

Masters Dissertation Thesis

**Impact of Quality of Grains Used For Seeds On
The Yield and Grain Market Price of Local
Sorghum in Gabiley**

Mohamed Warsame Farah

Food Society and International Food Governance Programme * In Partial Fulfillment For The
Requirements Of The Degree of Masters of Science * The Open University of Catalonia Barcelona,
Spain - Autumn 2018

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Submitted by

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Declaration:

I hereby declare that this work original and is the result of research I conducted, I am the sole author this thesis. This is a true copy of the thesis, including any final versions, as accepted by examiners.

Acknowledgment:

I am extending my deep and sincere gratitude to my family who have endured and showed maximum patience and perseverance towards my implementation of this research. Needless to mention, they offered all the help they could give at times so badly I needed, and they stayed beside me to express their solidarity for me to succeed.

I would like to thank very much my colleagues who were always with at work or away in their private time to give their support and advice which really paved the way for my completion and success in this work.

I am indebted to the teaching faculty of Universita Oberta di Catalunya (UoC), my kind advisor to whom I was rushing all the time provide a suggestion, advice, idea I so urgently needed to urgent issues. He made my completion of this work possible with his invaluable support, day and night.

Dedication of the Advisor:

I am dedicating this work to the best of people near me, they are my beloved wife and our children who eight in number of the best majority of them have already done their universities. My family has every right to have this work and I am offering it to them with my love for them. Finally I am dedicating this research work to the Catalonians and Somalilanders gave me all that it took to learn and graduate remarkably in the field of food systems in UoC, Barcelona, Spain.

**Impact of Quality of Grains Used For Seeds
On The Yield and Grain Market Price of Local Sorghum**

Abstract:

The study is intended to investigate into the assumed impact of genetic impurity, low germination rate and vigor of seeds sourced from the grain market on yield and quality of grain of local sorghum landraces. Therefore, its aim is to contribute to the scientific information and knowledge around the problem, allowing researchers and academicians to engage in a critical review of the findings and to perform more research work in the area of study.

The study assesses the effect of seed impurity and low rate of germination as key parameters contributing to poor yield and low production in sorghum grown by small scale farmers in the Gabiley region of Somaliland. The study aims at understanding the root causes and their effect on aspects production and impact over the long term on small scale farmer household economy and food security, and looks into farmer-based alternative seed sources scenarios recommended in Gabiley, and other regions of similar challenges and agro-ecology.

The research is based both on qualitative and quantitative methods for collection of data in the field including interview of a sample 36 small scale farmers selected from 1229 using questionnaire, 6 FGDs and 3 case studies farmers in 6 villages in Gabiley. Standard Seed Germination Test has been conducted on 2 lab samples from seeds 20 lot samples sourced originally from the Hargeisa grain market. Data collected from farmers was analyzed using the SPSS program comparing with summaries from the FGDs, CSs and germination results from the SGT in the laboratory. Results of this study showed that impaired seed quality parameters tested affect crop establishment, yield and market performance. 60% of farmers surveyed affirmatively supported the assumption sourcing of seeds from the grain market could impact on households economically in terms of food, income and diet quality.

The study demonstrates that in the investigated area, and namely in similar ones in other regions in the west of Somaliland, and also in other developing countries, the practice that farmers source seeds from the grain market, despite a solution adopted out of emergency, is not reliable as it puts them at risk to have a poor yield and grain product of inconsistent market quality. Study concludes, therefore, that use of grain market seeds could result in decline in HH economy and food insecurity. On the opposite, the best, and alternative sources for those seeds include government, seed bank and other farms.

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1. Chapter: Introduction

1.1. Introduction

Much of the sorghum produced in Somaliland falls within a quite optimal ecological zone of the western regions. Both soil and climate factors supported a fairly good crop under a resource low, subsistence agro-pastoral farming systems. Like any other important farm assets, much of the seed stocks of sorghum of small scale farmers in Gabiley district, were adversely affected or lost during the civil strife of 1988-1991.

The yield and production of local sorghum landraces experienced a substantial reduction over two and half decades in the major sorghum producing localities of the country. Farmers in rain-fed areas depended on market food grains as the feasible alternative to get the seeds of the sorghum landraces (S. bicolor L. Elmi Jama). The main cause of the decline in yield and production is due to degraded quality of seeds sourced from the grain market. This may not be the only factor affecting sorghum production. Key infrastructure and institutions essentially needed to maintain the genetic and agronomic quality of seeds of local cereal food crop landraces were missing also. The decrease in the productivity of sorghum, a key food security crop is believed to have impacted consistently on small scale farmer household economy (food security and income).

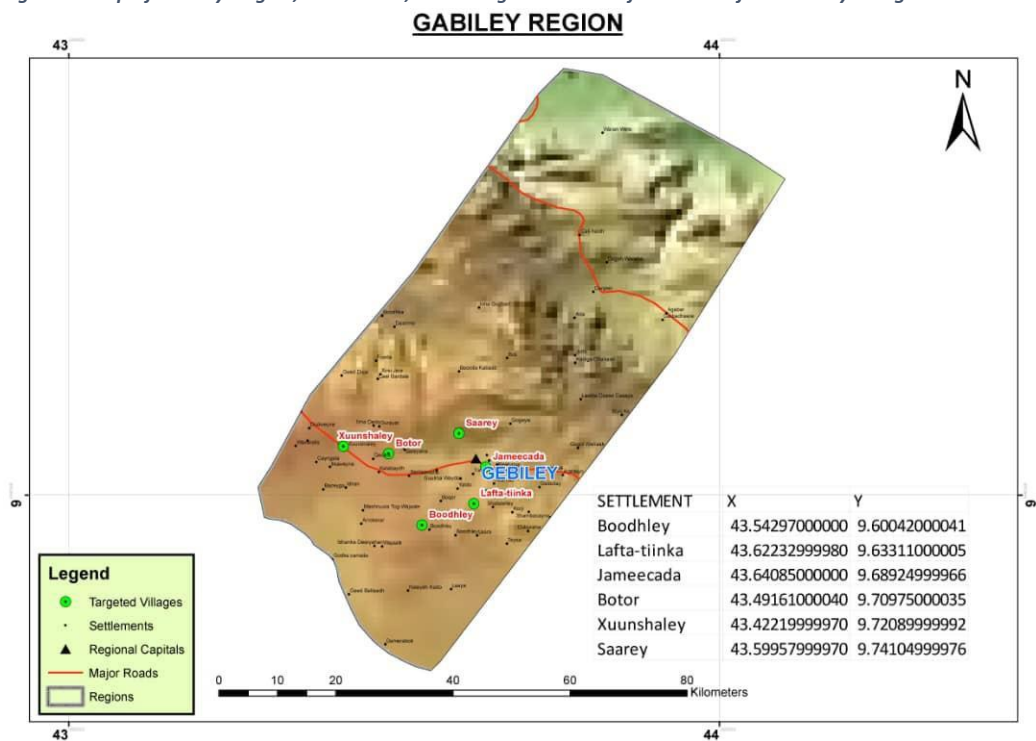
SOMLILAND

Legend

D Somaliland
D Maroodijeeh
D Gabiley

Courtesy: SWALIM/FAOSO 2018

Figure 1: Map of Gabiley Region, Somaliland, indicating locational information of the 6 study villages.



1.1. Background:

Among the major factors believed to contribute to poor performance of local food crops are climate change, poor soil fertility, poor crop management practices and impaired varietal quality. The sourcing and use of ordinary food grain marketed food grain and aid seed, alternative to seeds from ordinary seed systems, are suspected to be factors responsible for low crop yield, production and market price.

Recent studies reported a more or less consistent low for sorghum production. Part of this scenario could be as a result of a portion of rain-fed small-scale farmers, sourcing the seeds of sorghum and other food grains directly from the market, buying food grain as seed. In such a case, vulnerable groups and minorities are expected to suffer most in terms food insecurity and malnutrition. Among these groups women (pregnant and lactating) and children under five. Poorer households are expected to suffer from decline in food stock essentially needed during the dry period of the year, and drop in their income as a result of losing the proportion of income from surplus production of sorghum in normal and above normal years. Income of these households is proportionately divided in 70% and 30% respectively from crop and livestock. In normal to above normal years, food grains production could be able to easily supply potential markets in populated urban centers up to 100 tons of sorghum 70%, maize 20% and the remaining 20% as minor crops.

Impaired varietal seed quality in terms of low genetic purity and low rate of germination are believed in this study to be increasingly and more frequently responsible of poor production and market performance of local sorghum over last two and half decades in Gabiley, Somaliland. Attempts have been underway by different projects among which those implemented by FAO with the Ministry of Agriculture of Somaliland in an attempt to recover local landraces in their pure form and maintain them sustainably through reestablishment of the collapsed local seed systems. This effort implies building local capacities including both formal and informal seed systems. Despite this effort, many farmers are still sourcing sorghum seeds from the local food grain market which caused farmers to face a new challenge – the possible multifaceted effect resulting from seeds the origin or quality are completely unknown to the small-scale sorghum growing farmers.

1.2. Theoretical Framework:

Seed quality includes genetic; physical; physiological and pathological components. Of the five key parameters of quality (purity (physical and genetic); germination; vigor; appearance and freedom from diseases), of seeds recognized equally by researchers, seed producers and agronomists to be responsible collectively to contribute to crop adaption and performance, purity, germination rate and seedling vigor are considered as critical, keeping all other factors biotic and abiotic at optimally constant. Pure seeds with high germination rate and vigor are expected to contribute to close to optimal plant populations and high levels of homogeneity in germination, growth and development and eventual yield and

production. Effect of impurity, low germination rate and vigor are reflected on crop and expressed as poor adaptation capacity to stressful ecological conditions and relatively low performance in field and productivity which resulted poor crop performance.

1.3. Definition of Terms:

- a. **Local landrace:** Is a local variety of a domesticated plant species which has developed largely adaptation to the natural and cultural environment in which it lives. It differs from a cultivar which has been selectively bred to conform to a particular standard of characteristics .
- b. **Plant density:** The number of plants within a given unit of area. For instance, 10 flowers per square foot could describe the planting density of a small flower bed.
- c. **Seeds:** the fertilized, matured ovule of a flowering plant, containing an embryo or rudimentary plant used for planting. Seed is a basic input in agriculture. Strictly speaking seed is an embryo, a living organism embedded in the supporting or the food storage.
- d. **Seed quality:** Is the totality of a seed lot responding to a number of physical and physiological parameters including genetic purity, germination and moisture content.
- e. **Small scale farmers:** refers to households of limited resource endowment relative to other farmers in the sector.

2. Chapter: Rationale of Study

2.1. Preliminary Reports and Observations:

Preliminary field observations and small-scale farmer case stories and experiences related to possibility of negative impact of sorghum seeds sourced from the local food grain market on yield and production has been considered urgent and deserved investigation. This was the rationale that lead the researcher to prioritize the problem for field study.

The aim is investigate in the reported problem directly in the field to:

- i. Establish facts on the relationship between seed impurity and low rate of germination as parameters negatively affecting crop yield, production and market price.
- ii. Determine effect of seed impurity and low rate of germination as key parameters contributing to poor yield and low production in sorghum grown by small scale farmers in the region districts of Gabiley and Hargeisa.
- iii. Evaluate the agronomic, social, economic and cultural impact of the use of grains as seeds for growing local sorghum landraces in Gabiley and Hargeisa farmer livelihoods and economy in the area of study.

2.2. Statement of the Problem:

Among the major factors believed to contribute to poor performance of local food crops are climate change, poor soil fertility, poor crop management practices and impaired varietal quality. The sourcing and use of ordinary food grain marketed food grain, alternative to seeds from ordinary seed systems, are suspected to be factors responsible for low crop yield, production and market price.

The study focused on the problem of impaired varietal seed quality in terms of low genetic purity and low rate of germination are believed in this study to be increasingly and more frequently responsible of poor production and market performance of local sorghum over last two and half decades in western Somaliland.

3. Chapter: Objective of Study

3.1. Purpose of Study:

The study was intended to investigate into the assumed impact of genetic impurity, low germination rate and vigor of seeds sourced from the grain market on yield and quality of grain of local sorghum landraces, and therefore give a contribution to the scientific information and knowledge around the problem allowing researchers and academicians engage in a critical review of the findings and more research work in the area of study.

3.2. Objective:

- a. Main objectives of the study are to determine the effects of seed impurity and low rate of germination as key parameters contributing to poor yield and low production in sorghum grown by small scale farmers in the region and evaluate the medium and long-term impact of the use of grains as seeds on the livelihood of small scale farmer households.
- b. The study focused on **understanding the problem, find the root causes and the direct effect and impact over the long term on small scale farmer household economy and food security.**
- c. In the process of study the researcher will be alert to look for **alternative solution scenarios for farmer-based seed systems seed security** in Gabiley, and other regions of similar challenges and agro-ecology.

3.3. Scope:

Scope of the study limited in finding a scientific explanation for the problem of low yield and low market price are the direct of result of genetic impurity and poor germination capacity of the used seeds by:

Testing the hypothesis that the impurity and poor germination rate of seeds of local food crop land races of sorghum impacted persistently on yield, production and grain market price resulting in low yield, low production and poor marketability of grain product.

Assuming seed impurity and poor germination rate as mutually exclusive independent variants significantly contributing to poor performance of the selected local crops.

The study has focused on local sorghum landrace cultivated in western Somaliland and used for food and animal feed, both aspects have economic importance to small scale farmer households. Therefore, results of the study, if significantly true, will try to recommend options for sustainable supply of reliable sorghum seeds.

4. Chapter: Literature Review

Preliminary literature review: provide a summary of previous related research on the research problem and their strength and weakness and a justification of your research - What is known/what have been done by others? And, why your research is still necessary?

In an attempt to review enough literature as possible, the following brief review, actually highlights of key areas and issues discussed are presented under this section in sufficient detail. The aim was to capture how important is seed quality-particularly purity and germination rate- in crop agriculture. Impact of seed quality are expected and understood to reflect on the crop growth, performance, yield and production.

Omoro, W. (2013)¹, the study investigated the factors causing low productivity of small scale cultivation of sorghum in the study area by Looking at three resource aspects of production: financial, natural and human assets within access of the small scale farmer. Identified in the study are root causes of low production as: lack of inputs (bullocks, seeds, plough), lack of adequate labor, and low income from the farm. Findings suggest also the need for KARI to establish link with microfinance institutions and connect them to the small scale farmers to enable them improve their skills for diversifying income sources, make savings and access small farming loans. The suggestion to involve farmers was considered relevant for farmers learning improved skills. The study however did not suggest to what extent each of the identified factors affect production, for example seeds, how and why it remains relevant, which points at the need for more studies on impact of factors originating in seeds on yield, productivity and quality of end product. Important to the present research is the presence of seeds as a key input which needs to be carefully studied at different perspectives and context.

Muui, C. W., Muasya, R. M., & Kirubi, D. T. (2013)² Researchers aimed at investigated the problem at different angles related to socioeconomic factors and key aspects of the local farming system used by farmers. Factors studied included landraces grown by farmers, source of seed, traits preference, maturity period, cultural practices, pre and postharvest handling, utilization and constraints in sorghum production in lower eastern Kenya region.

Researchers established the importance for farmers to use diverse landraces that are unique in their adaptation, food quality, grain yield, quality of harvested products and biotic stress resistance. The root causes of low production identified by the study included lack of income to purchase fertilizer and chemicals, inadequate quality seed, susceptibility to pests and diseases resulting to low yields. The researchers suggest that solution to the problem of low production could be the use of improved production technologies and creating awareness to farmers on importance of the crop to increase the production area. The study did not overlook the need for farmers to use quality seeds and could be understood that uncertified seeds of unknown quality could not be reliable for farmers and may not ensure reasonable yields and quality product.

Sugri, I., Nutsugah, S. K., & Yirzagla, J. (2011)³ studied three key factors on pearl millet seed viability including time of harvesting, some seed physical characteristic and moisture content by evaluating relationship of days after harvest to viability of seed. Out of four time regimes of 1, 3, 5, 7 and 14 days after harvest from the physiological maturity or the hard-dough stage, 7 days after hard-dough resulted consistently in the highest germination rates. The study found direct relationship of earliness of harvest with germination and seedling vigor after nine months of storage. Study suggests, where pearl millet seed production is done by largely peasant farmers, efforts to achieve higher germination should concentrate on prompt harvesting, adequate drying and appropriate storage. It also suggested the need for farmers to understand the complex interrelationships among seed size, moisture content and good storage. Researchers highlighted the criticality of farmers' capacity to store seeds at or near optimum conditions seed viability.

Gupta, S. C. (1999)⁴ reviewed seed production procedures in sorghum and pearl millet and clearly indicated importance of functional and healthy seeds in improving agricultural production. The researcher had also indicated areas of responsibility in the development of cultivars which are breeding, commercial production of seeds and seed certification. Equally, the researcher highlighted that both sorghum and pearl millet crops require adequate precautions to be taken against physical admixtures during sowing, harvesting, threshing and storage. There are also crop-specific requirements for protection against contamination of seeds.

Bortey, H. M., Sadia, A. O., & Asibuo, J. Y. (2016)⁶ investigated germinability and storability of a newly released cowpea genotype and the influence of four different storage material under ambient storage condition on seed vigor and germination over time. Results from the present study suggest that cowpea genotype differences affect germination rate and storability. The storage material significantly affected the quality of seed in terms of percentage vigor and germination.

Garoma, B., Chibsa, T., Keno, T., & Denbi, Y. Effect of Storage Period on Seed Germination of Different Maize Parental Lines⁷, carried out with the objective to determine the effect of storage period on seed germination, emergence and seedling traits of different maize parental lines. Four parental lines of

seeds were produced in three different cropping seasons and stored for their respective years. Each parental line seed was tested and necessary data were collected on germination characteristic, emergence and seedling traits. Result of analysis variance showed significant ($p < 0.001$) difference within and among parental lines that produced and stored in different years for germination percentage, mean time to germination, germination index, emergence percentage, fresh weight of shoot and root. Results indicated that germination was decreased as the seed stored longer. They also indicated that the more energy to germinate earlier and likely had more vigor. Phenotypic correlation observed among germination parameters and seedling traits. As seed storage period increased, the tested maize parental lines seeds showed low germination, decreased germination rate and index, emergence and low weight of seedling traits. Thus directly influence the agronomic seed quality traits, since farmers need high quality of seed that enable to germinate high percentage and uniformity of seedlings under required field conditions.

Moshatati, A., & Gharineh, M. H. (2012)⁸, Studied effect of thousand grain weight on germination, seed vigor and seedling establishment of wheat. They investigated the effect of thousand grain weights on germination, seed vigor, seedling establishment and yield, using horizontal step and frequency parameters of gravity in two stages. Subsequently, in a Standard Germination Test (STD), using ten treatments of thousand grain, and seedling growth test in CRD design with 4 replications were conducted. In the standard germination test, traits of seed germination including percent, germination rate and mean of germination time and in seedling growth test traits of seedling length and seedling dry weight have been measured. Results indicated higher thousand grain weight in this range used had not significant effect on germination percent, germination rate and mean germination time, but resulted in more seedling growth and more seedling weight, which be result in better seedling establishment and higher plant growth and production more yield in field. The study worked on seeds with standard seed characteristics, and focused on whether increase in weight of thousand grains could affect germination, seed vigor and seedling establishment which all are factors critically affecting yield and grain quality. The same test would be useful to be applied to seeds of unknown purity, germination rate, seed vigor, and sourced from the grain market.

Finch-Savage, W. E., & Bassel, G. W. (2015)⁹. The authors, in the article, argued that the seed vigor is responsible of the ability of seeds to germinate and establish seedlings uniformly and robustly, reasonably quickly. Seed vigor directly governs the yield defining stage of the crop. It is elucidated in the article the need for further understanding more around seed vigor which is believed to be critical to understanding seed performance particularly during the establishment of crops. They also argued seed vigor is generally overlooked despite its importance to agriculture and industry. The article recommended more studies the seed vigor trait which will possibly help ensuring of reliable food security into the future.

In the review, the author focused more on seed vigor when seeds are pure and their source is well established. In this case seed vigor could be studied in isolation of other seed parameters. On the other hand, conditions before and after seeds are put to the field conditions.

From review of number of literature selected on their expected relationship to the problem of the present study. The conclusion arrived at is existence of critical gaps in the body of reviewed information. But many authors studied or indicated in their reports, articles or reviews the importance seed quality parameters and the factors affecting them. Among others effect of seed vigor, seed viability, seed weight, storage conditions and days after harvesting on seedling establishment and yield were studied. The status of yield of sorghum and the factors causing low yields was the theme of research for some of the reviewed studies. The criticality of seed purity and germination rate and vigor to crop performance and productivity did not establish strong evidence on the impact of seed sourced from grain market on sorghum crop yield and grain quality and therefore its price. Many of the studies tried to answer research questions and therefore proposed body of recommendations with indication of potential to improve production. Number of studies in the review emphasized on understanding socioeconomic factors determining livelihood conditions and status of their production and income, proposed participation of farmers in the process of change and the need to engage them together with all stakeholders working with them, in the roll of new initiatives to improve production and therefore food security and income. Role of seed systems as a key mechanism in sustainable seed systems and the joint and continuous effort of FAO, governments and institutions involved in seed production, regulation and conservation is also discussed in the below literature.

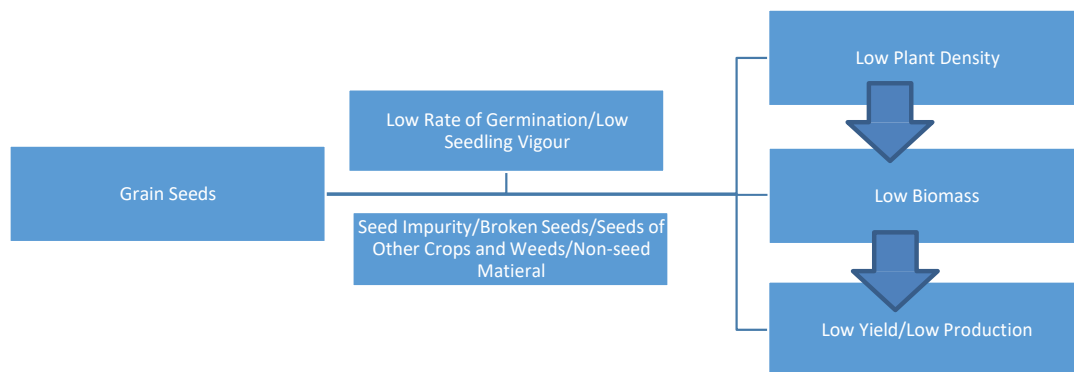
Review of the literature helped in the redesigning of the research proposal and tailoring it to the conditions and context in which the research problem was identified.

5. Chapter: Conceptual Framework

5.1. Concept of Problem Impact

The problem of this study is considered critically detrimental to successfully productive and sustainable cultivation of major food crops by local farmers. Dry land farmers in the area of study relied on seeds traditionally selected, processed and conserve d. Seed selection was an activity in crop production calendar. Replaced the seeds of sorghum landraces including **E. jama** traditionally but rigorously selected and maintained are seeds sourced from grain market the quality attributes of which are totally unknown to small scale sorghum producer. This seeds as such have high chances of being impure (or highly mixed) and of low vigor and capacity to germinate and grow to robust seedlings. The fact these two key seed quality attributes, the first genetic and the second physiological, are believed to seriously impact on crop productivity in terms of density, population, yield, production and grain quality. The last affects marketability and price of sorghum grain produced by the small scale farmer. The economic and food security aspects of this impact could not be overlooked which brings us to the reason of this study.

Fig. 2: Diagram represents the proposed impact pathway of the two key quality parameters, impurity and low germination rate, suspected to be responsible of the persistent poor crop performance (low yields) and poor grain market performance.



5.2. Variables:

Based on the above conceptual framework the following key variables are considered as relevant for studying the problem:

Independent Variables:

1. Grain seeds Impurity
2. Low germination rate

Dependent Variables:

1. Sorghum crop yield

2. Grain market price

5.3. Hypothesis

5.3.1. **Null Hypothesis (H_0): Use of genetically impure and low rate of germination and seedling vigor seeds is:**

- a. Directly responsible of crop performance (low yield and production, and low grain quality) of sorghum.
- b. Indirectly responsible of low market price and therefore low returns on sales.

5.3.2. **Alternative Hypothesis (H_A): The opposite of above statement of H_0 , based on scientific evidence, is true.**

To enable a thorough and valid explanation and conclusion of results the following will be essentially required:

Extensive citation and review of literature around the problem will be done to study how much information is generated on seed impurity and poor germination and seed vigor on yield and grain quality.

Conducting of field/laboratory experimentation and survey will be conducted on variables of the variables of the two parameters of germination, yield and grain quality.

It is important for this study (adopting the right design, methods, tools and questions to be asked, implementing the research and therefore enabling the testing of the hypothesis) to question on the possibility of market grain seeds affecting production of local rain-fed sorghum, E. jama, trying to find scientific explanation leading us to justify the present below potential low sorghum productivity and market value as accommodated by the following questions:

- What factors are leading local smallholder farmers to consistently depend on grains for seeds?
- What is comparative advantage of using grains as an option for seeds for farmers?
- Could grains sourced from market for seeds be genetically impure?
- Could grain sourced from market for seeds be of low germination rate?
- Could grain sourced from market for seeds be of low vigor resulting in poor seedlings?
- Could grain sourced from market for seeds cause low crop yield and low production?
- Is the impact of poor seed quality reflected in final product in the market as poor grain quality?
- What is social impact of grain seeds on small holder farmer house hold income and food security?

What is long term socioeconomic impact of grain sourced from market for seeds on small holder farmer house production?

6. Chapter: Research Design

6.1. Methods:

Extensive sourcing and review of secondary data assisted in understanding nature and trends of agricultural production in Gabiley.

For primary data collection and analysis, both quantitative and qualitative techniques were employed.

Data was from both the field and from laboratory records. On the former a research consisting five enumerators and researcher conducted a social survey to collect data from rainfed sorghum growing famers in Gabiley.

6.2. Materials:

Key material used in the study included: Interviewees from a sample (to respond to questions in survey questionnaires); Questionnaires (administered to Farmer Households and Grain Suppliers of a samples); Check lists for topic questions for guiding FGD discussions to a consensus; and Lab equipment for standard germination test, and measurement of seed and seedling vigor measurement.

Study was conducted in the following locations: 6 villages in the districts in Gabiley for conducting small scale farmer survey, FGDs and SCs; Hargeisa grain market for sourcing of sample seeds for SGT, and Seed Laboratory of Ministry of Agricultural Development, Hargeisa, Somaliland.

6.3. Implementation Plan and Procedures:

The timeframe for data collection was two weeks including: Preliminary collection of secondary data; sampling and instrumentation; pilot testing of methods, tools and material; data collection will continue and be completed in two weeks; Implementation of the study will have a work plan and budget to cover cost of basic needs (for material, transportation and for paying to the service of facilities and study team members); Consultation with the supervisor will be closely maintained for guidance and review of methods, instruments, process, activities, inputs and expected outputs; Tentative start date of research activities is 15th August, while completion date is expected to be 2nd of September 2018.

Activities of the study will be carried out in:

- Villages in Gabiley.

Table 1: Villages in Gabiley in study was conducted.

No.	Village	East	North
1	Boodhley	43.54297000000	9.60042000041
2	Lafta-tiinka	43.62232999980	9.63311000005
3	Jameecada	43.64085000000	9.68924999966
4	Botor	43.49161000040	9.70975000035
5	Xuunshaley	43.42219999970	9.72089999992
6	Saarey	43.59957999970	9.74104999976

- Seed Laboratory of at Ministry of Agricultural Development, Hargeisa, Somaliland.

6.4. Sampling:

Out of a total of 42 villages 6 with a total population of 1229 farming HH were randomly selected for inclusion in the study.

Out of the 1229 the team then selected a sample of 36 small scale farmers cultivating sorghum to participate in interviews using a questionnaire.

In another exercise, the team conducted 6 FGDs in the six villages, one each, and three case studies with the different stakeholders in the area of study.

Finally 20 lot samples were collected from 5 women grain dealers in the Hargeisa market to be used from extracting laboratory samples on which SGT was conducted to study rate seed germination and level impurity of the seed samples.

6.5. Pilot Testing of Tools/Questions:

Testing of data collection instruments and questions in the field, targeting a small number of persons with characteristics similar to those of the target group of the study for understanding level of feasibility, applicability and relevance purpose.

All material and processes will be readily planned and practiced during the pilot testing of data collection methods and instruments.

6.6. Data Collection

Data collection will continue and be completed in two weeks.

Data will be collected by the researcher assisted by part-timer university graduates.

Implementation of the study will have a work plan and budget to cover cost of basic needs (for material, transportation and for paying to the service of facilities and study team members)

Consultation with the supervisor will be closely maintained for guidance and review of methods, instruments, process, activities, inputs and expected outputs.

Tentative start date of research activities is 20th August, while completion date is expected to be 10th September 2018.

6.7. Data Analysis:

In the data analysis the researcher used SPSS and conducted interpretation and comparison of data summaries from the FGDs, CSs and SGT records.

Units of measure employed in this study included: HH as the unit for a household; Qooddi as the local measure for land units (each Qooddi in the area of study equals to 44m x 44m).

7. Chapter: Limitations and Delimitations:

7.1. Limitations

The instrumentation, data collection and analysis will be conducted in a social context where reservation, social set up, traditions and norms and personal attitudes may affect outcome.

The assumption is initially data collection process may be slightly slow due to unfamiliarity of some of the methods and tools of data collection.

7.2. Delimitations:

Direct questions that have personal or social implication may cause delay in responding or create temporary barrier preventing the respondent give his or her opinion freely.

Current research is planned to be done in the three food-basket regions of the country.

The fact that farmers and suppliers of other food producing regions are not included is based on the intensity of production, prevalence of the problem and its impact on comparatively wider population.

Chapter: Significance of the Study

The study is part of an effort to establish information for understanding if and to what extent the present low yield and production and relatively low grain market price could be attributed to impurity and poor germination rate of grain used as seed among the local small scale sorghum growers in Gabiley, Somaliland. Results of this study is expected to provide scientific explanation and conclusions which will shed more light on role of seed

quality parameters on sorghum crop performance and production, and grain price. It is likely that results of this study could assist researchers and policy makers develop appropriate policy framework and guidelines for sustainable management of sorghum seed and crop in the future.

8. Chapter: Results and Discussion:

8.1. Livelihood:

In normal to above normal years, food grains production could be able to easily supply potential markets in populated urban centers up to 100 tons of sorghum 70%, maize 20% and the remaining 20% as minor crops. Impact of lose reliable seeds of local crop landraces in their pure state have significant effect in terms of social, economic and cultural aspects of farming communities locally, from both rural and urban poor population.

In such a case, poorer households are expected to suffer from decline in food stock essentially needed during the dry period of the year, and drop in their income as a result of losing the proportion of income from surplus production of sorghum in normal and above normal years. Income of these households is proportionately divided in 70% and 30% respectively from crop and livestock.

Impaired varietal seed quality in terms of low genetic purity and low rate of germination are believed in this study to be increasingly and more frequently responsible of poor production and market performance of local sorghum over last two and half decades in Gabiley, Somaliland. Attempts have been underway by different projects among which those implemented by FAO with the Ministry of Agriculture of Somaliland in an attempt to recover local landraces in their pure form and maintain them sustainably through reestablishment of the collapsed local seed systems. This effort implies building local capacities including both formal and informal seed systems. Despite this effort, many farmers are still sourcing sorghum seeds from the local food grain market which caused farmers to face a new challenge – the possible multifaceted effect resulting from seeds the origin or quality are completely unknown to the small scale sorghum growing farmers.

8.2. Assets:

The main assets of a typical small scale household in the Gabiley region is dictated by the nature of climate, traditional characteristics of production and climate and soil regimes. There are two distinct assets owned by almost all household and are:

8.2.1. Farm holding.

8.2.2. Livestock.

Other assets observed during the study which are not indicated in the systematically collected or statistically analyzed data include animal traction unit, tractors, pit storage facility and farm implements of different categories. Purpose of owning as asset is despite varying language among the assessed households, have been described as economic or livelihood. In these terms assets claim relevance as source of income, source of food, source of animal power. The HH assets serve the production of food and fodder in the case of crops or live animals, milk, hides and other products.

8.3. Farm Information:

8.3.1. Farming System:

Farm is the unit of production where different activities occur in the seasonal cycle of production. Farmers in the region follow a production pattern with a defined cropping systems. The two prevalent farming systems identified by the study were:

Rain-fed/Food Crop and livestock/seasonal/ multiple-cropping and Rain-fed/Food Crop and livestock/seasonal/mon-cropped

Rain-fed/food crop and livestock/seasonal/multiple-cropping

Rain-fed/food crop and livestock/non-cropped

Table 2: The farming systems adopted by majority of small scale farmers in villages of study, Gabiley Region, Somaliland.

Farm Information: Type of Farming System	Percent
Rain-fed/food crop and livestock/seasonal/multiple-cropping	25%
Rain-fed/food crop and livestock/non-cropped	14%
Rain-fed/food crop/cash crop/crop and livestock/seasonal/mixed cropped	8%
All	6%
Rain-fed/food crop and livestock/seasonal/ multiple-cropping and rain-fed/food crop and livestock/seasonal/mon-cropped	28%
Rain-fed/food crop and livestock/seasonal/multiple-cropping and cash crop/crop and livestock/seasonal/mixed cropped	11%
Rain-fed/food crop and livestock/seasonal/mon-cropped and cash crop/crop and livestock/seasonal/mixed cropped	8%

8.3.2. Farm Holding

Data on farm holdings varied widely among the assessed farmers with ownership of 5, 6, 10, 15 and 30 were on the high level of the range, recording equaled in number of responds as indicated in the below figure. The important issue here is the average of areas of land holdings is 28.45 Qooddi which normal in the area of Gabiley for small scale farmers.

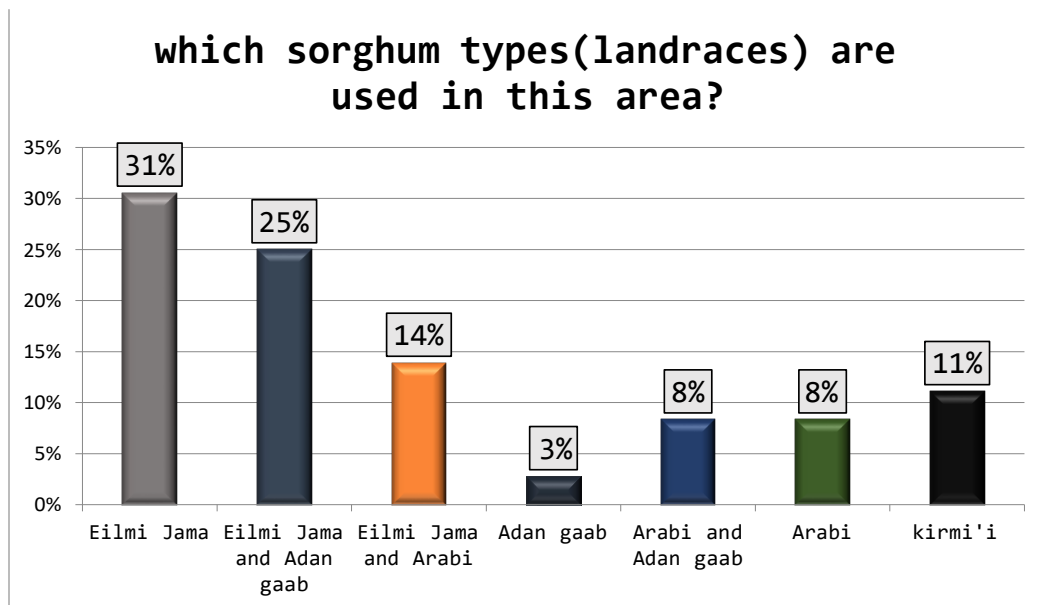
8.4. Crop/Sorghum Production:

The agro-pastoral farming system in study area has production pattern dominated cereals (sorghum, maize and rye) covering over 90% coverage of the area under seasonal production. Cultivation of sorghum is a common practice, for most of the assessed households, and therefore takes the first place in terms of food security and household economy. All interviewed farmers confirmed practicing of sorghum cultivation.

8.5. Sorghum Types

On the sorghum types usually cultivated in their area, responses varied but it was clear the landrace, Elmi Jama was in the lead taking 31%, followed by 25% of farmers supported planting of the two types, Elmi Jama and Adan Gaab together. Field observation and FGD results indicate the two types could be used together or are interchangeable depending on the availability of reliable seeds.

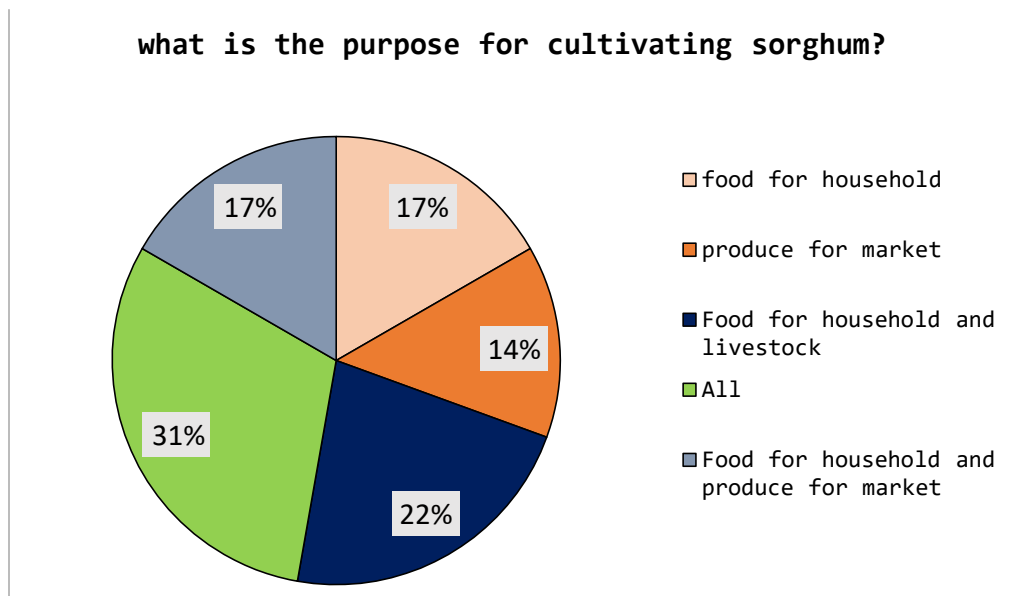
Figure 2 indicates responds to the types of sorghum cultivated in the area, Gabiley Region.



8.5.1. Purpose of sorghum cultivation:

Responses to the question of: What is the purpose for cultivating sorghum? Have also shown a wide variation among respondents . Here, responses on those indicated all purposes at 31%, followed by food for household and fodder for livestock at 22%, food for household and produce for market and food for household each at 17%, and finally produce for market getting 14%.

Figure 3: Shows distribution of answers on the purpose for cultivation of sorghum by farmers in six study villages, Gabiley Region.



8.5.2. Cropping system:

Prevalent cropping system identified by the study were:

- Rain-fed/Food Crop and livestock/seasonal/ multiple-cropping and Rain-fed/Food Crop and livestock/seasonal/mon-cropped
- rain-fed/food crop and livestock/seasonal/multiple-cropping
- rain-fed/food crop and livestock/non-cropped

8.6. Crop management practices:

Crop management practices used by small scale farmers did not show variation and have indicated adherence to a traditionally customized system which passed between generations and strictly observed. Crop management practices recorded which almost all farmers confirmed their practice fell under two categories:

8.6.1. Pre-harvest Practices:

8.6.2. Postharvest Practices:

8.7. Cropping Calendar:

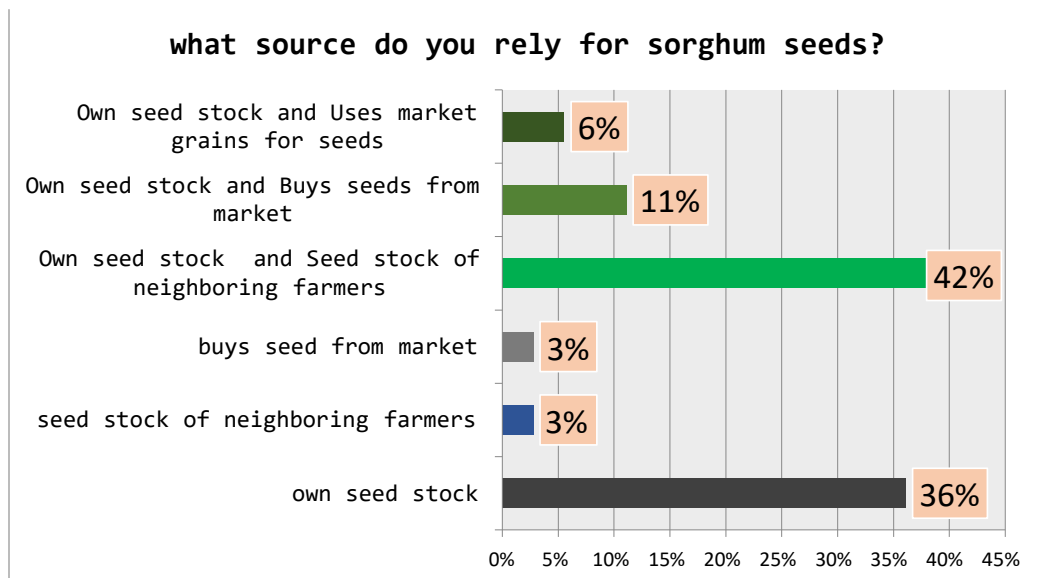
Farming in the area of study follows a tri-modal cropping calendar considered as very important and at least previously strictly observed. The three parts of the production season are:

1. March - April
2. May - June
3. July - August

8.8. Farmers seed sources:

Farmers confirmed different seed sources on which they rely for sourcing sorghum seeds prior to the planting. When farmers asked about their seed sources they rely under normal condition (when own seeds or seeds from other farmers in the same village are available), response of 42% as own seed stock and seed stock of neighboring farmers, followed by response of 36% as own seeds, leaving small space only 22% for all other views.

Figure 4: Key sources small scale farmer households depend for cultivation of local sorghum in normal years, Gabiley Region.



8.9. Reliance of the type of source:

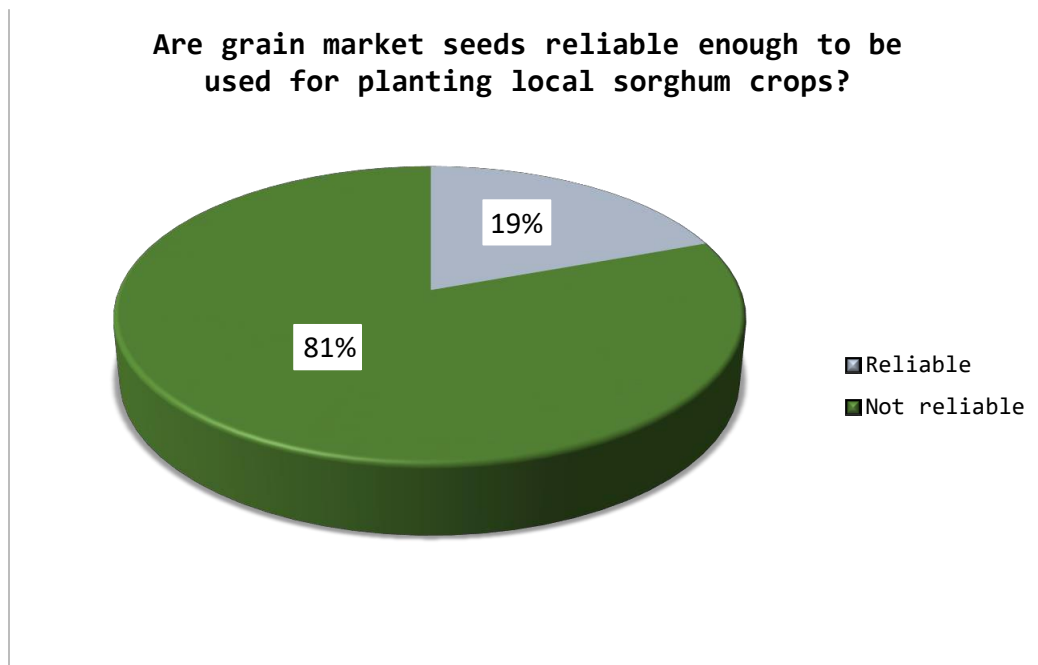
Reliability on seeds has been a major challenge among small scale farmers. Seeds could only be good or quality type if they respond positively to a set of known standard parameters. Farmer's own seeds are usually and normally considered reliable because they are selected, controlled, preserved and used within a predetermined and, informal though, accepted local seeds systems.

Lack of own or local seeds of the known sorghum types, opens to chances to uncertainty in sourcing seeds for cultivation of local sorghum. Under this uncertainty are forces farmers to cope looking for alternative seed sources, sometimes at risk of crop failure due inadaptability to the local conditions or loss of value in the local grain and fodder market.

8.9.1. Are grain market seeds reliable?

Figure x. indicates that out of the 36 interviewed farmers 81% gave responses supporting the assumption grain market seeds are not reliable for use in the cultivation of local sorghum crop. While only 19% believe grain market seeds could be reliable. In community follow up consultation discussions, it was observed this small percent of responds were based on issues of trust with food grain traders, which could true but under isolated situation in the context of social relations.

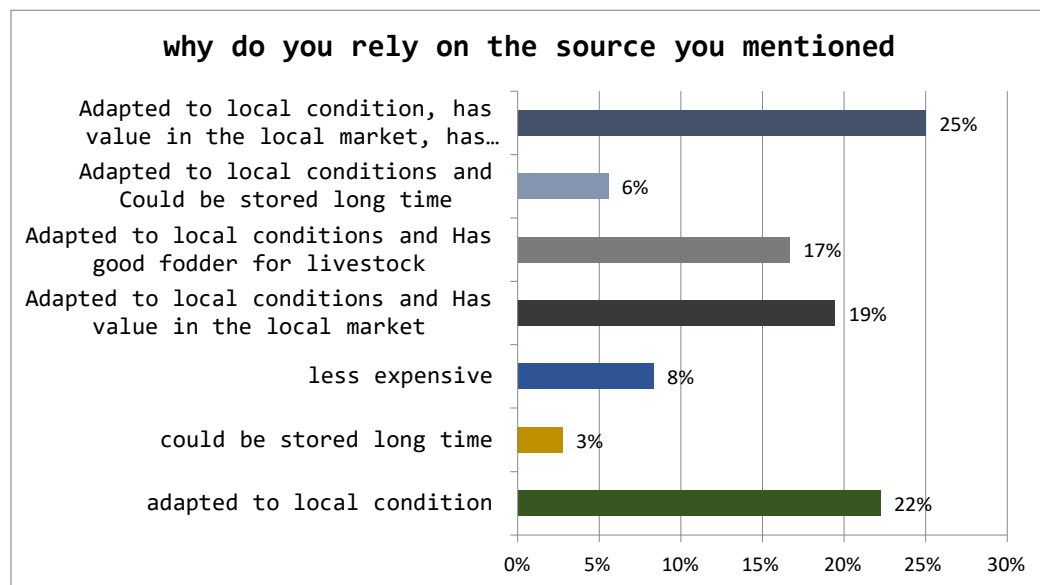
Figure 5: Answers of farmer participants of the survey on whether grain market seeds are reliable enough to be used for planting local sorghum crop



25% of farmers interviewed under this study seem to be critically looking at key economic parameters and stated that seeds to be reliable should be adapted to local condition, has value in the local market, has good fodder for livestock, and could be stored long time. Followed them were those scored 22% who opted for seeds to be adapted to local conditions which is a general term encompassing adaptability to both biotic and abiotic factors affecting crop performance. For farmers however, seeds should be reliable enough to contribute to sorghum productivity in terms of yield, production and market quality. 19% supported adapted to local conditions and has value in the local market.

8.9.2. Why do farmers rely on (reliable seed) source mentioned?

Figure 6: Indicates responses of interviewed farmers on why they rely on specific seeds sources (own or other farmers seeds rather than grain market seeds)



8.9.3. Aspects of production affected by grain market seeds:

Farmer's responses to aspects of production affected by seed quality are summarized in the below table. 31% of responses focused on market value of sorghum products, while 28% rather see production for both grain and fodder, is the major aspect affected. The rest responses spread thinly on the remaining aspects.

Table 3: *Effect of grain market seeds on the performance of sorghum crop, Gabiley Region.*

How does grain market seeds effect the performance of sorghum?

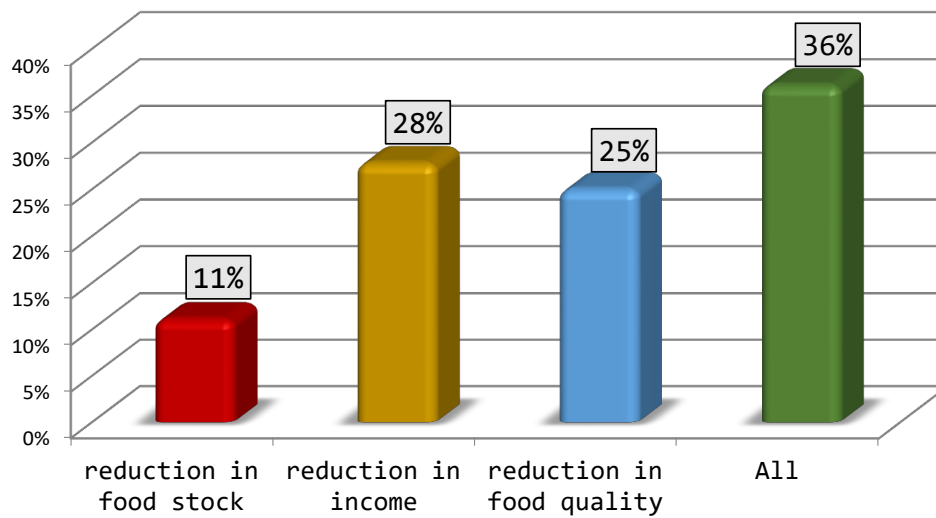
	Percent
yield(grain and fodder)	8%
production(grain and fodder)	28%
market value of sorghum products	31%
storability of sorghum products(grain and fodder)	3%
retention of seeds from sorghum crop	6%
Yield (grain and fodder) and Production (grain and fodder)	6%
Production (grain and fodder) and Market value of sorghum products (grain and fodder)	8%
Market value of sorghum products (grain and fodder) and Storability of sorghum products (grain and fodder)	8%
Storability of sorghum products (grain and fodder) and Retention of seeds from sorghum crop	3%

reduction in income 28%, reduction in food quality 25%, and only 11% reduction food stock.

8.9.4. Economic and food security impact of grain market seeds.

Regarding the possible economic and food security impact of grain market seeds on HH economy and food security, 36% of respondents focused on all areas of possible impact, followed by

Are there any significant economic or food security implications experienced by your HH in the use of seeds from grain market for cultivation of local crop?



8.10. Farmer's seed quality parameters

For their own seeds farmers have certain set of parameters that guide them to select seeds for purity and other seed parameters. These parameters could not be applied to the grain market seeds as such. For grain market seeds in principle it is difficult to determine date of harvesting, date of packaging and duration and conditions of storage.

Same is the identity of the type or types of sorghum from which grains are produced. Despite all this however, as study confirms, the small scale farmer could be forced under certain set of conditions to source seeds from the next, closest and accessible source.

Table 4: *shows farmer parameters to the selection of sorghum seeds.*

farmer seed quality parameters	Percent
Seed dryness and hard and uniform germination	3%
Hardness and size	3%
Seed Color and hardness	11%
Seed Color and hardness and leave size	6%
Seed Color and size	19%
Seed Color and size and germination uniformity	3%
Seed Color and size and leave size	6%
Seed dryness and hard and uniform germination	14%
Seed hardness and color	3%
Seed hardness and size	33%

1.1. Alternative seed sources:

When farmers where asked about the alternative seed source they think more reliable for the small farmer for cultivation of sorghum, majority of response point at

Figure 7: Distribution of responses of the small scale farmer interviewed in the study on alternative sorghum seed sources.

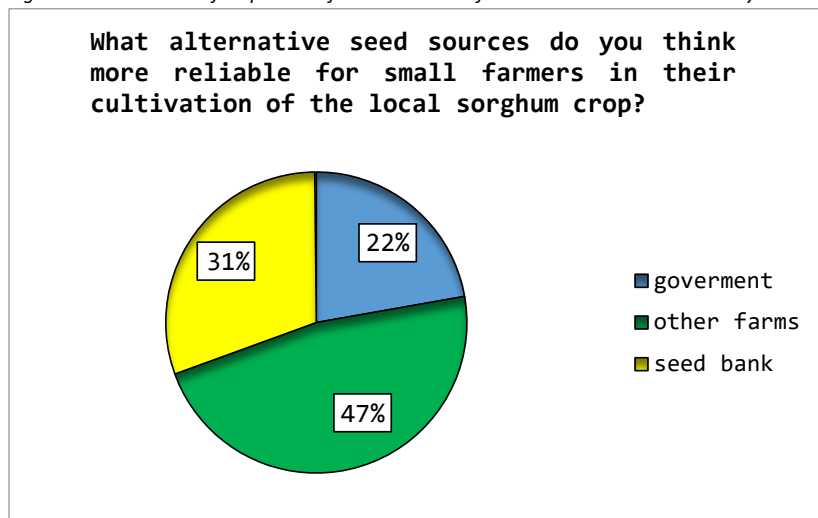


Table 5: Results of the study have validated the conceptual framework adopted for the study, depicting in sufficient clarity relationship between independent variables and dependent variables described on scientific foundations.

		Dependent Variables					Effectuated (% responds)	Food Security Impact (% responds)	Reliability
		Density	Yield	Production	Grain Quality	Market Price			
Independent Variables	G S I	Genetic impurity leads to different plants varying in their growth, development. Physical impurity leads to miscalculation of seed rate in presence of inert material, broken seeds, other seeds, etc. which cause low yield. Presence of seeds of other crops and weeds affect plant growth, development and yield.	Due to genetic impurity yield physiological and phenotypic variation is expected: grain size, ripening, color, weight is expected. This will also affect fodder yield. Yield could be affected because some plants may not have reached harvesting and therefore weigh less in dry state.	Crop plants may respond differently to management, moisture, soil fertility, pests and diseases. As dates of maturity vary among crop plants harvesting time also vary also which will affect drying, storage, weight and appearance.	High chances of poor quality grain product	Grain product finding difficult to compete with sorghum produced from pure seed of known origin.	a) <i>Yield (grain and fodder) (8%)</i> b) <i>Production (grain and fodder) (28%)</i> c) <i>Market value of sorghum products (grain and fodder) (31%)</i>	1. <i>Reduction in food stock (11%)</i> 2. <i>Reduction in income (25%)</i> 3. <i>Reduction in food quality (22%)</i> 4. <i>All (36%)</i>	Grain market seeds are not reliable for small scale farmer cultivation of local sorghum landraces or types. The effect of using sorghum seeds sourced from food grain market may exposes farmers to loss in yield, production, grain quality and therefore market price. The critical result is expected based on the findings of this study, substantial loss of income which reflect on HH economy and food security of small scale famer families in the Gabiley region, and may be in other regions of similar farming systems and type of livelihood.
	L G R	LRG is expected to cause less vigorous seedlings not able to withstand normal field conditions. Some plants may not grow or perform to potential. Some seeds may not germinate, and therefore result in low density crop at a time farmer is unable fill this gaps Low density means low yield per unit area.	Seeds of LRG impact on yield in different ways. Poor germination, poor seedling vigor, poor plant growth and development. Plants never be equally resistant compared to health and vigorous plants. Weak plants produce poor, under-weight grains easily attacked by field and store pests. Weak plants will never compete with weed	Poor yield accompanied widely varying maturity among crop plants result in relatively low production.	LRG seeds eventually result in product of poor quality and incompetent in the market	Sorghum price is expected to be low. The producer of this poor quality product is expected to gain less in returns from sorghum grain sales.			

			plants or plants of the same specie							
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Chapter Eleven:

Conclusions:

All small-scale farmer HH depends on the farm as base unit crops and livestock are raised. Sorghum is a cultivation practiced for the main purpose of securing food for household, fodder for livestock and for the market in surplus years. Among local landraces indicated by farmers, Elmi Jama, was in the lead taking 31% of responds, followed by 25% for Elmi Jama and Adan Gaab together. Farmers explained the use of these two crops for their quality food grain and good fodder. Majority of small scale farmers get their seeds from reliable seed source under two distinct categories on two seed sources as follows: a) 42% rely on both own seed stock and seed stock of neighboring farmers, b) 36% rely on own seeds, while c) Only 22% of assessed small scale sorghum cultivating farmers source of seeds from all sources, including grain market. Out of the 36 interviewed farmers 81% of given responses supported the assumption that grain market seeds are not reliable for use in the cultivation of local sorghum crop. Farmers mentioned lack of information on seed identity, conditions of storage, age and purity. FGD information supported this information.

Farmers see grain market seeds do actually affect production of sorghum, and have significant economic impact in terms of interviews responses, which covered all areas indicated in the question, partially or in totality. Farmer's own seeds are usually and normally considered reliable because they are selected, controlled, preserved and used within a predetermined and, informal though, accepted local seeds systems. Lack of own or local seeds of the known sorghum types, opens to chances to uncertainty in sourcing seeds for cultivation of local sorghum.

To sum up, it is clear from all evidence for all evidence mentioned above, that the practice of sourcing seeds from the grain market by farmers cultivating sorghum under rain-fed conditions is potentially risky, with the high level of uncertainty in terms of yield, production and market quality grain. In this case farmers are forced to buy sorghum grain for seeds while they have no reliable information on the seed including: sorghum type, age, germination rate, presence of diseases, age and the condition under which grain were stored.

Market grain seeds may affect yield and grain product quality due to impurity, low germination rate and vigor as a direct result of inconsistency to plant population, growth and development inconsistency of production. The indication is that in the normal year scenario, farmers strongly believe their own seeds and the seeds from other local farmers are reliable. Under certain conditions, particularly recurrent droughts, many farmers lose or fell in shortage of the seeds they were familiar with. The indication of alternative seed sources, as suggested by farmers included: government seed and community seed banks (which are not widely available currently) and seeds from other farms.

More research is advisable for aspects that have been found important in this study including: economic implications for the small scale farmer HH, role of specific quality parameters such seed impurity, presence of weeds and other types of sorghum, issues to grain quality and market price dynamics. Ongoing work on the local seed systems, like the Somaseed Project (Improving quality of seeds in Somalia, 2016-18, despite progress to recover seeds of local food crop (sorghum, maize and cowpea) landraces in their pure form and building the technical capacity of local seed growers, and the Ministry of Agricultural Development to assume the role of germplasm management in the country, there is, however; a lot to be done regarding operationalizing and stabilizing the system to reduce the

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Commented [BD2]: Then, why don't they use their own seeds? Are they insufficient? Why? Explain.

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impact of seeds sourced unreliable sources the quality information of which could not be verified by these source. At a practical perspective, for farmers to avoid this challenge, the recommendable solution could be reconstitution of local seed systems, operationalizing the national seed policy, working with all stakeholders towards development of strategic seeds programme. This opens a safe avenue for local farmers to access quality seeds, which currently is existing partially. Assurance of the essentially needed seeds, particularly those of the different sorghum types, will depend more on the functional capacity of the parts of the local seeds system including: informal and formal (institutional) seeds systems, seed trader networks, national mechanisms for germplasm conservation and a viable regulatory framework under which the functions of all these are consolidated.

Chapter Twelve:

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List of Small Scale Farmer Participated in the Survey.zip

Conclusions

