmers can be trained on the relevant CSA practices to make them more climate resilient. **Loan product development stage:** the loan product shall incorporate a climate risk insurance to cover the farmer and financial institution against unforeseen losses.
Bird infestations	Likelihood: high Cost: high	White sorghum seeds are highly susceptible to damage by birds Measure: picture-based monitoring of pilot farms and reports from farmers	**Planting stage:** use more resilient sorghum variety such as Advanta ADV 23012 that is less prone to damage by birds **Loan product development stage:** the loan product shall include inputs for trap crop (millet) cultivation.
Poor produce quality and quantity	Likelihood: medium Cost: high	Production quality and quantity by the smallholders may not be sufficient to meet the market's needs. Measure: extent of farmer application of CSA activities and crop health monitoring reports	**Loan appraisal stage:** mandatory farmer capacity development on GAP and CSA practices before loan approval. **Crop monitoring stage:** regular updates to farmers on expected weather pattern changes through SMS based climate information services.

5.4.2 Input Financing and Loan Repayment Phase

Table 5 - D: Financial Risks and Mitigants

Risk	Likelihood and potential cost	Description	Mitigation
Farmer Credit risk	Likelihood: high Cost: high	Farmers' inability to repay the loans leading to losses. Measure: framer credit scoring by LendXS. Farmer savings groups historical operations.	**Pilot development stage:** targeting farmers who are already organized into savings groups and CBOs. **Loan appraisal stage:** incorporating individual farmer credit scores as part of the loan appraisal process.
Interest rate fluctuations	Likelihood: medium Cost: medium	Fluctuation in loan interest rates. Measure: monthly interest rate statistics.	**Loan product development stage:** the pilot loan product could include interest rate caps and floors to protect both the financial institution and farmer

Farmer fund diversion risk	Likelihood: high Cost: high	The risk that the loan funds or repayments will be diverted to meet other household obligations.	**Loan disbursement stage:** channeling the loans through the off taker with the farmers receiving only farm inputs. **Loan repayment stage:** produce payments to be made to the financial institution first for loan settlement before the farmer receives the remainder of the funds.
Off taker fund diversion risk	Likelihood: medium Cost: high	The risk that the loan input funds will be diverted to meet other business needs. Measure: tallying of the farmer input receipts against the loan approvals.	**Loan disbursement stage:** funds shall be released to the off taker for purchase of inputs only when the farmers' loan applications have been approved.

5.4.3 Sorghum Marketing Phase

Table 5 - E: Sorghum Marketing Risks and Mitigants

Risk	Likelihood and potential cost	Description	Mitigation
Lack of Market	Likelihood: medium Cost: high	Lack of market to absorb all the farmers' produce. Measure: monthly commodity demand and supply statistics.	**Pilot development stage:** targeting farmers who are already organized into savings groups and CBOs. **Loan appraisal stage:** incorporating individual farmer credit scores as part of the loan appraisal process.
Price risk	Likelihood: high Cost: high	Fluctuations in the price of the grain. Measure: Monthly commodity price statistics.	**Pilot development stage:** Setting a viable price range which may include a price floor during the offtake contract negotiations with the selected off taker.

5.4.4 Other Risks

Table 5 - F: Project Partnership Risks and Mitigants

Risk	Likelihood and potential cost	Description	Mitigation
Partnership risk	Likelihood: medium-high Cost: medium-high (depending on the stakeholder)	Risk that a partnership with any of the key stakeholders identified (financial institutions, insurance provider, off taker etc.) may not operate as agreed. Measure: project milestone achievement	**Pilot development stage:** Perform due diligence on the capacities and capabilities of the selected partners to execute their roles. Clarify responsibilities of each stakeholder in a project matrix and setup a pilot committee made up of members from project stakeholders for coordination.

6 Recommendations and Next Steps

6.1 Recommendations

Based on the findings of the report, the study recommends the implementation of a channeled lending pilot financing scheme through an off taker targeting 1,000 smallholder farmers in both Kitui and Makueni. The pilot can be implemented in the long rain season from March to June 2023 or the short rain season from October to December 2023. If the pilot scheme is implemented in the long rain season, the smallholder farmers will need to be concentrated in one region i.e., 1,000 smallholders from two neighboring wards in one county. Since most farmers plant the crop in the short rain season, utilizing this strategy will help to spread the losses from bird infestations across multiple nearby farms which wouldn't be the case if they were isolated from each other.

Based on discussions with ACRE Africa, a leading player in agriculture insurance, the study recommends the incorporation of climate risk insurance through soil moisture index and picture based monitoring. By regularly monitoring the moisture content of soil and the condition of the farms, the insurer will be able to predict potential production losses and work with farmers to minimize them. In line with the insurer's policies and procedures, farmers or the partner financial institution will stand to be compensated in case of climate related production losses. The study also recommends the provision of a loan portfolio guarantee cover for the group of smallholders selected in the pilot scheme. This will cover the partner financial institution in case of pervasive non-climate related losses in production by the farmers. Table 6-A below lists the three external partners selected for the implementation of the pilot financing scheme and their role.

Table 6 - A: Pilot Financing Scheme Implementation Partners Selected

Role	Selected Partner
Partner Financial Institution	Family Bank
Off taker	Tegemeo Cereals Enterprises
Climate Risk Insurer	ACRE Africa

6.2 Next steps

Below are the envisioned next steps to prepare for the next phase of the project which is geared towards bringing the pilot financing scheme to fruition. Key among them will be the discussion and agreement on the financing scheme parameters in the pilot kick-off workshop which will bring all the participating parties together to develop a roadmap for the successful implementation of the pilot financing scheme.

Table 6 - B: Next Steps and Proposed Timelines

Activity	Proposed Timelines	Purpose
Internal workshop to review and discuss the final report before reaching out to the selected project partners for planning of phase 2.	By 14th October	To validate the findings of the final report and align internally on the proposed parameters for the successful implementation of the financing scheme
Phase 2 Kick-off meeting with selected pilot implementation partners and key stakeholders	By 28th October	To discuss and develop the pilot scheme's implementation roadmap. Roles and timelines will also be agreed upon in this workshop.

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Annex I: Sorghum Farmer Profitability Calculations

Items	Units per Acre	Unit Price (KES)	Total (KES)
Revenue	1,000 Kgs	40	**40,000**
Cost Items			
Land Preparation, Planting & Fertilizer Application			**(5,000)**
- Ripper ploughing tractor with mounted planters	1 tractor	3,000	3,000
- Ridge tillage labor	4 laborers	500	2,000
Certified Seeds			**(1,000)**
Sorghum seeds	2 Kgs	400	800
Biofortified millet seeds	0.5 Kgs	400	200
Fertilizer Cost			**(12,500)**
- Organic fertilizer	1 ton	3,000	3,000
- Chemical Fertilizer	75 kg	126.67	9,500
Weeding			**(2,000)**
- Labor (December)	2 laborers	500	1,000
- Labor (January)	2 laborers	500	1,000
Harvesting			**(2,700)**
- Labor	2 laborers	400	800
- Packaging	10 bags	40	400
- Threshing and winnowing	1,000 Kgs	1.5	1,500
Climate Insurance[1]			**(2,238)**
Transport	1 trip	750	**(750)**
Loan Interest Expense[2]			**(2,357)**
Net Profit			**11,455**

[1] *Cost indicated is an estimate, the exact cost will depend on the location of the farms and historical yield data amongst other factors.*
[2] *Details of the interest calculations can be accessed in the accompanying financial model.*