ASSESMENT OF IMPACT OF SORGHUM FOR MULTIPLE USES (SMU) VALUE CHAIN PROJECT ON SMALL HOLDER FARMERS IN KENYA

FINAL DRAFT REPORT

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Abstract

Kenya is a food deficit country even in a bumper harvest year. The challenge of food, nutrition and income security is more highly felt among communities living in the rural areas. Though agriculture engaged about 75% of the population, 80% of Kenya's land area is classified as arid and semi-arid and is considered unfavorable for rain fed agricultural production. The intermittent drought has resulted in a significant portion of the population regularly starving and heavily dependent on food aid and Kenya perennially remain on the global hunger index. Climate change and low rainfall limit the options of crop technologies that can be used in these areas to address food security so the challenges of poverty, food insecurity and income inequality persisted. Despite persistent drought in this semi-arid part of the country, farmers have for years opted to grow maize, which is highly vulnerable to the conditions.

The challenge of food and income security has made government and development agencies to promote initiatives centered on climate smart agriculture. Sorghum has been identified as one of the climate smart crops with broad adaptation and resilience. Sorghum also has a high nutrition value. But sorghum is considered as a poor man's food with a very narrow market outlet. Due to low production, the market outlets for sorghum have stagnated or declined over the years (Vitale and Sanders 2005).

To improve the livelihoods of poor rural smallholder farming household in the arid and semi-arid lands in Kenya and Tanzania, the 'Sorghum for Multiple Uses (SMU) value chain' project started in 2011 with the development of sorghum cultivars which are adapted to biotic and abiotic stresses. These varieties/cultivars are expected to play a critical role in increasing food security and income of the rural small holder farmers living in ASALs. The value chain was promoted because it is recognized as an effective means to reduce the rural poverty prevalent in the region.

With the support of International Fund for Agricultural Development(IFAD), International Crops Research Institute for the Semi-Arid Tropics(ICRISAT) and Africa Harvest International Biotech Foundation(AH) Kenya, developed and implementation "Commercially Sustainable Sorghum for Multiple Uses Value Chain Project" between 2011 and 2015 in the drought prone, poverty stricken and food insecure areas of Kenya and Tanzania. The SMU project was implemented through five output components comprising baseline, sorghum value chain upgrading, sorghum cultivars development, partnerships and capacity building.

The objective of the SMU project was to support the development and adaptation of agricultural rural innovations in sorghum value chains that would reduce food insecurity and increase the income of the small holder farmer households. The benefits derivable include capacity building in sorghum production systems, value addition and products enterprises development, participation in selection of preferred varieties and hybrids for recommendations to seed

companies during variety releases, improved access to seeds of improved sorghum varieties and enhanced linkage to market.

Stakeholders contributed to the goal by supporting the development, dissemination and uptake of the new sorghum for multiple use varieties. The project targeted 30,000 farmer household in Kenya.

This research seeks to assess the impact of the project on the food security and income of the beneficiary small holder farmers' household in selected project sites in Kenya. The research will adopt a Theory based approach using mixed method evaluation design and Participatory Impact Evaluation. The study location covered 6 sub-districts in Eastern Kenya and 477 semi-structured questionnaires were administered to both the beneficiaries and non-beneficiaries group in the project using multistage stratified random sampling.

The research will analise the contribution of the project to the reduction in food insecurity and increase in income of the small holder beneficiary households. The findings would reveal both the strength and areas of weakness in the value chain and knowledge gained will form the basis for recommendations on how to maintain or further strengthen the value chain for sustainable Sorghum production in Kenya.

Key words: value chain, climate smart agriculture, food deficit, income, food security

Executive Summary

This impact assessment survey was carried out on the beneficiaries of the Sorghum for Multiple Uses (SMU) Value chain projects in Tharaka North and Kitui Central districts of Eastern Kenya. A total of 477 questionnaires were administered. Adopting a theory bases approach and mixed methods evaluation technique, results were analysed using output, outcome and impact indicators. About 60% of the respondents are female and about 63%of the respondents beneficiary fall between the age of 18 and 45 with 27% in the 45 to 60 age brackets.

The study showed that the main planting season is October to January with 92% of the beneficiaries planting during this period and 86% of the information supplied by respondents relating to year 2016 main planting season. It is important to note that serious drought was recorded in Kenya in 2016 which necessitates the government declaring a national emergency (World Weather Attrittion,2017).The survey showed that the average cultivated land for the beneficiary is 4.1 acres out of which 56% was for planting sorghum as against 44% and 33% for non-beneficiaries and baseline .The increase in land for sorghum is as a result of more land being used for planting and as a result of conversion of some land previously used for maize, beans and other crops. The yield per acre was 405kg/acre for beneficiary (despite the OND drought of 2016) and 158kg/acre for non-beneficiaries. Gross margin is 8,925Ksh/acre and 1,149Ksh/acre for beneficiary and non-beneficiaries farmers respectively. In comparison to the main crops grown by farmers in the study area, sorghum contributed an average 41% of income as against 10% before the SMU project. The beneficiary households have therefore being able to eat better, get more food varieties, pay school fees more easily, have more comfortable homes and generally feel more in control of their life. As a food source, Sorghum contributes 28% of the household food as against 12% before the project. In terms of availability, more than 76% of beneficiary farmers have food that can last for more than 7 months as against 44% of non-beneficiaries and 30% of baseline farmers. In addition 41% of the beneficiaries can feed for the whole year. Food availability in this respect refers to own production as well as ability to purchase food when in need ( ).This means that among the beneficiaries 41% of the household fed for a whole year as a result of their participation in the SMU project . It is also discovered that beneficiaries are less dependent on food aid from government and NGOs while harmful coping strategies like selling of productive assets and picking of firewood and wild foods had greatly reduced.

The Kenyan Economy has also benefit greatly from the SMU project. The project had also been able to support the diversification strategy of the main commercial brewery in the country thus saving cost and keeping employment. Providing the substitute for barley as well as reduction of imported sorghum has helped to save the country's meager foreign exchange.

The use of sorghum in feed and food industries is presently very low while the potential is very enormous. The main concern for the industries is mainly consistent availability and competitive pricing. At the present sorghum price is set "artificially" buy the East African Breweries, the

main up-taker. The present sorghum utilization in Kenya is estimated at 120,000 tonnes per annum while this researcher believed that the country has the potential of using at least 500,000 tonnes of annually.

To be able to its potential and replace maize, barley , rice and wheat partially and wholly in food and industrial levels, there is need for aggressive campaign to change the citizens attitude/perception of sorghum as a poor man's food. Then industries should be given the necessary support (including policy support) in relation to substitution, availability and pricing of sorghum.

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1.0 Introduction

Background

Kenya covered a land area of 582,646 km2. It is a country of climate and ecological extremes with altitude varying from sea level to over 5000m in the highlands. Kenya has 80% of its land as arid and semi-arid land and unfavorable for rain fed agriculture despite the fact that about 75% of the population depend on agriculture for sustenance. The Arid and Semi-Arid lands (ASALs) has annual rainfall of between 200 and 1000mm and is vulnerable to drought and climate change with annual rainfall patterns increasingly becoming less predictable (Apollo, 2006).In Kenya 53% of the rural people live below poverty line, 93% of which are located in ASALs .Climate change and low rainfall limit the options of crop technologies that can be used in these areas to address food security so the challenges of poverty, food insecurity and income inequality persisted. The people in this area tend to respond to drought-related crop and livestock loss by adopting harmful coping practices, such as selling their only income generating assets, withdrawing children from school, and undertake income-generating activities that damage the environment. (WFR, 2017). According to Reuter; Kenya has not gone below having one million people on food assistance in the last 12 years, with the number raised from 1.3 million in September 2016 to 2.6 million in January 2017.Though the Government of Kenya has come up with different initiatives, Kenya remain on the Global Hunger Index. Since Agricultural sector is increasingly showing high level of vulnerability and impact to climate, farmers need to be able to adapt or remain impoverished (Olayide et al.2017).

The challenge of food and income security has compelled government and development agencies to promote initiatives centered on climate smart agriculture(CSA) since sustainable agriculture and climate change are intrincly linked (Terdoo and Adekola,2014). CSA is one of the approaches that have been championed as the "holy grail" of agricultural development (Naess, 2011) and according to FAO (2011) CSA not only sustainably increase production and resilience but also remove greenhouse gases while enhancing national food security and developmental goals. In Kenya, sorghum has been identified as one of the climate smart crops with broad adaptation, resilience, and high nutrition value. Sorghum is a cereal that originated from Africa. It is the 5th world most traded cereal after maize, rice, wheat and barley. Farmers in Kenya have always grown red sorghum varieties, but in small quantities as few people cared to eat it because it is considered a poor man's food, and there was limited market for it. Due to low production, the market outlets for sorghum were stagnated or on a decline over the years (Vitale and Sanders 2005).The perception of sorghum as poor people's food has also frustrated the national effort to promote the crop as a viable and commercially marketable food (GOK, 2007).

In 2011, the "Sorghum for Multiple Uses (SMU)" project started with the development of sorghum cultivars which are adapted to biotic and abiotic stresses. These varieties/cultivars were expected to play a critical role in increasing food security and income of the rural small holder

farmers living in ASALs of Kenya and Tanzania. The value chain was promoted for its recognition as an effective means of reducing the rural poverty prevalent in the region.

It was expected that the value chain would link the vulnerable smallholder farmers to a market system through which they would sell their surplus food commodities, and through which they access basic staples and competitive, efficient and reliable production inputs.

SMU project aligned with the country's long-term development blueprint: the Kenya Vision 2030, and the Agricultural Sector Development Strategy 2010-2020.

1.1 Description of the SMU value chain project

From 2011 to 2015 the International Fund for Agricultural Development (IFAD) funded Sorghum for Multiple Uses (SMU) value chain project in Eastern Kenya and Tanzania with the main objective of improving food security and income of the small holder farmers in the targeted rural area.

ICRISAT developed the Sorghum for Multiple Uses (SMU) cultivars that are higher yielding and adapted to both biotic and abiotic stresses .These varieties are expected to play a critical role in increasing food security and income generation because of its resistance to drought conditions, promising commercial uses and low cost of production relative to other staple foods. Africa Harvest (AH) as the implementing partner, developed the Value chain model using the aggregator approach, disseminate the SMU varieties, engaged in capacity building of the beneficiaries, actively link farmers to market outlets for surplus and facilitate linkage with input suppliers.

The SMU project was executed through five output components comprising baseline, sorghum value chain upgrading, sorghum cultivars development, partnerships, and capacity building. The objective of the SMU project was to support the development and adaptation of agricultural rural innovations in sorghum value chain that would reduce food insecurity and increase the income of the small holder farmer household.

The project covered 4 counties in Eastern Kenya and spread over 8 districts. It targeted 30,000 households (150,000) direct beneficiaries in Kenya. At the conclusion of the project it is expected that the beneficiaries will experience a 20- 25% increase in sorghum production, at least 20-30% of the targeted households (60,000) will be selling sorghum collectively to reduce transaction costs and realize a 20% increase in incomes after their capacity is enhanced and they are linked to commercial-scale sorghum value chain (ICRISAT, 2013).

This research provides analysis of the contribution of the SMU value chain project on the food security and income of the small holder farmer household in Eastern Kenya as well as on the Kenyan economy. This feedback from beneficiaries of the SMU project is important because an effectively implemented project initiative may not have the desired impact on the intended

beneficiaries. This Impact assessment is therefore necessary for accountability and learning which is relevant to decision on up-scaling or development of similar future projects.

1.2 Aim and Objective of the Impact Assessment

The general objective of this survey is to analyze the contribution of the Sorghum for Multiple Uses (SMU) Value Chain Project to the improvement of food security and income at the household level on the beneficiary small scale farmers in Kenya.

The specific objectives are:

1. To determine the contribution of the Sorghum For Multiple Uses (SMU) Project to improvement in food security and income of the small holder farmers and the Kenya Economy
2. To determine the most effective strategy to promote industrial and domestic utilization of Sorghum in Kenya
3. To determine the total demand for Sorghum for food, feed and industrial uses in Kenya.

2.0 METHODOLOGY

2.1 Timeframe of the Survey

The survey was conducted within three months which is the period of the researcher's internship program.

Table 0.1: Time Line for the Survey

S/N	Date	Activity
1	13th-17th February,2017	▪ Arrival at Host Organisation ▪ Pre-field presentation ▪ Meeting with the SMU team ▪ Meeting with ICRISAT team
2	20th February-14th March	▪ Review of Literature ▪ Formulation of questionnaire ▪ Testing of questionnaire
3	15thMarch -12th April	▪ administration of questionnaire ▪ Focus group discussion ▪ Key informant interview with grain assembler, agro-dealer, agric. Officers
4	13th – 21th April	▪ Coding and Data entry
5	24th April -5th May	▪ Analysis and Report writing
6	9th May	▪ Presentation of preliminary Report
7	11th May	▪ Trip back to Nigeria

2.2 Selection criteria for the site

The Eastern province of Kenya is estimated to have a population of about 6 million people, 50% of who live below the poverty line. The SMU project was implemented within Eastern Kenya which was divided into 2 agro-economic zones: Upper Eastern and Lower Eastern. Upper Eastern has better climatic condition like better rainfall, lower temperature and lower rate of evapotranspiration. This survey was therefore done within Eastern Kenya. For purpose of variability, samples for the assessment were selected from both the Lower and the Upper Eastern areas.

2.3 Sampling method/Sample Location

A multi-stage /Stratified Random Sampling method was used. Eastern Kenya was divided into Upper Eastern and Lower Eastern. Using excel Random sampling one district (sub- county) was selected from each strata. From each district three locations were purposefully selected. The

sample size was calculated in proportion to the number of beneficiaries in the location using sample size calculator.

Due to constraint of time and funds, 10% of the calculated sample size of the beneficiaries was administered with questionnaire. For the non-beneficiaries farmers half (50%) of the beneficiary sample size was used. The research administered a total of 477 questionnaires made up of 318 of beneficiary farmers and 159 non-beneficiaries farmers.

Figure 2.3.1: Map of Africa

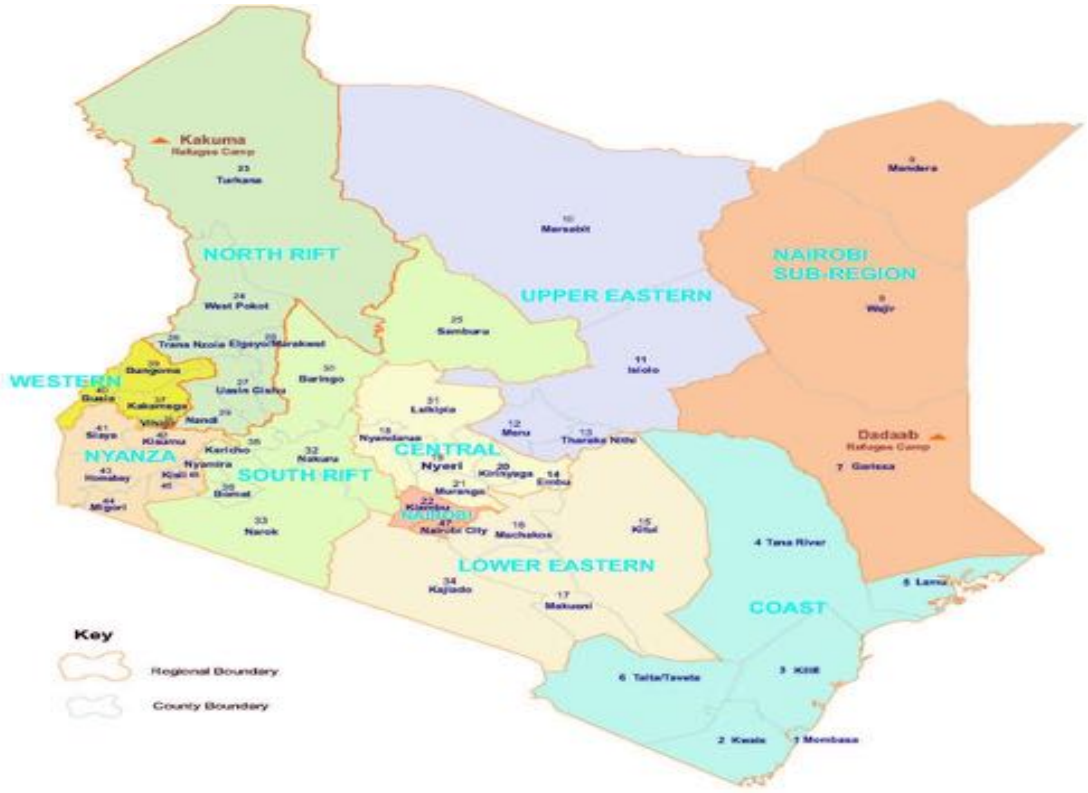

Figure 0.1: Map of Kenya

Table 2.2.2: Sample Locations and Sample Sizes

Province	Region	County	District (Sub county)	Locations	Sample Size(Beneficiary)	Sample Size(Non-Beneficaries)	Total
Eastern Province of Kenya	Upper Eastern	Tharaka Nithi	Tharaka North	Gikingo	128	64	192
				Thiiti	77	38	115
				Ntooroni	51	26	77
	Lower Eastern	Kitui	Kitui Central	Kavuta	26	14	40
				Mbusyani	23	10	33
				Utooni	13	7	20
Total Questionnaire					318	159	477

2.4 Sources of Data/Data collection methods

Both primary and secondary data were used. Secondary data were collected from journals, reports, newsletters, base-line survey, ICRISAT and AH annual reports, AH interview reports, published research works, internet and books.

Primary data was collected through key informant interviews, focus group discussions, individual farmers' interviews, questionnaires, observations and participatory impact assessment (PIA).

Adopting a mixed-method evaluation design, quantitative and qualitative data collection methods were used. Questionnaires were administered through enumerators after the objectives of the survey have been properly explained and they were properly trained on the questions. Testing of the questionnaires was done in the survey areas after which the responses were reviewed and necessary correction done to the questions and more explanation given to the enumerators where necessary. In the interests of comparability, some baseline questions relevant to the present were kept, although additional ones were added.

Meeting with farmers groups and other stakeholders in the study area were facilitated by personnel of Africa Harvest and ICRISAT. The focus group discussions and interviews with beneficiaries were conducted by the researcher through an experienced interpreter.

To strengthen and for better understanding of the data collected through questionnaires, data were also collected through Participatory impact evaluation and perceptions, opinions and feelings are expressed numerically using Participatory Ranking and Scoring methods.

2.5 Data Analysis

The survey measured outcome/output indicators and well as impact indicators. Outcome /Output indicators are activities relating to the implementation of the project while Impact indicators relates to changes that occur as a result of the project activities. Data were analysed using SPSS.

2.5 Analytical Framework

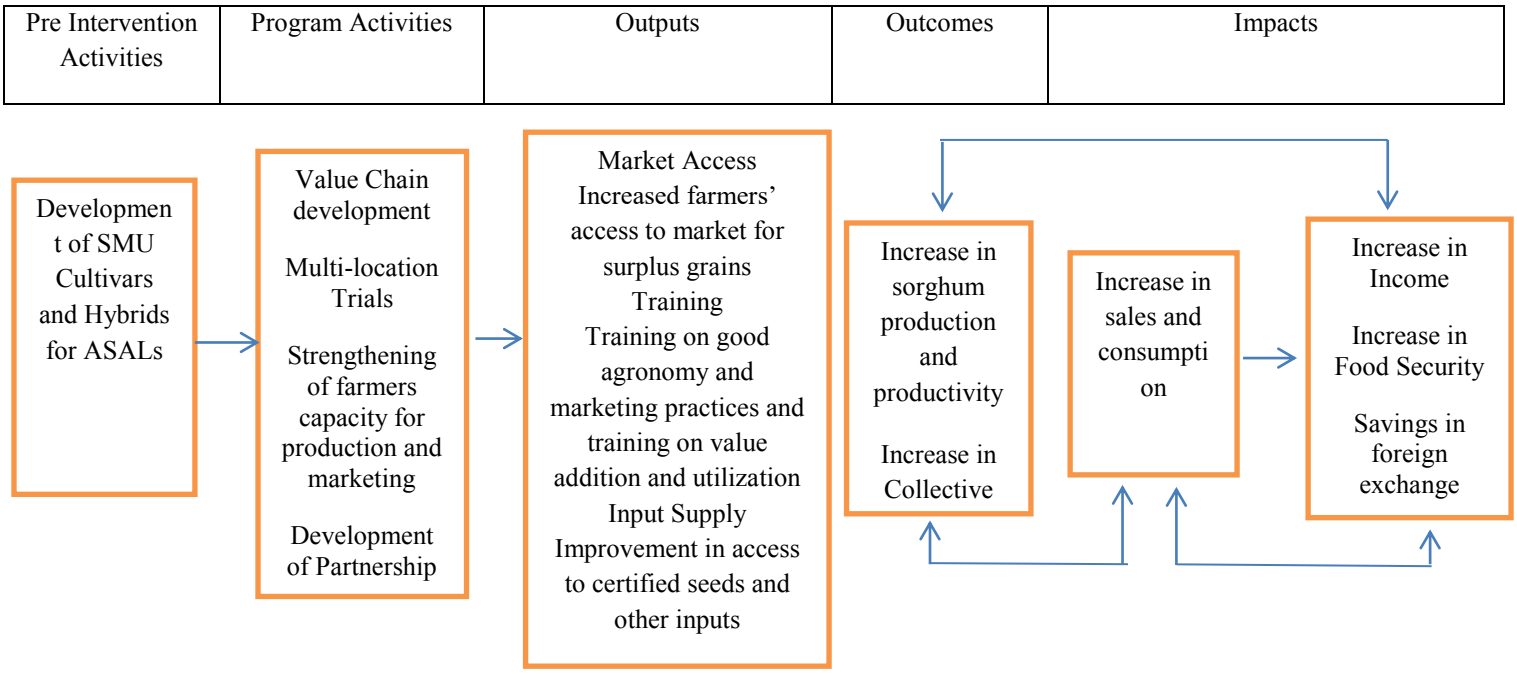

Figure 0.2: Causal Model for the SMU Project Assessment

2.7 Mitigation of methodological challenges

The researcher tried to mitigate some challenges associated with the assessment as follows:

i. Defining the boundary of time to make sure all survey participants (during qualitative data collection) are clear about the time period being assessed. This is to reduce recall bias.

ii. Duplication of questions to help reaffirm the correctness of responses

iii. Triangulation helps to confirm the correctness of the analysis

iv. Calculation of attrition to further assist in correctly attributing the portion of the observed impact that is as a result of the activities of the SMU project.

v. Making allowance for the split-over effect of the SMU on the non-beneficiaries

vi. Use of PIA to compensate for the absence of longitudinal survey data to assist in counterfactual

vii. Cost and time constraint were mitigated through stringent cost and time management

3.0 Results

3.1 Demography

About 40% of the respondents are male while 60% are female. This is in consonant with the project beneficiary female gender bias of ratio 40:60 and with the fact that women participation in agriculture is higher in Developing countries(Adesope etal, 2014) More than 90% of the beneficiaries are within the active age. Age is an important factor in decision to adoption innovation and continue to use it(Atibioke et al,2012).

Table 2.1.1: Age Distribution of Respondents

Age Range(in years)	Beneficiaries	Non-beneficiaries
18-35	30.5%	40.3%
36-45	32.8%	28.3%
46-60	27.4%	25.2%
More than 60	9.3%	6.3%

More than 65% of the respondents fall between the age of 18 and 45 which agrees with the young population of Kenya with less than 3% of the Kenya total population falling above 65years of age (Index Mundi, 2017 and KNBS, 2017).

About 74% of the respondents are married while about 10% are single. High number of married farmers means more family labor on the farm. 81% said they are involved in other initiative apart from SMU project. This means that the observed change/impact may not be attributable only to the SMU project which make the calculation of the project attribution very important. Respondents who are decision makers or take part in decision making were 77.5% and 61% for the beneficiaries and non-beneficiaries respectively. Kenya has two planting seasons March-June(long rain) and October-January(short rain). 92% and 97% of the beneficiaries and non-beneficiaries respectively said their main planting season is October-January reason being more stable rainfall resulting in higher yield.

81% of the data on yield used in this survey came from the 2016 October-January planting season when there was very low rainfall.

3.2 SMU project Contribution to Income

The average cultivated area for beneficiary farmer is 4.1 acre out of which 2.3(56%) acres are for sorghum. The non-beneficiaries farmers cultivated an average of 3.3acres out of which 1.4 (42%) are for sorghum. This is against the baseline sorghum land of 33%.

The increase in sorghum land was due to marginal increase in the total area of land cultivated by the farmers and the fact that lands were switched from planting other crops.

Table 3.2.1. Average Income and Yield of Respondents

	Beneficiary Farmers	Non-beneficiaries	Baseline Studies
Average Total Cultivated land/household	4.1 acres	3.3 acres	
Sorghum cultivated land/household	2.3 acres	1.4 acres	33%
Average sorghum Yield/acre	405kg	158kg	
Average sorghum price	33.3Ksh	31.8Ksh	28Ksh
Sorghum Gross Margin/acre	8,925Ksh	1,149Ksh	

The average yield per acre for sorghum for beneficiary is 405kg while non-beneficiary is 158kg per acre.

The average price of sorghum for beneficiary is Ksh 33.3 while for non-beneficiaries and baseline studies are 31.8Ksh and 28Ksh respectively.

The gross margin for beneficiary and non-beneficiaries is 8,925Ksh and 1,149Ksh per acre respectively.

There is wide variability of yield and the prices at which sorghum is sold by beneficiaries . EABL which is the main up-taker presently buys(at the time of the survey) at 33Ksh/kg, brokers buy as low as 23Ksh/kg depending on the desperation of the seller, while at the market after incurring transport and other cost a kilogram can sell as high as 70Ksh. It is important to know that this data being analysed related to 2016 October-January planting season when there was severe draught that necessitated increased food aid to millions of Kenyan. Though the drought reduced the yield but for those farmers that planted at first rain or before first rain, some yield was up to 7 bags /acre for sorghum where maize was complete failure.

Using Proportional Pilling Method during the PIA, the percentage of crop income contributed by Sorghum before and after beneficiary joined the project is stated in the table below.

Table 0.3: Income Proportion from the Major Crops

Crops	Before	After
Sorghum	10%	41%
Maize	32%	23%
Beans	35%	18%
Millet	5%	8%
Peas	18%	10%

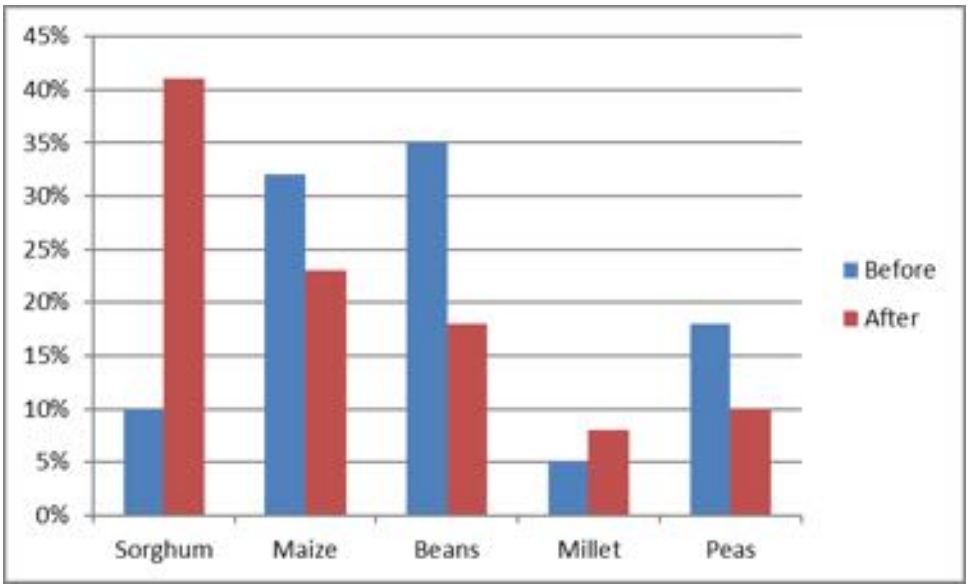

Figure 3.2.1: Income Proportion from the Major Crops

Income from sorghum increased in relative terms from 10% contribution to over 40% contribution as a result of the farmers' switching more cultivated lands to sorghum and therefore have more sorghum to sell for cash compared to other staple food crops.

The quantitative data indicated that income contribution of sorghum ranges between 40-50% while it is less than 30% in non-beneficiaries farmers.

When questionnaire respondents were asked to rate their income situations, 80% of beneficiaries rated 'better off' while 11% rated 'the same'. The non-beneficiaries have 53% and 41.5% respectively.

The questionnaire also asked whether farmers has been able to make some savings, 82% of beneficiaries said 'yes' while 57% of non-beneficiaries said 'yes'.

This result therefore indicated that beneficiary farmer household had made more money and had been able to safe some of the money.

3.3. SMU Project Contribution to Food security

3.3.1 Impact Calendar

Using PIA the beneficiary participants were given 25 counters representing house hold post-harvest food balance and asked to distribute the counters along the twelve month calendar.

Table3.3.1: Impact Calendar

	Before	After
January	44	76
February	100	100
March	100	100
April	72	88
May	64	88
June	76	92
July	84	80
August	64	92
September	52	90
October	20	88
November	0	44
December	0	32

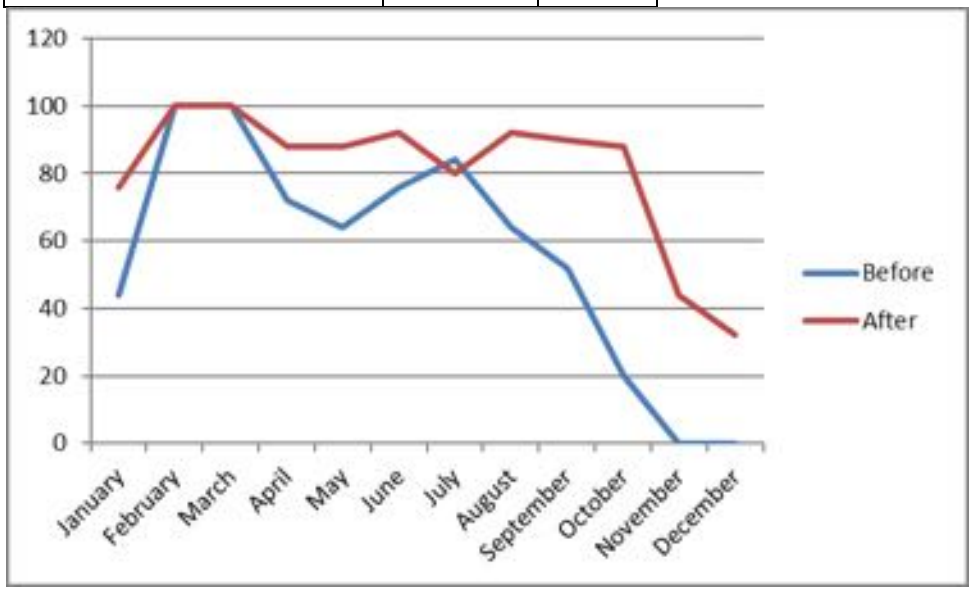

Figure 3.3.4: Impact Calendar Chart

The result showed that 44% of the non-beneficiaries farmers have food that can last for at least 7 months while more than 76% of the SMU beneficiaries have food that can last for more than 7 months. The baseline result showed that only 30% of the respondents have food that can last 7months and above. When the farmers were asked in the questionnaire whether they have being able to produce and/or purchase enough food that can last the whole year 41% of beneficiary said 'yes'.

When the respondents were asked how many meals they eat per day on the average, 69% of the beneficiaries eat 3 times while 31% eat twice a day .This is against the non-beneficiaries respondents of 62% and 37% respectively. This result indicated that beneficiary farmer

households can feed themselves for longer periods in the year thus reducing periods of hunger and food insecurity.

3.3.2. Contribution of major food crops

The research also showed that the contribution of sorghum as a source of household food has increased. The change in relative proportion of sorghum consumption against the other main cereals grown in the study area is depicted in table below:

Table3.3.4: Food Source from Major Crops

	Before	After	Absolute change
Sorghum	12%	28%	125%
Maize	31%	20%	25%
Beans	22%	14%	10%
Millet	11%	10%	15%
Peas	21%	19%	15%

Beneficiaries now moving from dependency on maize to sorghum .Beneficiary farmers are now less vulnerable to unpredictable local weather pattern and frequent drought by changing their eating habit to sorghum which is more resilient to weather variability thus improve their food security.

The SMU beneficiaries are also less (27%) dependent on Aid from governments and NGOs than the non-beneficiaries group (33%).At the same time practicing of harmful coping strategies like selling of household assets and picking firewood for sale to buy food is less frequent with the beneficiaries. The project has therefore able to reduce the food insecurity of the participants, reduce their dependency on food aid and also reduced the practice of harmful coping strategies.

3.4 Assessment of the SMU project Activities

The beneficiaries were asked in the questionnaire to rate some SMU project activities according to whether it is Highly Helpful, Helpful or Not Helpful:

Table 5.4.1: Rating of SMU project Activities

	Activities	Highly helpful	Helpful	Not helpful	Point
	Input availability	56.6%	42.1%	1.3%%	767
Market Linkage	Aggregator System	16.8%	49.4%	33.9%	578
	Collective action	22.5%	52.5%	23.7%	617
	Group Marketing system	26.9%	48.1%	23.7%	634
	Training activities	46.5%	46.8%	4.4%	751

Input availability and training came tops with 767 and 751 points respectively, while all the market linkage activities were far behind.

Breaking the training activities further during the Participatory Impact Assessment and asking farmers about their perceptions of the relative effectiveness of the various SMU project activities/outputs by ranking according to which of the activities has the most impact, the following scores were recorded:

Table3.6.2:

SMU Activity	Total Score
Agronomy Training	124
Improved Seed Availability	110
Marketing Training	92
Utilization Training	86
Marketing Linkage	80
Others Input Supply	52

The Agronomy Training was most impactful followed by Availability of Improved seed and Marketing training. The project participants believed the agronomy training has helped not only in increasing the yield of sorghum but also other crops. The least impactful is access to other

input such as fertilizer and chemicals. This is because these other inputs are only available in towns where transportation cost, distance and road access are big issues.

3.5 BENEFICIARIES PERCEIVED CHANGES IN LIFESTYLE

During the participatory assessment, the participants identified the following as indicators of the benefits of the SMU Project which represent changes they were expecting in their life as a result of their participation in the program. Availability of more food, availability of more varieties of food, ability to pay School fees more easily, better house, better clothing and self-confidence as priority. The first four also represent the most frequent items of household expenditures as confirmed in the questionnaires. They were then asked which of the expectation has been met and by how much .The responses from the participants are summarized in the table below:

Table 3.7.1

	Rank score	Met	By How Much
More Food	3rd	92%	56.8
Varieties of Food	1st	88%	58.2
Payment of School Fees	2nd	88%	59.2
Prestige/confidence	6th	60%	34.8
Better House	5th	76%	42.6
Clothing	4th	68%	37.5
		AV	48.18%

92%,88% and 88% of the respondents believed their expectations as concern Food ,food varieties and Payment of school fees has been met partially (56,58% and 59%) respectively.

Finding the average of the total showed that the SMU project has been able to meet the farmer beneficiary expectation by 48.18%

3.6. Impact on Kenya Economy

Sorghum has helped the East Africa Breweries Limited (EABL) to stay in business by supporting its diversification strategy aimed at hedging against high price of barley. This has helped the Kenya economy in terms of employment and taxes since EABL has 90% market share of commercial brewery industry (Africa yield.com, 2017).

SMU project has contributed to the reduction of the ballooning Kenya current account deficit by providing substitute to corn, wheat and rice which annual importation were put at 1MT,1.5MT and 470,000 tons annually (FAS/Nairobi,2007).Providing the substitute has helped to save the country's meager foreign exchange.

The SMU project is helping the beneficiary farmers move from subsistence to cash economy as seen especially in the Upper Eastern of Kenya where sorghum is being seen as a cash crop with relatively little percentage consumed. This attitudinal change not only contributes to the economic growth of both the farmers and the Kenya.

Ability of farmers to provide regular supply of sorghum to commercial breweries has created a sustainable alternative to illicit brew trade that killed thousands of Kenyan in 2004 thus preventing avoidable human capital losses.

3.6.1 Un-intended /Negative Impact

Some farmers' dependency on free seeds and input distribution has hampered their view of farming as a business. This has also had an adverse effect on commercial seed companies' ability to grow and offer affordable good quality seed to the farmers.

3.7 Analysis of the SMU Outputs

Other findings during the impact survey are categorized below under "Things Working Well" and "Things Not Working Well".

Table 3.7.8: Analysis of the SMU Outputs

	Things Working Well	**Things Not Working Well**	**Things Needed to be Done**
Agronomy Training	Agronomy training is very effective as farmers imbibed the skill of good agronomy and practice it	Farmers still use the traditional way of bird chasing thus discourage planting bigger area.	Partnership and more aggressive advocacy with national government on policy support for sorghum farming and marketing
	Involvement of farmers in the selection of their preferred varieties through multi-location participatory variety/hybrid selection trial encourage farmers to take ownership of the project		County government of Kitui and Ukambari talking about policy support (agriculture is devolved), need to speed up the process through aggressive lobbying and expand such to other county governments.

Input Supply	Assistance in identifying equipment need of farmers and assisting the aggregators to procure loans for its purchase and subsequent rentage to farmers.	The partnerships with private seed companies and the agro-dealers has not be effective in providing needed improved seeds and other input to the SMU beneficiaries	Breweries and milling industries are two out of the four prominent industries in Kenya. High energy and time must be devoted to getting the major players in milling/feed industries into the loop.
Marketing Training and Market Linkage	The use of aggregators who happens to be a farmer in the locality has built trust and is highly effective	The collective action by farmers is very low as seen in very few farmers collectively selling to EABL and very many selling to brokers instead of pulling together and transporting to the aggregators	More encouragement ,emphasis and support for collective action and group selling.
	Getting World Food Program interest in buying sorghum grains from the farmers in Eastern Kenya for its relieve program	EABL is still the only main up-taker from beneficiary farmers, efforts at getting other users like food and feed industries not working yet	Aggressive targeting of millers and feed processors for inclusion in the chain.
	Encouraging and helping farmers to maintain quality grains as reflected in less than 1% rejection rate by EABL	Few numbers of aggregators and semi aggregators give chance to sharp practices and exploitation of desperate farmers by the stockbrokers. Farmers loosing up to 10KSH per kilograms.	Policy support for sorghum marketing and storage as seen in maize.
Utilization Training and	Consumption and value addition strategy well embraced especially in	The negative stigma attached to the consumption of	

Utilization	Kitui (Lower Eastern area)	sorghum is still strong in Tharaka.	

Source: Field Survey 2017

3.8. Benefit Attribution

The Benefit attribution is important in this survey because the Eastern part of Kenya has many on going and past development initiatives from different organisations aimed at bettering the lots of the people in the area.This was confirmed by the project beneficiaries where 81% of them are involved in other initiatives apart from the SMU project.

Beneficiary farmers were asked to ascribe present wellbeing to the activities and initiatives going on around them including the weather condition. The farmers attributed 47% of their present wellbeing to the SMU activities.

Table 3.8.1:

Attribution		
	Points	%
AH	985	47
Good weather condition	450	21
Infrastructure and Extension Activities	330	16
Activities of Other NGOs	340	16
	2105	100

3.9. Demand for Sorghum for food, feed and Industrial Use

3.9.1 **Estimated Demand for Sorghum for food**.

Generally, most sorghum grain produced by local farmers in Kenya is consumed after grinding it into flour to make porridge ‘Ugi’, and hard porridge known as ‘ugali’.It was reported that Kenya produced 177,553 tons of sorghum in 2014 (FAOstat, 2017) . 53 percent of the total sorghum supply in Kenya each year is consumed as food in the form of grain or flour (MAFAP-FAO,2013) . The present demand of sorghum for food is estimated at 94,000 tons per annum. At present, the milling industry mostly mill sorghum as a composite flour with other grains. The present consumption of sorghum mostly through composite food formulation is estimated at 10,000 MT per annum.

Because of shortage of other grains, the milling industries are operating between 30%-40% of their capacity (worldgrain.com/department, 13 June 2017) milling about 600,000 tons of grain

per annum for consumption. With sorghum substituting for at least 15%, demand for at least 90,000 tons of sorghum will be created.

3.9.2 Demand for Sorghum for feed

The animal feed industry is growing due to increase in population and growing middle class which has resulted in increase in demand for meat and egg.

Most of the rural sorghum farmers use sorghum grains as food for their chicken while the folders, leaves and stalks kept at home or in the field as food for the ruminants. Key informant interview with some of such farmers using sorghum as chicken feed shows a positive opinion regarding its suitability for use as feed and in home feed formulation.

Interview with a small scale feed manufacturer in Kitui indicated the producers readiness to substitute sorghum for maize provided it is readily available and the price is much less than price of maize. He is not bothered by the issue of tannin.

Data by Kenya's State Department of Livestock estimates that demand for feeds and supplements in 2014 is about 650,000 tons out of which 80% is for poultry feed. The feed sector is expected to grow at 10% yearly.

Maize is the main ingredient in commercial animal feed in Kenya. However, big processors prefer consistent formulation and do not routinely shift ingredients of the formulation. 80% of the feed formulation is made up of grains with sorghum constituting 4%.Only the sorghum is sourced locally while other grains are always imported because of shortfall in local production.

The use of sorghum by the commercial feed manufacturer started in 2014 when the price of sorghum became disproportionally low due to refusal of East African Breweries to take up sorghum from farmers because of increase in government tax on sorghum beer. During this period sorghum was available at KSH2300 as against KSH2500 per bag for maize. The present utilization is estimated at 20,000MT per annum.

If the price is right and the commercial feed manufacturers are coopt into the sorghum project with necessary support, the potential in the next five years in poultry feed (given a 50% substitution of maize) can be up to 260,000 MT per annum.

3.9.3 Demand for sorghum for industry

The East Africa Breweries in Kenya is the only known industry using sorghum in large scale in Kenya. The brewery is a stakeholder in the SMU value change project as the main up-taker of the grain.

The quantity demanded by the brewery has increased over the years from 2,000 metric tons in 2009 to 27,000 metric tons for the 2017/2018 planting season.

Table: Sorghum demand/supply to EABL in Metric Tons

Table3.9.3.9:

	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Demand	18,000	20,000	22,000	15,000	27,000
Supply by Beneficiaries	12,000	2,000	12,000	7,000	?

The 44% of the country's overall alcoholic beverage market is commercial and EABL controls over 95% sales in this market. (Excise taxes in Kenya).With the popularity of the Senator Keg (low price beer being made from sorghum), it is expected that over time more people will move from the traditional and illicit beer consumption to the more hygienic and safe one being produced by EABL thus resulting in increase in demand for sorghum.

The present demand by EABL is 27,000 MT. It is expected that the demand for sorghum for beer will continue to increase EABL will increase the Sorghum to Barley ingredient ration along 60:40.Thus within the next 5 years it is expected that the company will demand 60,000MT per annum.

Table : Estimated present demand and Potential demand for Sorghum grains

Table3.9.3.10:

Utilization	Present Demand(MT)	Potential Demand(MT)
Food	94,000	180,000
Animal Feed	20,000	260,000
Industrial	27,000	60,000
Total	141,000	500,000

3.10 SMU Value Chain Project Relevance to Increase Utilization

The volatility of government intervention may create uncertainty in the sorghum market, which not only hinders domestic trade, but also increases the risk borne by farmers. (Chemonics, 2010).Effective advocacy and partnership with government to ensure stable and supporting policies for sorghum production and utilization.

4.0 CONCLUSION AND RECOMMENDATIONS

The SMU project has been effective in improving the food security and income of the small holder farmers in the project areas. The Sorghum for Multiple Uses Value Chain Project had effectively contributed to increase in income and food security of the beneficiary farmers as well as the economy of Kenya.

Diversification of the end user markets is urgently required to stimulate competition and further open up additional avenues for trade. There is need to establish more value chain platforms, plan a monitoring and evaluation system to draw lessons for future improvement of the value chain and for up scaling.

The following strategies are recommended for improvement in the utilization for food, feed, and industrial uses.

Strategy to increase utilization for Food

i. Extensive awareness campaign in market places and group meetings to counter the belief that sorghum consumption has adverse effect on male fertility and to reinforce its health benefits. Men to be targeted through the community leaders.

ii. Campaign in schools and demonstration of various delicacies that can be prepared with sorghum for food and allowing sampling by the pupil. Partnership with necessary authority with the aim of incorporating this into the school feeding program will encourage consumption even at home.

iii. Targeting restaurants preparing local dishes and training them on how to prepare delicious meals from sorghum and then branding them as food health ambassadors.

iv. City/Urban households are encouraged to increase household consumption through "ready to use" sorghum and sorghum composite offered in retail stores and supermarkets. (Dicko et al. 2006)

v. Training locals/farmers on proper and attractive packaging of sorghum flour and linking them to retail outlets (Chemonics, 2010).This opened new channel will thus result in potential higher returns to farmers.

vi. Promotion of more post-harvest threshing and cleaning equipment for use at community and group levels will help to improve sorghum grain quality used by food processors.

vii. The government of Kenya should intensify its call for diet diversification and prepare to lead by example.

Strategy increase utilization as feed

i. Livestock owners and feed companies to be giving training and demonstration on the fact that sorghum can be substituted for maize in poultry, beef and pig feed without loss in weight and "palatability". Education on protein and fiber content of sorghum and capacity building on switching of grains in feed formulation is very crucial to successful uptake.

ii. More effective and efficient aggregation system will help in the area of credibility and availability and thus provide quality assurance to the feed manufactures.

iii. More aggressive production campaign and up-scaling the program will bring more farmers into sorghum planting which will increase yield. Increase production will bring economy of scale which may bring relative price down and provide a more stable supply of raw material which may further encourage the utilization by the feed manufacturers.

iv. Support investment in drying and storage facility or grain stockholding in sorghum producing areas to assure availability throughout the year.

v. Government of Kenya can contribute by committing funding to programs aimed at improving drying and storage facilities in sorghum as done for corn.

Strategy to increase industrial use

i. As suggested above, more aggressive production campaign and up-scaling will result in economy of scale for the farmers and subsequently reduce price per kilograms of sorghum. This reduction in price will be beneficial to industries because it will translate to lower input cost.

ii. Assisting farmers to maintain quality standard and stable supply will encourage more food and beverage companies to buy into the idea of using sorghum as alternative to other grains in their formulation.

iii. Targeting sugar manufacturer to use sorghum juice to produce crystallized sugar to meet Kenya's annual sugar deficit of 200,000 tons. The appropriate SMU varieties can be targeted at area traditionally growing sugarcane for sugar.

iv. The potential use of sorghum juice as a non-polluting source of energy should be explore since sorghum is one of the crops that can be used to produce bioethanol. Extensive experience has been accumulated with using ethanol as pure fuel and for blending with gasoline (Wyman, 2004).This drive will align with the vision of the Kenya Government Biofuel Policy to increase access to energy through sustainable biofuel production, and reduce dependence on fossil fuels by 25% in volume by the year 2030.

v. The program can help in sourcing for a flexible conversion facility capable of serving both sugar and ethanol markets.

vi. Sorghum is a fine material for papermaking industry. Incorporating the paper making industries apart from increasing utilization will also reduce dependency of paper industries on hard wood thereby helping the environment.

vii. Advocacy for government policy support as in maize and wheat.

Strategy for sustainability of production

i. Reduce the activities of the stock brokers by having more aggregators and sub aggregators in the remote communities

ii. Identification and establishment of grain collection points should also be factored into the aggregation system.

iii. To reduce the vulnerability of farmers to stock brokers, farmers groups and cooperative societies should be strengthened and a stop gap finance to pay for school fees and buy necessary insecticides when needed should be facilitated.

iv. Strengthening of the farmers group will also improve availability of certified seeds to the farmers in the most remote places

v. Over dependency on one major up-taker should be broken by working on the concerns of the feed manufacturers and coopt food industries subsector into the program.

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