

Funded by the Ministry of Agriculture, Forestry and Fisheries of Japan

**Feasibility Survey on Local Production for
Local Consumption (Chisan-Chisho)
Activity and Extension in Africa**

Final Report –First Year-

March 2017

JAICAF ジェイカフ

**Japan Association for International
Collaboration of Agriculture and Forestry**

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Collaboration of Agriculture and Forestry

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Preface

Today, more than half of the employed population in Africa are involved in agriculture. Even so, the percentage of agriculture sector accounting for GDP is under 20%, calling for a resolution to the problem of poverty in rural areas. To solve this problem, it is essential to improve the incomes of farmers in Africa by encouraging the transition from subsistence agriculture to commercial agriculture. To that end, there has been a greater attention to utilizing Japan's knowledge in promoting the local production for local consumption model in Africa.

Based on the circumstances, we, JAICAF, with subsidies from the Ministry of Agriculture, Forestry and Fisheries of Japan, implemented the technology of puff cereals (popped cereals) in rural areas in Kenya as part of the activities of local production for local consumption in the context of the actual situations in Africa to survey a dissemination possibility. While the project surveyed the feasibility of local production by making a prototype of pressure popping machine in local factories based on the Japanese-made pressure popping machine, we lent the pressure popping machine to farmer groups and entrepreneurs so that they could produce and sell popped cereals made using local agricultural products to check and see if they have a new opportunity to increase their incomes. It also revealed that by processing local grains, beans, nuts and potatoes into popped cereals, which were not utilized in the past, these crops became available for consumption, contributing to nutritional improvement. The primary objectives of this project are to disseminate activities using pressure popping machine and to provide support for sustainable management. The results of these activities highlighted several technical problems and challenges.

In this report, we put together the outline and the results of the activities above. We expect that the project results will contribute to the activities of local production for local consumption in the region and concurrently, they are utilized by private companies in Japan as well as people who are involved in international cooperation. We will be pleased if our report is of help to those concerned.

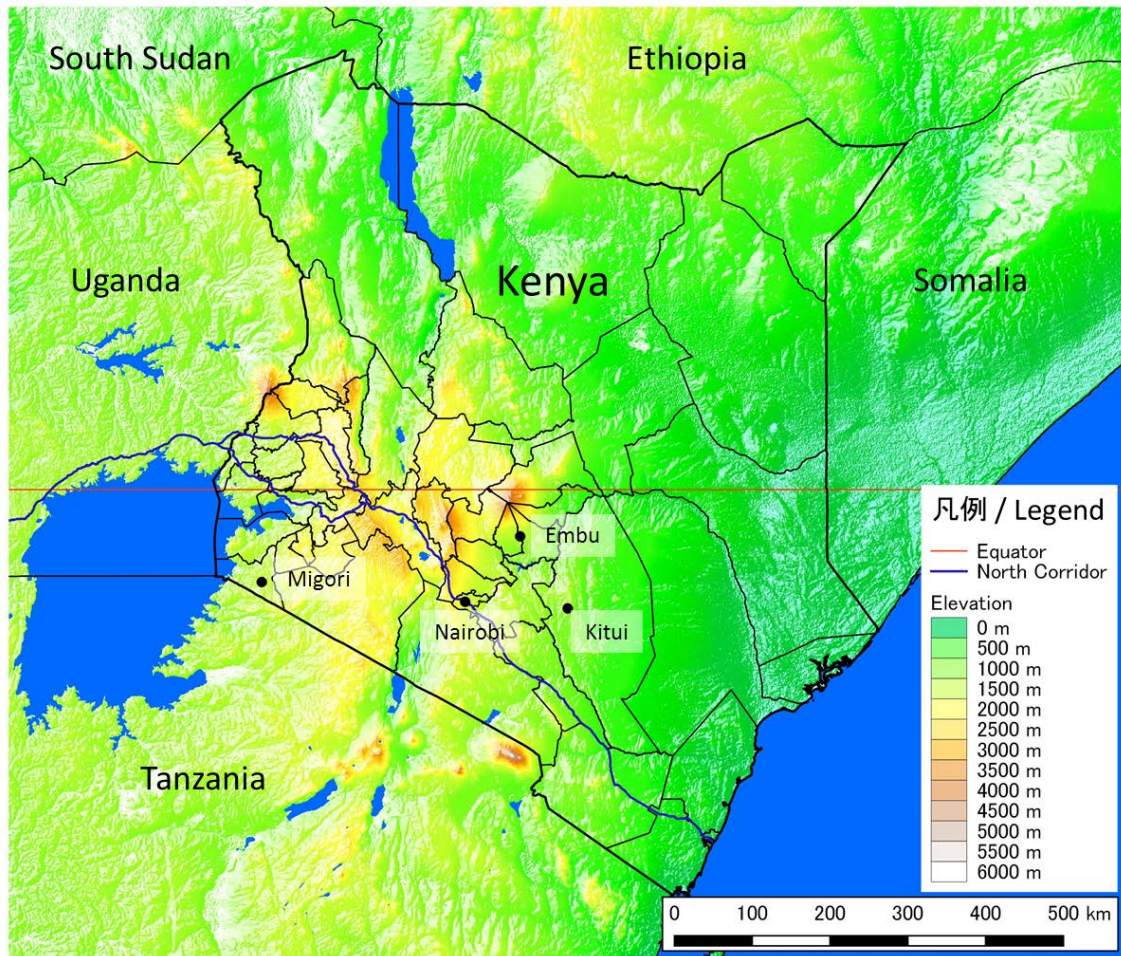
For the implementation and operation of this project, we received a tremendous support from each expert dispatched to the site. In addition, the expert committee, which was separately established in the JAICAF headquarters, provided us with guidance and advice on planning this project and the evaluation studies. For the activities by our experts in the country concerned, we received cooperation from many organizations: the

Japan International Cooperation Agency (JICA) Kenya Office and JICA's Rice-based and Market-oriented Agriculture Promotion Project, Smallholder Horticulture Empowerment and Promotion Unit Project, Dr. Morimoto, who is a researcher of Bioversity International and Dr. Kanda of the CDC International Corporation. We deeply appreciate their cooperation.

Lastly, we wish to make clear that this report was created under the responsibility of our association and does not represent the opinion of the Ministry of Agriculture, Forestry and Fisheries and the Japanese Government.

March, 2017

Ryuzo Nishimaki, President
Japan Association for
International
Collaboration of Agriculture
and Forestry



Project Activity Map

Source: Javis, A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled SRTM for the globe Version 4, available from the CGIAR-CSI SRTM 90m Database (<http://srtm.csi.cgiar.org>)

Project Photos



Photo 1 Farmers Self Help Group in Kitui. They are selected as first group to introduce a popping cereal.



Photo 4 Technical guidance by Ieda Seika in Kitui. They were processing popped cereal to plate shape like a Biscuits.



Photo 2 Self Help Group in Kitui started to use a pressure popping machine.



Photo 5 Popped cereal processed as plate shape. Processing will make profit rate improved.



Photo 3 Popped cereal made by Self Help Group in Kitui. They used local agricultural products like a Sorghum.



Photo 6 cereal which was not popped is cooked to porridge.



Photo 7 Trial production of a pressure popping machine in the city (JKUAT).



Photo 10 Seasoning of popped cereal. They used brown sugar or honey.



Photo 8 Trial production of a pressure popping machine in the city (DK engineering)



Photo 11 Self Help Group were packing using candle fire.



Photo 9 The training team introduced popping machine to Self Help Group in Migori.



Photo 12 The training team demonstrated a pressure popping machine in suburbs of Embu.



Photo 13 Popping machine was introduced to an entrepreneur in Embu. He popped many times in a day to improve profit rate.



Photo 16 Local government officials who are strongly interested in popping cereal inspected Self Help Group in Kitui.



Photo 14 The popped cereal that processed like a ball using starch syrup. It will improve profit rate.



Photo 17 The project held the workshop. Engineers gave a lecture about technical know-how of popping machine.



Photo 15 The entrepreneur in Embu was wearing popped cereals for efficient exhibition sale.



Photo 18 Participants of the workshop discussed about excellent business model using pressure popping machine.

Abbreviations List

Abbreviation	Standard name
ACEF	Africa Children Education Fund
CARD	Coalition for African Rice Development
CGIAR	Consultative Group on International Agricultural Research
GDP	Gross Domestic Product
JAICAF	Japan Association for International Collaboration of Agriculture and Forestry
JICA	Japan International Cooperation Agency
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural and Livestock Research Organization
KEBS	Kenya Bureau of Standards
KIRDI	Kenya Industrial Research & Development Institute
NPO	Nonprofit Organization
ODA	Official Development Assistance
RiceMAPP	Rice-based and Market-oriented Agriculture Promotion Project
SHEP UP	Smallholder Horticulture Empowerment and Promotion Unit Project
TICAD	Tokyo International Conference for African Development

Kenya Shillings :

1 JPY = 0.89050 Ksh (<http://www.exchange-rates.org/converter/JPY/KES/1/Y>, access 2017/03/10)

Feasibility Survey on Local Production for Local Consumption (Chisan-Chisho)

Activity and Extension in Africa – Final Report – First Year –

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Chapter 1 Project Report Summary

1. Purpose of the project

While more than half of the workers in Africa are engaged in farming, the proportion of the agricultural sector to GDP is less than 20% and an initiative towards the improvement of the agricultural field, which is the largest economic sector in Africa, is important to solve the issues on poverty in rural districts.

Recently, in Africa, its economy is developing based on the urban areas and economic development is expected in conjunction with the infrastructure improvements based on the “five major growth corridors improvement support” that was announced in TICAD V. For the increase of income of the rural areas, an initiative for expanding the economic development towards the rural areas is required.

In Japan, income increase, employment creation, and revitalization of the regions have been achieved through the approach for direct sales stores and processing of agricultural products whose integrated business plans have been approved by the law concerning the creation of new business interests by agriculture, forestry, and fishery etc. utilizing regional resources and promotion of use of agricultural, forestry, and fishery products in the region (Law No.67, 2010). The objective of the “Feasibility Survey on Local Production for Local Consumption (Chisan-Chisho) Activity and Extension in Africa” is to improve the farming income in Africa by shifting the self-sufficient type of agriculture in Africa to the commercial agriculture through demonstrations, while examining the approach of local production for local consumption based on the actual conditions of Africa by utilizing the knowledge gained in Japan.

2. Contents of the project

This project selected Kenya as the target country. In Africa including Kenya, there are many agricultural products that are grown locally, which are native agricultural products. As most of these products have hardly any added values, the products are regarded as underused local agricultural products. This project selected these native local agricultural products. A “pressure popping machine” was focused as the primary candidate of agricultural product processing and direct sales operation due to its low initial investment required by farmers and processing simplicity, while the independent agricultural product processing method used by local farmers are assumed to be extremely difficult.

In this project, local agricultural products that can be used for agricultural product processing such as popped cereal processing were selected including local cereals, beans, nuts, and potatoes. Empirical secondary research was conducted regarding the

nutritional values and local knowledge for using the products such as the traditional food cooking methods and at the same time, empirical research was conducted for the process including prototyping of a pressure popping machine locally, loan to farmers' groups, production and sales, product development, and promotion.

Specifically, local prototyping of pressure popping machines was implemented by using a pressure popping machine that was manufactured in Japan. Through the attempts of production and sales of popped cereals by leasing a pressure popping machine to farmers' groups and entrepreneurs, verification was conducted as to whether a pressure popping machine can contribute to the activity towards the local production for local consumption based on the actual situation in Africa. By inviting farmers' groups and entrepreneurs that were engaged in the production and sales of popped cereals and government officials, a seminar (workshop) for promoting the local production for local consumption was conducted.

3. Summary of the result

Three manufacturers around Nairobi were selected for producing prototypes of a pressure popping machine and through trial and error, one manufacturer successfully produced a prototype. Technical problems regarding the molding of furnace and lid were solved by the technical guidance provided by a Japanese company, Pressure Popping Machine Sales.

Regarding the installation of pressure popping machines, farmers' groups and entrepreneurs who are interested in the use of pressure popping machines were selected from Kitui County, Migori County, and Embu County and pressure popping machines were installed. In all the cases, popped cereals can be produced and sold after the proper installation and training. Pressure processing by a pressure popping machine brought a new economic value to the local agricultural products as a new cooking method based on grains. It was also found out that beans, nuts, and potatoes could also be processed by a pressure popping machine as well as grains.

Many original ideas were presented for popped cereal processing and flavoring methods, sales methods, and price setting through the initiatives of farmers' groups and entrepreneurs. The profitability of popped cereals can be improved by molding them with brown sugar and malt syrup. The molding of popped cereals was made possible by the technical support provided by Ieda Seika, a Japanese company.

The achievements of the project were widely promoted by presenting them at various events including presentations at agricultural trade fairs, demonstration sales, and seminars. Each local government showed strong interest in the activities of local

production for local consumption under this project and started examination of the support measures including human resource development. Although the support interests that farmers' groups can receive include bank loans, independent methods such as the fund management system within the region seem to be effective since the bank loan interest rates are high.

The farmers' groups, entrepreneurs, factories, and government organizations that installed pressure popping machines participated in the workshop that was conducted at the end of the project and the farmers' group and the entrepreneurs announced their activities for local production for local consumption. During the discussions at the workshop, many opinions were presented in order to achieve an excellent business model such as the development of new products, the determination of an optimum price and sales volume, and a demand enhancement method.

According to the case study that was reported, while the unity was enhanced among the members of the farmers' group, cracks appeared within the group once the operation did not go smoothly with the aspect of unfair distribution of business revenues and work force, impairing the business progress. This issue was caused by unclear direction towards the purchase of a machine using a loan, dependency on the machine, and ownership within the organization. As a countermeasure for such a problem, discussions were commenced in this project regarding the independent purchase of machines for farmers' groups or individuals in a farmers' group to clarify further the dependency of the machines that were leased.

It was proved that a pressure popping machine increased the utilization opportunities of local agricultural products, thereby contributing to the improvement of income and livelihood of farmers, and presenting a high expectation. In response to this expectation, local staff provided a suitable support (training) to the business operators who wished to undertake this business for the purchase of machines, handling and installation methods, popped cereal processing techniques, and sales. For further promotion and expansion of the business, it is necessary to reinforce the structural improvements so as to enable development of specialist staff and provide individual consultations.

Chapter 2 Extension survey of “local production for local consumption” activities

1. Overview of the project

1) Selection of project target regions

For this project, the Republic of Kenya (referred to as Kenya henceforth) was selected among the Northern corridor neighboring countries of Sub Sahara Africa. The reasons for the selection are as follows.

- ① Dr. Yasuyuki Morimoto, a researcher in Bioversity International, who played the central role in the activities of this project has conducted the feasibility research on the production and sales of popped cereals from cereals (sorghum and pearl millet) that are sourced from Africa since 2006 and his contribution to the revenue increase as well as his abundant experience have already been proven. Problems and improvements to be made relating to the activities have been clarified and the focal points of the activities in this project have been determined. Dr. Morimoto has a wide range of contacts within the research institutes of Kenya and has a good foresight regarding the implementation of promotion activities through the cooperation with KALRO and nutrient composition analysis at the local sites.
- ② The industrial technology of Kenya, which is the starting point of the economy and distribution in East Africa, is more advanced than those in the surrounding regions. Kenya supplies automotive parts to the entire East African region and at the same time, there are many private companies that have advanced lathe technology and metalworking technology. There are also excellent machine tool manufacturers that are specialized in food processing and order placement and technical cooperation to these private companies were considered to be essential for local production and part procurement for puff processing and pressure cooking equipment (pressure popping machine).
- ③ JAICAF established cooperation relationships with many concerned parties in the “Ministry of Agriculture, Forestry, and Fisheries subsidized project: Feasibility Survey Project on Agricultural Mechanization for the Small Scale Farmers in Sub Sahara Africa” (implemented from 2013 to 2015), enabling the smooth and effective implementation of research within Kenya.
- ④ In Kenya, there are many research institutions associated with the JICA project such as government organizations and universities, bringing advantages in implementation of collaboration activities over a variety of fields such as agriculture, mechanical engineering, environment, nutrition/health, and so on. In particular, there is the Kenya Bureau of Standards (KEBS) certificate as a processed agricultural food certification system, and the Jomo Kenyatta University of

Agriculture and Technology (JKUAT) that provides training for the acquisition of the KEBS certificate.

2) Background

According to the population census of Kenya conducted in 2009, about 70% (28 million) of the population of Kenya live in rural regions and about 80% of the land is within dry or semi dry regions. Kenya has many issues including the environmental disasters due to drought and flooding, unemployment mainly among the younger generation, concentration of population in urban areas, and an increase of underclasses. A half of the rural population depend for their livelihood on rainfed agriculture and due to the low availability of local industries in rural areas, farmers are forced to depend for their livelihood by earning their income from limited natural resources (charcoal making and building materials by cutting trees) (Nabutola 2010 and Muyanga 2014).

Based on these facts, the Japanese Government has provided production promotion (CARD, etc.) through the improvements of agricultural infrastructures and production technology of staple crops, a market-oriented production support (SHEP UP) for horticultural crops (tomatoes, cabbages, etc.), and agricultural promotion support (RiceMAPP) based on rice farming. Although the production has increased based on these efforts, many agricultural products remain unprocessed and there exists a necessity for future improvements and development latency in terms of improvement of farming income, development of local industries (including distribution and storage), chronic malnutrition due to the seasonal and climate change, and agricultural ecosystem conservation.

On the other hand, there are many crops (local agricultural products) that are cultivated in the limited regions in Africa such as native vegetables, grains, and fruits. Many of these local agricultural products have high locality and often remain within the self-contained production and consumption in the region. However, they play extremely multi-facet roles for farmers, have high adaptability towards the limited environment, can grow even by low input, closely adopt to the climate and customs of the region, are closely related to the local cuisine, and ethnic language, and are useful as the income source of the rural village as well as a source of nutrition for the residents.

According to the report by Maundu and others (1999), there are about 850 types of edible plants in Kenya (50% account for fruits including nuts) and 80% of these plants are underused local agricultural products that are not distributed in the local markets due to their low added values. In Embu County, which is famous as a rice-producing district, cereals that originated from Africa (sorghum, pearl millet, finger millet, and

yam) have been mainly cultivated as the staple food until the beginning of 1960's and even currently, in the eastern region of the County, cowpea, pigeon pea, corn, green gram, hyacinth bean, cassava, sweet potato, tea, and coffee are cultivated as well as these cereals (Hirose 1988).

Such local agricultural products as these, in particular, most of the cereals, are being replaced by the selection of minor crops/minor varieties due to the economic preferences and introduction of improved varieties due to modern germination techniques in the course of the increase of food production associated with the population increase. The traditional knowledge relating to the use of these products is disappearing without being fully understood for their diversity and usefulness due to the change of sense of values by modernization, migration of young people out of rural areas, and the death of old people who are familiar with and pass on the use of such products.

Kenya advocates the development and promotion of the agricultural industry, and new industrial technologies to enhance the distribution and added values of agricultural products in its medium-to-long term national development strategy "Vision 2030". This situation is considered to continue in the future also and it is desirable to maintain the diversity and availability of the native plants, which is the issue indicated above, while aiming at the targets that are set out by the development strategy.

Based on this background, this project attempted to add the high values and diverse utilization of local agricultural products including grains, beans, nuts, and potatoes, which are specific to the region by focusing on these native local agricultural products and introducing "popped cereals" as the food processing technology. In addition, this project conducted empirical research to achieve income generation in the rural areas. As the empirical incidental research, this project identifies the local agricultural products that can be used for popped cereal processing.

3) Related activities prior to the implementation of this project

While local agricultural products have many merits as described above, their utilization has not been progressed due to the factors such as those listed in Table 1. By identifying such problems comprehensively, Dr. Yasuyuki Morimoto, a researcher of Bioversity International focused on the grain pressure expansion (puff processing) technology and a pressure popping machine as the potent technology leading to the increased utilization of local agricultural products. Since the beginning of 2006, he has been engaged in the feasibility study for the improvement of farmers' income and children's nutrition in Busia County and Kitui County in the West of Kenya by using popped cereals made of the native cereals (sorghum and pearl millet) of Africa and has

demonstrated the contribution to the improvement of farm income. Through these preceding activities, the problems and improvements to be made have been clarified and the focal points of the activities to be implemented by this project were selected.

Table 1. Factors hindering the progress of utilization of local agricultural products and effects of the introduction of pressure popping machines

	Factor	Effects by the introduction of pressure popping machines
1	Low economic efficiency. Low demand. Limited distribution and supply.	Addition of a new economic value by processing
2	Seasonal and difficult to store.	Storage by processing
3	Traditional cooking method. Cumbersome cooking process.	Proposal of new cooking methods
4	Limited cooking utensils	Use of the existing technologies within the region
5	Insufficient research. The use is not widely known.	Recording of traditional knowledge and analysis of nutrients by project activities

The activities performed by Dr. Morimoto's research regarding popped cereals prior to the implementation of this project are as follows.

① May 2006: Development of a first prototype model of a pressure popping machine in Kenya

By receiving a drawing of a pressure popping machine from Mr. Fukui, teacher of the Machinery Department of Himeji Technical High School, Hyogo Prefecture, all the parts were procured through the technical support of Mr. Hideki Ishigaki, a member of Japan Overseas Cooperation Volunteers (welding).

② December 2006: Leasing of a prototype model to the farmers' group 1.

A prototype model was leased to the young farmers' group in Busia County of Kenya and production and sale of popped cereals using the local cereals were attempted. As a result, puff processing was applied to 32 types of local agricultural products by the farmers' group in Busia County and it was confirmed that 13 types can be used for popped cereals. As a result of the market evaluation that was conducted, popped cereals that were produced from four types of crops (sorghum, rice, corn, and soybean) were highly evaluated. It was confirmed that this proposal does not require any initial investments other than the installation of a pressure popping machine and is effective as a new income source of the activity members by selling the products within the

region. This popped cereal production and sales trial under the resident initiative received the award for excellence at the “International Symposium for Low-Use Crop Resources” that was held in Tanzania in March 2008. “BBC Radio”, a UK broadcast organization, widely broadcasted this popped cereal production as the first attempt in the rural village in Africa and the farmers’ group as the successful case study. On the other hand, it was revealed that no companies or human resources that are capable of handling faults and improvements of the machines are available within the region and the identification of private companies that can respond to the utilization requirements of the farmers’ groups and technology introduction are the issues to be resolved.

③ May 2011: Leasing a prototype model to a farmers’ group 2

Africa Children Education Fund (ACEF), an NPO of Kenya, installed a Yoshimura type pressure popping machine that was manufactured in Japan, and a women’s group in Kitui County leased this machine. With the stable production and sales of popped cereals by using the Japanese pressure popping machine, information and experience on the profitability and the distribution that could not be verified at Busia County could be obtained. A net profit of about US\$5 could be gained from 1 kg of corn (about US\$1) and a net profit of about US\$6 could be gained from 1 kg of sorghum (around US\$1). Although popped cereal market within rural districts is limited, the support for production farmers such as KEBS (Kenya Bureau of Standards) acquisition is expected based on the supply of popped cereals to the supermarkets and schools in the region into the perspective. The problem is the absence of human resources and companies that are capable of proper repair and improvements at the failures of machines within the country of Kenya, and the identification of the local private companies that are capable of repair and improvements of machines and staff training are required. The machine needs to be designed so that only the section to be repaired can be isolated when a repair is required, instead of having to send the entire pressure popping machine to the factory. Dr. Morimoto received enquiries relating to pressure popping machines and questions relating to the business from the Government, private operators, and individual investors in South Africa, Mozambique, and Tanzania. Most of them are the questions on the availability of the local companies that can manufacture pressure popping machines and installation of machines from Japan, thereby showing high expectations towards the continuation and further development of this project. Yomiuri TV in Japan also introduced the efforts by Mr. Morimoto on the TV program called “Globe Zoom-In”.

4) Popped cereal technology

(1) Advantages

The popped cereal technology offers the following advantages.

- ① New values can be added to local agricultural products (abundant and cheap grains native to Africa: sorghum and millet) through puff processing. New values can also be added to staple crops that are currently sold unprocessed such as rice, corn, and wheat. As for rice, old rice and rice stored for two years are more suitable for producing the products of better texture and tastes than new rice in relation to its water content.
- ② By gradually releasing the pressure, a pressure popping machine can also be used as a normal pressure cooker. As a result, perennial beans, nuts, and potatoes can be processed differently from the conventional way, leading to new ideas for processing products by farmers (such as processing beans and nuts into powder form after roasting them). It has been confirmed that, by applying puff processing for beans including soybeans, digestive enzyme inhibitors can be deactivated.
- ③ This technology generates a new income source for farmers. The cost can be set for the product by processing. The impact associated with the fluctuation of the raw material values can be reduced.
- ④ Local agricultural products are suitable for the local environment and many crops do not require much input. An increase of production as a result contributes to the conservation of the local environment and soil, and also improvement of environment resilience. (Utilization of diversity and agroforestry, and so on).
- ⑤ Consumption of more local agricultural products results in the intake of a variety of nutrients regardless of the season. The main consumers of popped cereals are children and women and this technology has a possibility of giving a substantial contribution to the improvements of their nutrition.
- ⑥ Local agricultural products are closely related to the food culture such as local cuisines. This technology generates a new market, thereby contributing to the utilization of the products by young people and enhancement of preservation consciousness.
- ⑦ The structure of a pressure popping machine is simple, enabling local manufacturers for mass production and parts supply. The manufacturing cost is also not different (possibility of popularization).
- ⑧ Various types of fuels can be used to operate a pressure popping machine, including firewood, charcoal, gas, and electricity, enabling the selection of the energy resources that can be most easily available.

- ⑨ The processing is very simple and the product is completed in 5 to 7 minutes after feeding in the ingredients. The procedure from the processing to the sale (packing, packaging, etc.) is very simple, enabling the handling within the rural villages.
- ⑩ Since processed popped cereals can be stored at a normal temperature for a period of around one week, they can be produced in advance to some extent and can be handled by rural shops without adequate infrastructure.
- ⑪ Popped cereals can be flavoured as desired by glazing with heated treacle, or sprinkling powder sugar, salt, or chilli pepper.

(2) Overview and production method

Popped cereals are also called “Ponpon cereals or Panpan cereals”, or “bomb” due to its popping sound when they are cooked. The production machine is called a grain expander. Place grains such as uncooked rice in the rotary cylinder type pressure cooker, seal the cooker airtight by replacing the lid, and heat the whole cooker by rotating. When the inside of the cooker is adequately pressurized (around 10 atm), release the pressure of the cooker at once by releasing the valve of the pressure cooker with a hammer. At this time, the moisture inside of the ingredients expands suddenly and the contents pop out vigorously with a loud explosive sound. Therefore, in places other than special factories, the lid must be released by installing a net basket on the machine to catch the lid. For the sound emitted at this time, the product is called “Pon confectionery” or “Don confectionery”. In the process of expansion, the volume of rice expands to 10 times of the original volume, producing a confectionery of light texture. The shape is an expanded shape of the original shape and the taste and texture are very similar to those of cereal food items. In Japan, in general, popped cereals are flavored by glazing with heated treacle or by sprinkling with powder sugar.

(3) Origin of puff processing

The puff production method from grains has a long history. In 1901, Alexander Pearce Anderson, a researcher in Minnesota University, discovered that rice expands during the implementation of research on grains. He placed rice in a test tube and placed a lid on the tube by mistake while heating it in an oven, resulting in explosion of the test tube. Expanded rice grains were found among the broken glass pieces. Anderson obtained a patent and conducted experiments on various materials as to their expandability in the Research Laboratory of Quaker Oats Company by affiliating with the company. Later, he marketed the popped cereals from rice as “puffed rice”. The flashy puffed rice making demonstration that was presented by using a brass cannon in

Saint Louis EXPO in 1904 attracted much attention and as a result, puffed rice was widely recognized and immediately gained a popularity.

(4) Use of popped cereals in Japan

In Japan, popped cereals were popular amongst the children as a standard confectionery from the Taisho era to around the middle of the Showa era. Popped cereals were sold in the open air by peddlers who went around regional areas and those that were produced in special processing factories were packed in individual plastic bags and sold. As they are susceptible to moisture and are much crispier immediately after being cooked, popped cereals that were sold by peddlers were much favored. It was often seen that a peddler brought popped-cereal equipment to an open space where children gather and demonstrated the making of popped cereals in front of them. However, the number of such peddlers decreased and currently it is rare to see the production of popped cereals.

In the Japanese army, a “compressed ration” was developed and applied as a portable food ration by pressing expanded refined rice firmly into a small shape and using it as supplementary food. The ingredients of the staple were changed to a mixture of 70% of brown rice and 30% of pearling barley or 100% of barley and the compressed shape was also changed to bite-size equivalent to a large mahjong tile (extracted from popped cereals in Wikipedia). A zinc plate was used for packing the lid to maintain the air pressure inside of the cooker previously, currently a Teflon plate is used since the health damage caused by zinc contamination was reported.

5) Superiority of this project

The superiority of this project is based on its comprehensive inclusion of all the elements of the three pillars proposed by the Ministry of Agriculture, Forestry, and Fisheries, towards the hosting of TICAD VI (① Adding values to agricultural crops, ② Nutrition improvement of residents, ③ Improvement of environment resilience) and contribution to the sustainable use and conservation of regional resources.

By using the local agricultural products that have no added values, this project contributes to the development of local industries, increase of farming income, and nutrition improvement by food diversification as well as advocates a new form of local production for local consumption in Africa such as conservation of crop genetic resources, and traditional agricultural production environment.

Based on these themes, the aim is to demonstrate the leadership of Japan in the agricultural and environmental fields, which are important fields for Africa, by

proposing sustainable use and management of agricultural resources and realization of a healthier and richer life (defined as the green revolution in Africa) in many African regions where unstable agricultural management is forced due to the unstable international food market and the impact of the climate change.

2. Contents of the project

1) Activity schedule

The project was implemented for the period of 11 months from May 6, 2016 (subsidy granted) to March 31, 2017.

2) Contents of the activities

In this project, empirical research was conducted for the consumption increase and increase of farming income by adding new values to local agricultural products such as region-specific grains, beans, nuts, and potatoes by using the popped cereal processing technology as the food processing technology and by marketing and spreading the products as processed food products of the local brand. The empirical research activities are classified into the following two main categories.

① Local manufacturing of pressure popping machines

A prototype was produced by faithfully duplicating the pressure popping machine manufactured in Japan (Japanese machine installed in Kenya by the Africa Children Education Fund: Yoshimura One-Sho type pressure popping machine) and improvements were examined. The sections that cannot be manufactured locally were specified including the suppliers of the parts. Consequently, local sales of the machines were commenced for the purpose of the local manufacturing of the machines and the establishment of the manufacturing engineering for mass production and repair and management methods.

② Popped cereal promotion and empirical research activities

Production and sale of popped cereals were implemented by leasing a pressure popping machine to the farmers' group. The following five activities were supported.

- Development of local brand products under the farmers' initiative
- Training relating to the acquisition of the food sanitation certificate, label indication, and packages
- Promotion of the business and development of achievements
- Supply of information and technology to voluntary entrepreneurs (individuals and

groups)

- Production and sale of popped cereals by leasing a pressure popping machine to farmers' groups

For the local manufacturing of the machines, technical support was provided by the Pressure Popping Machine Sales in Otaku, Tokyo and for the aspects of popped cereal processing and product development, technical support was provided by Ieda Seika in Chita-gun, Aichi Prefecture.

The following six items were examined as the secondary empirical research.

- ① Local agricultural product diversity evaluation
- ② Specification of popped cereal processing of target crops
- ③ Local product sales evaluation
- ④ Target crop nutrient composition analysis
- ⑤ Recording of traditional use of target crops (Traditional Foodways)
- ⑥ Support system investigation towards business expansion

3. Results of activities

1) Local manufacturing of pressure popping machines and establishment of a mass production system

(1) Specifying factories

Field survey was conducted on May 2016, targeting five potential companies engaged in machining operation in the industrial district in the suburb of Nairobi, which is the largest industrial district in East Africa. As result, three companies were selected (Table 2) based on the several items including the manufactured products, working machine, factory environment, field of expertise, estimated cost for the machine production, and response of the company towards the visit to each company, and an order for production of a prototype of a pressure popping machine was placed to each company. At the ordering, production of a prototype was requested by providing the design drawing of the pressured popping machine that was provided from the Himeji Technical High School and a Yoshimura One-Sho type pressure popping machine manufactured in Japan was provided for about two weeks.

Table 2. Three companies to which a pressure popping machine was ordered

	Name	Feature	Initial estimate	Ordered date	Result	Company URL information
1	Multi-demotion Engineer LTD	Factory with expertise of iron processing	KSH 36,700	May 23	Incomplete (atmospheric pressure leakage)	http://www.multidimensions.co.ke/
2	Engineering workshop, Jomo-Kenyatta University of Agriculture and Technology (JKUAT)	Machine Engineering Department, National University	KSH 55,889	May 10	Incomplete (atmospheric pressure leakage)	http://www.jkuat.ac.ke/colleges/engineering/
3	DK engineering LTD	Expertise in cooking utensils	KSH 58,000	June 8	Complete (KSH 80,000) Sale price (KSH 100,000)	http://www.dkengineering.co.ke/

(2) Prototyping of the machine

This is the first prototyping experience for all the three companies and the production time limit and final amount were not set. Although each company finished a duplicated prototype model within the period of one month to one and half months, they were frustrated by the atmospheric pressure leakage from the pressure cooker and repeated trial and error. The main cause of the atmospheric pressure leakage was lack of uniformity of the shape of the lid or parts of the cooker. The Jomo-Kenyatta University initially overcame the problem of the atmospheric pressure leakage. However, the lid section was deformed due to the insufficient strength during the use of the machine, resulting in the pressure leakage again. To solve this problem, cooperation was requested to Mr. Yoshimura of Pressure Popping Machine Sales in Japan and engineering guidance was received through Skype. Based on this guidance, DK Engineering in the industrial district of Nairobi City applied the super-alloy containing a large content of sulfur constituent called En9 to increase the strength of the lid section. As a result,



Photo 1.
Part broken due to the inadequate strength. It shows a large air bubble in the part that was produced by the foundry technique. Manufactured by DK Engineering.

the company completed a pressure popping machine that can be produced stably without part deformation under frequent tests. Furthermore, DK Engineering realized a reduction of cost and time by manufacturing the machine with the foundry technique using En9 for the cooker and the lid section, thereby establishing a machine manufacturing production system for mass production. Major improvements were made in the screen and net sections of the pressure popping machine of DK Engineering, achieving the level close to that of the machine manufactured in Japan for local use. As a result, the machine production that was implemented since May could produce a complete product within about 6 months. During the course, suppliers and the procurement method of the parts that require regular replacement (Teflon plate, pressure gauge, etc.) were specified. DK Engineering is applying for the KEBS certificate under the name of “Yoshimura model”, by using the name of Mr. Yoshimura who provided the engineering support. At the final stage of the project, DK Engineering commenced the local manufacturing and sales and established the mass production system of pressure popping machines.

2) Empirical survey of the local production for local consumption model

(1) Achievements made by the activities

Production and sales of popped cereals were commenced by commencing the leasing of the machine to the SyoKinili Self Help Group on July 11, 2016. The following achievements were made.

- ① Pressure processing by a pressure popping machine brought a new economic value to the local agricultural products (mainly grains) as a new cooking method. The profitability ($\text{profit/price} \times 100$) varies depending on the processing method, which ranges from 8.1% to 57.0%.
- ② Beans, nuts, potatoes in addition to grains were found to be the best processing candidates for a pressure popping machine.
- ③ The main consumers of popped cereals are children and sweet flavors such as treacle and sugar are favored.
- ④ Development, processing, and flavoring method of the local production for local consumption products (flavoring ideas, puffed grains, commercialization of beans and nuts in powder form by grinding them), sales method, and price setting were conducted under the initiative of the groups and as a result, many unique techniques were created.
- ⑤ Fixed prices can be set for the products by processing them regardless of the season.
- ⑥ No substantial difference in the nutrient compositions was identified between the

grains before and after the processing. Grains such as sorghum and pearl millet can be more readily used by processing them into confectioneries. The demand for the target crops increased.

- ⑦ Grains of rice and corn are large and the varieties of a large expansion rate are found to be favored. By the introduction of puff processing, the varieties that have not been used as food including crushed rice and sorghum, which has a strong bitter flavor, can be used as tasty food.
- ⑧ The procedure for producing and sales of popped cereals is simple (packing and packaging) so that it requires only a small new facility investment cost other than the machine. In addition, the machine hardly ever breaks down even under the continuous use for a period of six months and the expenses and consumables that are required for long-term maintenance management were clarified.
- ⑨ Sorghum and pearl millet were selected as the crops to be recorded for the traditional use. The technique of Traditional Foodways of Bioversity was used for the recording. The detailed processes of eight typical cooking methods, from harvesting and acquisition of the crops to cooking and presenting them on the table, were recorded by photographs and texts and the summary was reported. This research was conducted in Kitui County only.
- ⑩ The project was exhibited in 24 events in total including presentations, demonstration sales, and seminars in agricultural trade shows and the achievements of the project were widely promoted. Among these agricultural trade shows, Kitui County and Embu County received Third and First Awards respectively. In addition, the project was exhibited in TICADVI and Agribusiness Creation Fair 2016.
- ⑪ In addition to the support projects of each local government, bank loans and fund management systems that are available for independent commercialization by individuals and farmers' groups (Table Banking, etc.) were specified. However, while the support by banks are general, it imposed high interest rates of around 20%. Considering that the price of the machine is US\$1,000, an independent method such as Table Bank was found to be more effective ultimately.
- ⑫ It was found that the support for ideas of processing techniques, development and improvements of machines and equipment that support cooking is important as well as the nutrition analysis and functionality evaluation and in particular, the support from private companies is required.

(2) Effects of popularization and examination

Through the implementation of this project, several examples of starting a business by local business operators by the voluntary purchase of the machine were verified. As a result, it was proven that a pressure popping machine expands the utilization opportunities of local agricultural products and contributes to the enhancement of the income and livelihood.

Through the demonstrations at the agricultural trade shows, the approach attracted the attention of officials of the local governments (Embu, Kitui, and Kapenguria) and they are examining the installation of a pressure popping machine as the support activities of the farmers' groups. High expectations on this project are assumed based on the many individual enquiries that have been made regarding the study and observation of this project and handling of the machine. The future issues are education and staff training for providing direct support to the business operators wishing to start the business and improvement of the system to provide individual consultations.

Based on the following background, the process of the activities to become independent in a short period of time was confirmed. The process includes the manufacturing and sales of machines, leasing to the farmers' groups, sales of popped cereals, voluntary investments by entrepreneurs.

- ① High profitability. Low priced machine. The cost of the machine can be recovered in 2 to 3 months.
- ② Pressure popping machine manufacturing and maintenance management services are available.
- ③ Simple machine structure. Popped cereals can be produced after a comparatively short period of training. The machine is robust.
- ④ Low initial investment cost for starting the business. At the initial stage, by focusing on the sales channel within the region, the plan is to gradually proceed with the handling from expansion of the sales channel together with the sales increase, food sanitation certificate, packing, to labeling.
- ⑤ Use of abundant local agricultural products. Ingredients are locally accessible by anyone.
- ⑥ The ingenious ideas of farmers (particularly flavoring) stem from the knowledge and approach based on the experience in the use of local agricultural products. Therefore, it is necessary to provide the opportunity to learn from the traditional knowledge and experience by recording the traditional use of local agricultural products as well as evaluating the diversity of the product. On the other hand, the business is comparatively too small for entrepreneurs and examples of negative attitudes

towards active investments were also identified.

3) Technical guidance for product development, food sanitation, label indication, and packaging

Support for participation in the training for the KEBS (Kenya Bureau of Standards) certificate

4) Traditional use recording of the target crops

Traditional use of crops was recorded by using the Traditional Foodways of Bioversity. For the details, refer to the report in Attachment 2.

5) Promotion of the project activities

The activities of local production for local consumption by using a pressure popping machine by a farmers' group were widely introduced to government organizations and private companies through demonstration sales and participation in agricultural trade fairs, and business fairs. Table 3 shows the details of the promotion activities.

Table 3. Farmers' group promotion activities in this project

	Type	Date	Location	Target	Remarks
1	Demonstration	2016/Jul/06	Nice Rice Millers LTD, Mwea	General	
2	Demonstration	2016/Jul/11	Syokinili Self Help Group, Kitui	Target group	
3	Presentation	2016/Jul/21-23	Kitui Agricultural Show	General	Received 3rd award
4	Seminar	2016/Aug/04	Concord Hotel Nairobi		
5	Demonstration	2016/Aug/17-18	Syokinili Self Help Group, Kitui	Migoli team to visit Kitui. Exchange visit.	
6	Presentation	2016/Aug/26	NMK, Nairobi	General	
7	Presentation	2016/Aug/27-28	TICAD6, Nairobi	General	
8	Seminar	2016/Aug/29	Concord Hotel Nairobi	General	
9	Seminar	2016/Aug/31	Agricultural training Centre, Embu		
10	Seminar	2016/Aug/31	Kiamuringa, Embu		
11	Seminar	2016/Sep/01	Embu Government office		

12	Demonstration	2016/Sep/04-06	Okonyo Self Help Group, Migoli	Target group	
13	Demonstration	2016/Sep/09	Kitui Government office	Kitui Government	
14	Presentation	2016/Oct/13-15	Migoli Agricultural Show	General	
15		2016/Oct/18	Migoli Primary school		
16	Presentation	2016/Oct/26-29	Kitare Agricultural Show	General	Received 1st award
17	Demonstration	2016/Nov/11	Kanyiriri market, Embu	Kamgaa FFS group, General	
18	Demonstration	2016/Nov/18	Okonyo Self Help Group, Migoli	Anglican development service (ADS) Western ltd Kakamega came to visit Migori group	
19	Demonstration	2016/Nov/18	Migoli market	General	
20	Demonstration	2016/Nov/23	Nairobi Japanese School		
21	Seminar	2016/Dec/07	Concord hotel Nairobi		
22	Presentation	2016/Dec/17	Kitui Cultural show	General	
23	Demonstration	2016/Dec/18-20	Africa children education fund, Embu	Target group	
24	Presentation	2016/Dec/14-16	Tokyo Big Site		

6) Workshop

At the final stage of the activities, a workshop was conducted by inviting the groups and individuals who installed a pressure popping machine in each region, pressure popping machine manufacturers, and local government officials to announce the achievements of the activities and exchange information. For the details, refer to the report of Attachment 1.

7) Analysis of nutrient compositions

Table 4 shows the result of the analysis of the nutrient compositions of popped serials that were produced by the famers' group.

Table 4. Analysis result of the components of brown rice, corn, pearl millet, and sorghum

			Energy	Moisture	Protein	Fat	Carbohydrate	Ash	Fibre	Ca	Mg	K	Na	Zn	Fe	P	VA	VB1	VB2
			kcal/g	%	%	%	%	%	%	%	%	%	%	%	%	%	IU/100g	mg/100g	mg/100g
B.Rice	Raw	Q	346.0	10.7	12.5	0.56	72.70	0.51	1.59	0.019	0.052	0.127	0.012	0.010			0.020	0.010	0.030
	Raw	N	341.3	9.7	8.3	1.25	74.23	1.27	5.26	0.004	0.043	0.195	0.002	0.005	0.005	0.254			
	Popped	Q	385.7	2.4	11.6	1.80	80.82	0.09	0.89	-	0.084	0.147	0.014	0.010			0.950	0.800	1.030
	Popped	N	396.5	4.5	10.0	4.85	78.18	0.94	1.46	0.006	0.036	0.166	0.002	0.004	0.003	0.188			
Maize	Raw	Q	358.6	9.1	11.5	4.45	68.10	0.01	4.30	0.022	0.074	0.286	0.003	0.010			0.010	0.060	<0.01
	Raw	N	345.3	9.9	6.5	1.33	76.83	0.81	4.64	0.010	0.048	0.302	0.004	0.006	0.004	0.288			
	Popped	Q	373.1	5.5	7.7	4.05	76.46	0.06	5.46	0.015	0.033	0.149	0.003	0.011			0.610	0.410	0.080
	Popped	N	369.3	5.9	15.0	7.22	61.09	1.45	9.32	0.008	0.041	0.244	0.003	0.005	0.003	0.189			
Pearl Millet	Raw	Q	375.2	7.8	13.7	5.76	67.12	0.18	3.43	0.028	0.095	0.266	0.013	0.015			<0.01	0.370	0.110
	Raw	N	366.2	8.8	7.8	5.47	71.46	1.72	4.75	0.008	0.076	0.208	0.004	0.003	0.003	0.286			
	Popped	Q	400.2	3.0	14.0	5.33	73.85	0.05	4.90	0.022	0.081	0.247	0.002	0.014			0.630	0.370	0.490
	Popped	N	404.9	4.1	12.6	9.44	64.40	1.47	5.01	0.008	0.081	0.238	0.004	0.003	0.003	0.425			
	Popped	S	399	3.2	11.9	6.4	76.8	1.7	6.7	0.023	0.140	0.338	0.0039	0.0055	0.0127	0.350	-	-	0.08
Sorghum	Raw	Q	341.2	3.1	13.7	1.65	67.85	1.05	5.31	0.022	0.071	0.217	0.012	0.013			<0.01	<0.01	0.090
	Raw	N	366.2	7.9	7.2	3.32	76.93	1.08	3.60	0.007	0.066	0.266	0.003	0.004	0.004	0.247			
	Popped	Q	397.1	7.8	12.6	5.46	74.39	0.07	4.77	0.016	0.090	0.268	0.009	0.013			0.580	0.210	0.330
	Popped	N	357.1	6.0	9.3	3.06	73.04	1.51	7.04	0.006	0.062	0.256	0.003	0.003	0.004	0.232			
	Popped	S	381	4.7	11.1	4.2	78.5	1.5	7.8	0.016	0.144	0.334	0.0019	0.0022	0.0083	0.300	-	0.01	0.03

Q: AgriQ Quest (Kenya)
 N: Nairobi University (Kenya)
 S: Sunatec (Japan)

III. Possibility of promoting “local production for local consumption”

1. Concept of Japan’s local production for local consumption and case studies

Local production for local consumption is an effort which agricultural, forestry and fishery products produced by local people are consumed locally. Besides improving self-sufficiency in food products, the effort leads to the sixth industrialization of agriculture, forestry and fishery industry through the effort of direct retailers and food processors.

Of 69 excellent activities of local production for local consumption awarded between 2005 and 2015, the local production for local consumption activities are broadly divided into eight patterns as below. The following lists keywords related to each pattern.

- (1). Direct sellers: “The sales of fresh local produce (farm produce, fisheries products, flowers and ornamental plants, and processed food)”, “the standardization of standards and quality”, “a market offering fresh produce grown by local farmers (antenna shop)”, “a large retailer in shop”, “online shopping”, and “sales information communication system.”
- (2). Sixth industrialization: “Participation and entrepreneurship of women groups”, “coordination with local distributors, food manufacturers and confectionary manufacturers”, “product development of processed food”, “restaurant business” and “the development of menu and recipes utilizing local produce”.
- (3). School lunches: “Devised shipment and delivery methods” and “menu planning and the development of recipes utilizing local produce.”
- (4). Food and agriculture education: “Farming experience and learning”, “interaction with producers”, “the transfer of traditional cooking”, “cooking workshop”, and “knowledge about nutrition”.
- (5). Food safety and security: “Traceability”, “cultivation history”, and “pre-shipment inspection.”
- (6). Interaction between urban and rural areas: “Green tourism”, “staying at farmers’ house”, “local cuisine using local ingredients” and “community farms (technical guidance)”.
- (7). Environmental conservation farming: “Eco farmer certification” and “regional circulation system”.
- (8). Restoration of areas suffering from declining population and abandoned farmland: Understanding agriculture and farming village, “new farmers”, “farmer transplants” and “regional revitalization.”

Cross-cutting keywords

“Promotion of regional farming”, “diversified small-quantity production”, “shipment and payment method”, “the expansion of sales channels”, “the improvement of incomes for producers”, “technical guidance on circuit cultivation”, “cultivation technical workshop”, “face-to-face relationship”, “understanding consumer needs”, “utilization of the elderly”, “female entrepreneurs”, “employment creation”, “networking with many industries and diverse industries”, “product development”, “branding”, “agriculture-commerce-industry cooperation”, and “the creation of opportunities for cash incomes.”

1) Activity analysis

Based on eight patterns above, the activity groups that received a commendation are involved in the following activities: direct retailers account for the highest percentage, suggesting 36 groups (52%), which is more than half, are involved in direct retailing, followed by thirty-three groups (48%) in the sixth industrialization, 27 groups (39%) in school lunches, 23 groups (33%) in food and agriculture education, 20 groups (29%) in interaction between urban and rural areas, 18 groups (27%) in environmental conservation farming, 12 groups in food safety and security (17%) and eight groups (12%) in restoration of areas suffering from declining population and abandoned farmland in that order.

In addition, most groups implement these activities by aligning multiple activities organically. For example, when the activities of direct retailers are placed at the center to set diversified small-quantity production in place in region, people begin to pay attention to food safety and security, work on environmental conservation farming, develop businesses to the sixth industrialization, as well as to expand sales channels by collaborating with school lunches, improve incomes for producers and create employment.

2) Application of the local production for local consumption project in Kenya

By referring to Japan’s excellent case studies as described above, we assume that promoting the sixth industrialization model is the most suitable activity to deploy projects aimed at the promotion of regional farming, the creation of opportunities for cash incomes, the improvement of incomes for producers and the participation of youth and women, all of which are raised by the Kenyan government, under the concept of local production and local consumption.

For the sixth industrialization of agriculture, the keywords include “Participation and entrepreneurship of women groups”, “coordination with local distributors, food

manufacturers and confectionary manufacturers”, “product development of processed food”, “restaurant business” and “the development of menu and recipes utilizing local produce”. The production and sales of popped cereals proposed in this project deeply relate to cross-cutting keywords, including “agriculture-commerce-industry cooperation”, and “the creation of opportunities for cash incomes”, “product development”, “face-to-face relationship”, “understanding consumer needs”, “female entrepreneurs”, “employment creation”, and “networking with many industries and diverse industries”. Due to this, we made an attempt at analyzing the project with these keywords at the core.

2. Case studies of using pressure popping machine in Kenya

A pilot project of the production and sales of popped cereals was implemented targeting two groups and an entrepreneur in Kitui, Migori and Embu.

1) Case study 1. A self-help group in Kitui (Syokinyili Self-help group)

(1) Group outline

The group consists of 17 women and nine men, totaling 26 members. The ages of the members range widely from age 22 to age 67, with the average age of 43. As for the primary income source of the members, five members engage in farming, one member engages in farming and daily work, four members engage in farming and a small business, seven members engage in a small business, four members engage in daily work, two members work as a verger at church, one member engages in tailoring and two members are unemployed (junior high school graduates).

For the group’s activities, they get together weekly on Mondays and do a merry-go-round and produce and sell liquid detergent, seedlings for fruit trees and trees, and breed rabbits.

The group incorporated the production and sales of popped cereals as a new group activity. Mainly three men engage in machine operation related to production process and three women engage in the procurement and careful selection of ingredients, processing and packaging to pursue the activity. However, due to a lack of other members’ active involvement, the six members’ willingness for production declined, causing the activity itself to slow down.

(2) Activity achievements of pressure popping (Period: July 2016 to February 2017)

Syokinyili began pressure-popping with the participation in the Kitui Farming Show (July 20 to 23) as a starting point. To sell popped cereals at the venue of the farming

show, 40 kg of corn, sorghum, pearl millet and rice in total were processed in two days on July 18 and 19. The products sold out in four days from the 20 to the 23 and generated 10,510 shillings in sales. Subsequently, the group was active for 11 days in six months from August 8, 2016 to February 9, 2017, and pressure-popped 88 times, generating 88 kg of grains. Table 1 shows the detail of the activity. The group generated 16,940 shillings during that time. Of 128 kg of total grains, 98 kg of the grains, accounting for 77%, were corn, sorghum, and pearl millet, which were produced locally.

In general, the popped cereals made of sorghum, pearl millet and rice are seasoned with syrup made by heating brown sugar and dissolving with small amount of water. They also produce and sell 4 kg of popped cereals without seasoning after receiving an order from consumers with calorie restriction. In addition, they also produce a product called kashata that carries high margins. Kashata is made by pressure-popping damaged rice and seasoning with syrup made by dissolving brown sugar and white sugar. It is then pressured and hardened in a mold and cut into bite-size pieces. However, because it takes some time and effort for processing, the group made kashata only three times. For corn, they use only salt for seasoning.

Looking at the number of times the members produced popped cereals by grains, sorghum was used 43 times, pearl millet was used 31 times, rice and damaged rice were used 30 times and corn was used 24 times. Since the products are basically sold face-to-face, the preference of consumers can be assumed from the number of times produced.

The members yielded a profit of as small as 6,273 shillings during the six-month activity. Even a busy farming season, Christmas and year-end and New Year holidays are excluded, it takes five years or more to amortize the machine by making the profit of 6,273 shillings for four months of active period.

Table 5: Activity achievements of Syokinyili in Kitui

Grains	Production area	Number of popping (1 kg/time)	Processing	Quantity (bags/pieces)	Sales in Shilling	Profits in Shilling
Corn	Local	24	Salt flavor	456	4,560	1,591.4
Sorghum	Local	41	Brown sugar syrup	861	8,610	1,687.6
Sorghum	Local	2	No flavor	42	420	126.0
Pearl millet	Local	29	Brown sugar syrup	609	6,090	1,193.6
Pearl millet	Local	2	No flavor	42	420	126.0
Rice	Mwea	27	Brown sugar syrup	540	5,400	437.4
Broken rice	Mwea	3	Kashata (brown sugar, white sugar)	195	1,950	1,111.5
Total		128		2,745	27,450	6,273.5

(3) Cost management of products

As for cost calculation, because the cost per kg (once) is when 20 kg of grains are processed daily (the machine runs 20 times). Due to this, when processing less than 20 kg, the cost increases and when processing 20 kg or more, the cost decreases. The labor cost was calculated based on 48 shillings per hour by referring to the minimum wage of workers of sugar processing factory, 380 shillings per day (eight hours).

A bag containing 45 g to 50 g of sorghum, pearl millet, rice and corn is sold at 10 shillings. A bag containing about 15 g of kashata is sold at 10 shillings. As shown in Table 6, kashata has the highest margins, followed by corn, which has cheaper raw material cost and processing cost, sorghum, pearl millet and rice in order of low margins. Because rice has a relatively higher raw material cost, it carries lower margins. Since the objective of this project is the pursuit of profit, as the table suggests, they must reduce the quantity for each bag of rice, sorghum and pearl millet, or raise the price to anticipate business growth. In order to acquire the KEBS certification in near future, it

is necessary to carry out production where the hygienic environment is in place. For this, the product pricing must be set up based on highly accurate cost calculation, including the building (production center) rent, amortization expenses of machine and maintenance expenses. Concurrently, it also requires increasing the amount of production and making effort to boost sales.

Table 6: Cost calculation of the Syokinyili group in Kitui.

		Sorghum Pearl millet	Rice	Kashata (broken rice)	Corn
The cost of raw procurement	Of the cost, raw material cost	61.2 60	81.2 80	81.2 80	36.2 35
The cost of preparation of raw materials	Labor cost	4.2	1.2	1.2	1.6
Production cost	Labor cost	22.8	22.8	22.8	22.8
	Fuel cost	3.08	3.08	3.08	3.08
	Subtotal	25.9	25.9	25.9	25.9
Processing cost	Labor cost	9.6	9.6	28.8	0.96
	Seasoning and fuel cost	12.4	12.4	38.4	1.8
	Subtotal	22	22	67.2	2.76
Packaging cost	Labor cost	9.6	9.6		9.6
	Material cost	12.3	11.7		12.3
	Subtotal	21.9	21.3	0	21.9
Sales cost	Labor cost	33.6	32.2	104.2	28.8
Subtotal of cost		168.8	183.7	279.6	117.1
Sales		210	200	650	180
Profits		41.2	16.3	370.4	62.9
Profit ratio (%)		19.6	8.1	57.0	34.9

(4) Challenges for the future

- ① The standardization of standards and quality: The group needs to create a recipe for ingredients used for seasoning and use a scale and measurement cup to even out the content of bagged popped cereals and the weight per piece.

- ② Sharing the activity within the group: The self-help group engages in a voluntary and independent activity to solve problems by gathering people with similar problems to help each other. While this activity is considered an appropriate size to undertake as a self-help group activity, they need to figure out how they can make about 100,000 yen of the cost to purchase the pressure popping machine, which is the initial investment, and running costs, by sharing among the members again that it is a commercial activity aimed at making a commercial gain, as well as to discuss about the compensation for labor within the group. All the sales go to the bank account owned by the group. The most critical challenge is to construct a mechanism that does not generate any free riders.
- ③ The improvement of sales method: To boost sales, there is a pressing need to reinforce sales activities and increase the volume of production. For sales promotion activities, it requires the participation of all members. Not only the traditional hawking (street selling) and displaying products at stores, it is also necessary to make improvements by keeping an eye on selling at a periodic market that has a higher ability to pull in more customers and movable production and sales.

2) Case study 2. A self-help group in Migori (Okonyo Migori Self Help Group)

(1) Group outline

The group consists of nine women and five men, totaling 14 members. The age groups of the members are two members in their 20s, two members in their 30s, seven members in their 40s and three members in their 50s, with the average age of 43. As for the primary income source of the members, 12 members engage in a small business, one member engage is nursing, and one member engages in daily work, suggesting that the group has members who are highly interested in business.

For the group's activities, they get together weekly and do table banking and a merry-go-round, sell fish and process soybeans (soybean tea and toasted soybean flour).

Although the members began the production and sales of popped cereals as a part of the group activity, in fact, the group's three male members and two female members who are interested in pressure popping formed a new group within the group and work as a new group. In addition, the incomes obtained from the production and sales of popped cereals are used to prepare and open their independent bank account.

(2) Activity achievements of pressure popping (Period: October 2016 to January 2017)

This group also began pressure-popping with the participation in the Migori Show

(October 12 to 15) as a starting point. At the Migori Show, they sold popped cereals made of rice, corn, sorghum and soybeans produced in advance and obtained the sales of 2,915 shillings in four days. After taking a part in the Migori Show, the commerce and industry officer of the Migori country recommended participating in the Kitale Show. The group presser-popped rice, sorghum and wheat and sold at the show. At the Kitale Show, they obtained 7,210 shillings in sales in five days from October 25 to 29. The participation in these events and sales results became a driving force and led to subsequent popped cereal production and sales activities and product development.

For three months from November to January, the group got together nine times (nine days) to produce popped cereals. The grains mainly used for pressure-popping are four types, including rice, sorghum, wheat and sorghum. Among the ingredients, corn and sorghum are the only grains produced locally. The number of processing times by grains is unknown because there is no accurate record. The market surveys conducted for two and a half hours in the early evening on the day of periodic Sbaclear market indicate that the group sold 52 bags of pressure-popped rice seasoned with white sugar and honey, 37 bags of pressure-popped corn seasoned with margarine and white sugar, 32 bags of rice balls seasoned with brown sugar and white sugar syrup, 25 bags of brown sugar-flavored wheat, 20 bags of a mix of brown sugar-flavored wheat and peanuts and 10 bags of sugar-flavored sorghum.

From the results, the preference of consumers suggests that the white sugar-flavored rice and rice ball are the most popular, followed by corn, wheat and sorghum in that order. The sales figures sold by group members in three months were 17,995 shillings. In addition, the sales record suggests that most of the sales were from popped cereals of rice and corn including rice balls. The cumulative sales figures from the Migori Show are 28,120 shillings. Since the average profit rate of the rice and sorghum products is 37%, the profits made during this time reach 10,000 shillings. Compared to the Kitui group's monthly profits, this group reaps more than twice the profit. With the production and sales at this pace, it takes two and a half year to amortize the expenses of machine.

(3) Cost management of products (Cost optimization)

As described above, when the activity first started, the group used four types of grains to produce six types of products with different processing methods to sell a bag or piece at ten shillings. Because the product with a mix of wheat and peanuts has lower margins due to high material costs, the production stopped right away. While the five types of products were produced and sold until November, the average weight of about

8.5 g of rice ball with higher margins was changed to 17 g, which is doubled, with the same price in early December.

We can assume that the voice of consumers and the owners of kiosks was reflected. Also, the selling method was improved from the traditional method of selling individually to a package of twelve rice balls (a dozen) linked together to sell by handing at stores. The group distributes a dozen (twelve pieces) for 100 shillings and the price for ten rice balls to kiosks. In addition, the seasoning for corn was changed from white sugar and margarine flavor to salt flavor. The content of each bag was decreased from 28 g in average to 15 g. The price was also changed from 10 shillings a bag to five shillings, which is half. These improvements are one of the sales promotion activities that meet consumer needs. As a result, the profit rate of rice balls declined from 53.2% to 38%, that of for corn raised from 30.3% to 36%.

Table 7: Cost calculation of the Okonyo Migori group in Migori.

		Sorghum	Rice	Rice ball	Corn	Wheat	New rice ball	New corn
The cost of raw procurement	Of the cost,	42.4	102.4	102.4	47.4	102.4	102.4	47.4
	raw material cost	40	100	100	45	100	100	45
The cost of preparation of raw materials	Labor cost	4.2	1.2	1.2	4.2	1.2	1.2	4.2
Production cost	Labor cost	22.8	22.8	22.8	22.8	22.8	22.8	22.8
	Fuel cost	2.64	2.64	2.64	2.64	2.64	2.64	2.64
	Subtotal	25.4	25.4	25.4	25.4	25.4	25.4	25.4
Processing cost	Labor cost	9.6	9.6	27.36	9.6	9.6	19.68	9.6
	Seasoning and fuel cost	15.2	15.2	105.2	57.2	15.2	121.2	4.2
	Subtotal	24.8	24.8	132.6	66.8	24.8	140.88	13.8
Packaging cost	Labor cost	36	21.12	30	21.12	22.08	0	39.8
	Material cost	37.7	22.75	78	22.75	24.05	0	41.35
	Subtotal	73.7	43.9	108	43.9	46.1	0	81.15
Sales cost	Labor cost	92.6	56.2	192	56.2	59	92.64	105.6
Subtotal of cost		263.2	253.9	561.6	243.9	259.0	362.6	277.6
Sales		580	350	1,200	350	370	580	330
Profits		316.8	96.1	638.4	106.1	111.0	217.4	52.4
Profit ratio (%)		54.6	27.5	53.2	30.3	30.0	38.0	36.0

(4) Challenges in the future

- ① The standardization of standards and quality: The group will create a recipe for ingredients used for seasoning and use a scale and measurement cup to even out the content of bagged popped cereals and the weight per piece.
- ② Production increases: Although the activity initially started with the plan to produce four times a month (the group spends a day weekly for production and uses the rest of five days to sell), they engaged in production only three times a month. Since they have already accumulated know-how on production, the goal is to aim

for production twice a week to make production plans so that they can amortize the expenses of machine within a year.

- ③ Improvements of the pressure popping machine: At the time of opening the machine's lid, there is a high proportion that puffed cereals fall out of a receiving basket. To reduce the loss of products, the basket needs to be improved to have proper sizing and shape.
- ④ Reinforced sales: The group will put more effort into the sales for kiosks for a while to increase wholesale. Two young men will be hired as sales staff to boost the number of sales by hawking while raising the visibility of popped cereals. We are considering using a commission system as a wage system.

3) Case study 3. A young entrepreneur in Embu (Gichangi Cereal & Spices)

(1) Business description

The entrepreneur rents a section for store and open space inside a central market in Embu to sell cereals, spices, and processed soybean products (soya flour and soya drink). He has a production center for processing cereals and spices on the premises of his home. The production center is equipped with a boiling machine, roasting machine (roaster: 40 kg per hour), flour mill and a plastic drying facility to produce roasted peanuts, porridge flour, soya flour and soya drink.

This entrepreneur purchased his roasting machine from DK Engineering in Nairobi. When he visited DK Engineering, he happened to see pressure popping machine and heard about the machine's usefulness and function. Since then, he became interested in pressure popping technology. In fact, the entrepreneur requested the project staff to take him to a production site of popped cereals. There was a timely demonstration session of popped cereal production for self-help groups in Embu. We invited him to the session, where he got a taste of the production process and tried popped cereals. He then ordered the machine from DK Engineering with his own money.

Since the project was still at a substantive research phase at that time, we also provided a series of training related to the production of popped cereals to the entrepreneur. The machine was completed on January 18, 2017, and on the next day, it was shipped to Embu. The production began from January 20 with the support of project staff.

(2) Activity achievements (Period: January 20 to February 6, 2017)

The monitoring was implemented from the first operation on January 20 to the fourth operation on February 6 when the machine broke down. During the fourth

production, the pressure leak started after producing 7 kg, and the production was disrupted. The cause of pressure leak was due to a deformed bolt for a lid closure. DK Engineering responded immediately and delivered a new part in four to five days. As shown in Table 8, the first production used a total of 25 kg of locally-produced corn, sorghum, pearl millet, finger millet and amaranthus, as well as brown rice from Mwea and wheat grown in Mel in the vicinity.

The usage rate of locally-grown cereals was 62%. For the first production, light-taste popped cereals were produced by using as small as 80 g of honey dissolved in water to season 22 kg of popped cereals. Fifty grams of popped cereals were packed in each bag and sold at 20 shillings per bag. Since the visibility of popped cereals was low the first time, it took ten days to sell all of the products. For the second production on January 30, a total of 31 kg of corn, brown rice, pearl millet, sorghum and wheat were processed.

For seasoning, 2 kg of white sugar is dissolved in 500 ml of water. The white sugar water was added with 500 g of honey to make syrup. Popped cereals were seasoned with the syrup to make slightly sweeter than the first production. For the second production, bags containing 50 g and 25 g were produced and sold at 30 shillings and 20 shillings respectively. Since the products had more visibility than the first time, the second production increased the production volume by nearly 20%. Even so, it took seven days to sell all of the products. For the third production on February 3, five types including 18 kg of pearl millet, wheat, corn, sorghum and brown rice in total were processed and seasoned in the same way as the second production. Two types of bags with the same capacity were produced. The fourth production was implemented on February 6 and although the production was disrupted due to machine malfunction, a cumulative total of 84 kg of cereals were produced in 18 days. With some remaining products in stock, the profit of 18,000 shillings was anticipated in less than three weeks from the initial production.

As for the selling method, the entrepreneur himself sells at a store in the market and by hawking around the market to increase the visibility of the products. Although customers mostly response positively and there is an increasing number of positive response, three consumers said not tasty and a few consumers recommended changing to salt flavor. As for the preference of cereals, pearl millet is the most popular, followed by wheat, sorghum, corn and brown rice. He plans on producing and selling these five types of cereals with the same seasoning for a while.

Table 8: Activity achievements of an entrepreneur in Embu

Grains	Production area	Number of popping (1 kg/time)	Processing	Quantity (bags)	Sales in Shilling	Profits in Shilling
Corn	Local	15	Sugar and honey syrup	283	6,930	3,168.8
Sorghum	Local	14	Sugar and honey syrup	302	7,475	2,837.4
Pearl millet	Local	21	Sugar and honey syrup	471	10,930	4,017.9
Wheat	Mel	19	Sugar and honey syrup	400	9,295	5,444.7
Brown rice	Mwea	13	Sugar and honey syrup	285	6,865	2,911.9
Finger millet	Local	1	Sugar and honey syrup	15	300	-88
Amaranthus	Local	1	Sugar and honey syrup	18	360	-12
Total		84		1,774	42,155	18,281

*As for the sales quantity, sales figures and profits, the sales proportion of two types of bags containing 25 g (20 shillings) and 50 g (30 shillings) is unclear, the preliminary calculation was done by using the average value of selling 37.5 g bags for 25 shillings.

(3) The cost management of products (Cost optimization)

As shown in Table 9, seven types of cereals were processed for the first production. As for the production yield, corn was the lowest at 74% and pearl millet was the highest at 95%. The average was 89%. For the first production, all popped cereals were put in bags containing 50 g and sold at 20 shillings across the board. As a result, the sales of brown rice, amaranthus and finger millet with higher unit cost of raw materials were below cost. The profit rate of corn and sorghum with relatively lower yield was as small as a few percent. The profit rate of wheat and pearl millet was around 20%. Perhaps, the entrepreneur felt the low turnover in his bones by looking at the total expenses. As described above, the content and price of each bag were adjusted after the second production. This caused the profit rate of all products to exceed 50% or more and become stable. If the market grows in the future, this business is expected to grow sufficiently.

The entrepreneur newly hired two young men at 8,000 shillings monthly per person since this business was added to the conventional processing operation. For the labor cost, we asked the entrepreneur the number of work hours and work days in each process. The monthly wage was divided by 25 days, which are the number of work days in a month, to calculate a daily wage as 320 shillings.

Table 9: Cost calculation of a sole proprietor in Embu.

Cost unit: Kenya shilling

			Corn	Brown rice	Wheat	Pearl millet	Sorghum	Amaranthus	Finger millet	Subtotal
Production achievements	Raw material used (kg)	First production	2	3	8	9	1	1	1	25
		Second production	7	7	5	6	6			31
	Production amount (kg)	First production	1.47	2.63	7.07	8.5	0.77	0.94	0.75	22.13
		Second production	5.06	6.86	4	5.48	4.96			26.36
	Yield (%)	First production	74	88	89	95	77	94	75	89
The cost of preparation of raw materials	Unit cost of raw materials		40	140	45	50	50	130	150	
	Raw material cost	First production	80	420	360	450	50	130	150	1,640
		Second production	280	980	225	300	300			2,085
	Sub raw material cost	First production	3.84	5.76	15.36	17.28	1.92	1.92	1.92	48
		Second production	126.4	126.4	90.4	108.4	108.4			560

Cost of raw material selection	Labor cost	First production	51.2	76.8	204.8	230.4	25.6	25.6	25.6	640
		Second production	216.8	216.8	154.8	185.8	185.8			960
Production cost	Fuel cost	First production	10	15	40	45	5	5	5	125
		Second production	35	35	25	30	30			155
	Labor cost (three staff/day)	First production	76.8	115.2	307.2	345.6	38.4	38.4	38.4	960
		Second production	216.8	216.8	154.8	185.8	185.8			960
Packaging cost	Bag cost	First production	36	47.7	127.8	153	14.4	17.1	13.5	409.5
		Second production	148.5	136.5	80.25	110.25	99.75			575.25
	Labor cost (measurement and packaging)	First production	51.2	76.8	204.8	230.4	25.6	25.6	25.6	640
		Second production	216.8	216.8	154.8	185.8	185.8			960
Sales cost	Labor cost	First production	256	384	1,024	1,152	128	128	128	3,200
		Second production	289.0	289.0	206.4	247.8	247.8			1,280
Total cost		First production	565	1,141	2,284	2,624	289	372	388	7,663
		Second production	1,529	2,217	1,091	1,354	1,343			7,535
Sales figures		First	580	1,040	2,820	3,400	300	360	300	8,800

		production								
		Second production	3,350	4,550	2,650	3,650	3,300			17,500
Profits		First production	15	-101	536	776	11	-12	-88	1,138
		Second production	1,821	2,333	1,559	2,296	1,957			9,965
Profit ratio (%)		First production	2.6	-9.7	19.0	22.8	3.7	-3.2	-29.3	12.9
		Second production	54.3	51.3	58.8	62.9	59.3			56.9

(4) Business model

Based on the know-how obtained from the past practical activities, we simulated a business model. We can guess that it is reasonable to produce popped cereals once a week as shown in Table 10 and use the rest of five days to sell without having much stock on hand as much as possible. By setting the weekly (one day) production quantity as 25 kg on average (25 times) and producing popped cereals of pearl millet, wheat, sorghum, corn and brown rice in the proportion as shown in Table 10 according to the preference of consumers, the profits of 7,715 shillings will be generated from production and sales on a weekly basis. By implementing this production and sales practices four times a month, after 13 practices and in a little over three months, the expenses of machine will be amortized.

Table 10: The business model of an entrepreneur

				Raw material cost				Labor cost				
Grains	Raw material (1) kg	Yield (2) %	Production quantity (3) (1) x (2) kg	Raw materials /kg	Sub material cost Sugar, honey	Fuel cost Firewood cost	Consumable Bag cost	Production 3 persons/day	Raw material selection 2 persons/day	Measurement 2 persons/day	Packaging	Sales 5 days
Maize	4	74	2.96	180			86.9					
Wheat	6	89	5.34	240			107.3					
Brown rice	4	88	3.52	560			70.5					
Sorghum	5	77	3.85	250			77.3					
Pearl millet	6	94	5.64	300			113.3					
Cost total (4)	25		21.31	1,530	560	125	455.3	960	640	640	1,600	6,510.3
Sales figure (5)												14,225.0
Profit (5) – (4) – (6)												7,714.7
Profit rate % (6) / (5)												54.2

(5) Challenges for the future

- ① Reinforcement of sales promotion: Since the visibility of products is low, it is also necessary to focus on sales promotion. First, the most important thing is to name the products and implement activities to raise the name recognition of unnamed products. At the same time, it is essential to skillfully inform consumers about the content of products, types of cereals used, and processing method, as well as that the nutritional value of each grain does not change after pressure-popping. It is therefore necessary to continue doing the hawking sales that the entrepreneur himself sells around the market while having a dialogue with consumers.
*Although it is away from the concept of local production for local consumption, in consideration of the persistency of the activity, it is necessary to keep an eye on selling at large-scale large grocery stores in urban areas, where there is the ability to pull in more customers. To do this, the procedure for acquiring the KEBS certification is underway at present.
- ② The optimization of pricing: Although 25 g bags and 50 g bags are currently sold at 20 shillings and 30 shillings, it is also necessary to address new product development (packaging form, etc.) and price setting. Since the Migori group and Kitui group sell a bag or a piece from five shillings to ten shillings, the revision of packaging (quantity) and price is a key issue when targeting wide-ranging consumers.
- ③ Scale expansion: In near future, he plans on buying another machine to expand the production scale.

4) Analysis of case studies

The popped cereal production and sales project is analyzed based on the concept of local production for local consumption (keyword)

(1) Agriculture-commerce-industry collaboration

- DK Engineering in Nairobi manufactured the first pressure popping machine. The manufacturer reflected feedback from production sites to make improvements repeatedly to detail and completed the machine after spending nearly six months. We believe that close collaboration between the production site of new food and the manufacturing site of new machine helped create a new product of pressure popping machine.
- In order to smoothly function a series of activities of the manufacturing of pressure popping machine, the utilization (production) of local produce to sales,

the agriculture-commerce-industry collaboration requires human resources such as the staff of this project who can coordinate a series of the process from machinery manufacturing, product development, production to sales.

(2) Utilization of local produce

- By using sorghum, pearl millet and other less-utilized cereals that corn superseded the top position as staple diet for pressure-popping, products are transformed into a product that meet the needs of consumers.
- By utilizing sorghum and pearl millet, traditional regional food culture is handed down.
- All of the cereals, which were not puffed due to insufficient pressure, were not thrown away and used for porridge after milling. Roasted fruits are fragrant and become one of the popular items.

(3) Understanding consumer needs and face-to-face relationship (Direct sales to consumers)

- Through selling on the street called hawking and face-to-face sales at his own kiosk, he can provide information about how the products are processed to consumers. In addition, face-to-face sales allows understanding consumer needs and providing timely feedback to the production site.
- The outcome at events such as a farming show is significant. By showing consumers how the products are produced and the processing process, it is effective to increase the visibility of popped cereals. It is necessary to actively implement demonstration sales at periodic markets and city streets lined with stalls that can pull in more customers.

(4) Product development

- Since various types of grains can be used as raw materials, popped cereals are easy to season after processing with a lot of flexibility and can be combined (mixed) with beans as well as molding. We can assume that the freedom and ease of product development are one of the reasons for developing intrinsic motivation.
- Consumers with a calorie restriction of meals are asking for popped cereals of sorghum and pearl millet without seasoning. We can assume that it leads to product development targeting health-conscious consumers in the future.

(5) Women's participation

- The production process of popped cereals includes the procurement of raw materials, careful selection of raw materials, production, processing, packaging and sales. Although it is possible for women to do the entire process, by looking at the group activities, men work on the production process that requires handling of machine with firewood, and women play an active role and have the initiative in seasoning and molding process. Both men and women are equally engaged in the procurement of raw materials, selection, packaging and sales. Women's participation is essential in product development because the main process is seasoning and molding.

(6) The creation of opportunities for cash incomes (the creation of added value)

- As shown by the cost calculation, the popped cereal business using locally-produced grains generates profits and creates the opportunities for cash incomes for groups and entrepreneurs.
- Kashata, rice balls and other products with an extra service have a higher profit rate. We can assume that product development that address consumer needs provides additional value.

(7) The creation of entrepreneurship and employment

- As proven by the entrepreneur in Embu, the production and sales business of popped cereals is a highly feasible business plan and the project allows people to start a new business. In addition, the project can be used to develop entrepreneurs.
- Since he started the popped cereal production and sales project business, he employed two permanent employees.

5) Lessons learned from the case studies

-Activities targeting self-help groups

The popped cereal production and sales project as a group activity became an activity for developing autonomy for maintaining the motivation to participate as described above. At the same time, because it creates opportunities for cash incomes, people can obtain a sense of achievement in a relatively short time. The activity also promotes intrinsic motivation within a group. However, a single misstep can result in triggering a breakup of group members and generate free riders.

This is because it is a labor-intensive business and requires a sense of business, which are considerably different from group activities such as table banking and a

merry-go-round. In order to smoothly promote this business as a group activity, the entire members need to understand the essence that the activity itself is business. They also need to properly manage the split of work and work hours to prevent putting an activity load on certain members. In addition, to share activities within a group, it is necessary to standardize and manualize production process, share schedule and information about a set of spending and income.

- Collaboration with local administrative agencies

In this substantiative survey, the case study of Embu's entrepreneur indicated a possibility of developing a highly feasible business plan. To deploy this business extensively in the future, it is indispensable to collaborate with local administrative agencies. We were able to achieve the participation in various events implemented by the government during the survey period. However, although we had many opportunities to receive suggestions from local administrative agencies to hold group training and demonstration sessions aimed at the entrepreneurship of women and youth, the addition of high value to produce and the creation of opportunities for cash incomes, which are related to this activity, we were not able to make them a reality due to budgetary steps in most cases. For the implementation of collaborative activities with local administrative agencies, we always face with a budget problem that who bear expenses. In general, the budges are planned in a previous financial year, the government has a difficulty in responding to unplanned sudden spending.

Under these circumstances, to promote the activity with local administrative agencies, we believe that it would be easier for local administrative agencies to prepare budgets by designing and proposing a training course that comes in a package with demonstration and training and relates to the capacity building for women and youth, which is addressed by all counties as the highest priority.

-Comparison with the G-G based assistance

Since this survey was positioned close to the social development sector based on the concept of local production for local consumption, we were required to undertake grass-roots activities that respect the independence of residents by understanding the lifestyle and custom in the regions. This type of survey activities, which is implemented by integrating into regional community and involves a G-G-based development survey by the traditional ODA, tend to be greatly restricted by administrative capabilities of the local government (a relationship with regional residents and communication) and

budgetary steps (labor cost.) This time, this project was implemented with the cooperation of the International Plant Genetic Resources Institute, commonly called the Biodiversity International, in the region. Because it was a collaborative survey with a well-known international institution, we could obtain understanding of local administrative agencies about the survey and access information smoothly, expanding the scope of activity with community associations.

For the substantive survey in such a short period as in this case, we believe this survey's implementation system would be more effective without having many constraints from the local government.

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Final Workshop report on;

Feasibility Study on Local Production and Local Consumption (Chisan-Chisho) Activity and Extension in Kenya:- “Pop cereal project”

Date: 13th Feb 2017

Venue: Kitui Agriculture Training Center (ATC), Kitui County, Kenya.

Record taken by Fiona Njagi, Patrick Maundu, Yasu Morimoto

Edited by Yasu Morimoto

Summary

This workshop was hosted by Japan Association for International Collaboration of Agriculture and Forestry (JAICAF), and co-hosted by Bioversity International and National Museums of Kenya. The final workshop (one-day) aimed to provide an opportunity for exchange of experiences of the project stakeholders and address potential activities for future. The workshop was attended by representatives of the community groups which implemented activities (Okonyo Migori Self-help group, Syokinyili Self-help group), engineers who developed the pop cereal machines (Jomo Kenyatta University of Agriculture and Technology, DK engineer LTD), County officials of Kitui government, self-motivated entrepreneurs and a few interested individuals. In total of 25 participants was participated. The workshop featured presentations and practical demonstrations by project stakeholders on their findings, experience, challenges, ways to overcome the challenges, key factors of success, innovations and development needs on what they may offer to improve and/or up-scaling the activities. Based on these information, the project team enhanced synergistic effects among the partners and explore further up-scaling activities for other regions and neighboring countries. At the end of workshop, a short questionnaire survey was conducted to assess participants’ perceptions on the project achievement (Data 17/25 collected). The workshop started at 9.20 am with a word of prayer led by one of the participants and ended at 18:30 pm.

要旨

平成28年度 アフリカにおける地産地消（Chisan-Chisho）活動普及検討調査事業 “ポン菓子プロジェクト” の最終活動ワークショップの実施と内容報告

このワークショップは国際農林業協働協会の主催、バイオヴァーシティ・インターナショナルとケニア国立博物館の共催で、2月13日にケニア東部州、キツイ県、キツイ農家研修センターで行なった。本年度活動で中心的な役割を担った関係機関、地域団体の関係者25名を招聘し、経験から得られた成果や課題、成功と失敗の事例、現状、今後の方向性を共有し、関係者の連携を強固にする目的で行った。報告はパワーポイントの他、地域団体が生産販売をする商品の展示、機会を用いた実演を通じて行なった。これにより、参加者間の相乗効果を期待すると同時にプロジェクトとしてはパフシリアルを用いた地産地消の取り組みを更に広く普及させ、地域

内をはじめ、ケニア国内での定着を強固なものにするための来年度活動に向けた重点課題の選定と活動の方向性を特定した。ワークショップ最後には参加者を対象に本年度活動から獲られる社会貢献性についてアンケート調査を行ない17/25名から結果を得た。ワークショップは09:20に始まり、18:30に終了した。

Table 1. Workshop Program.

0830-0900	Registration	Welcome Tea/Coffee Mr Dominic Tumbo	
Opening session			
0900-0915	Welcoming remarks	Mr Shinichiro Nishino	JAICAF
0915-0930	Opening Remarks	Ms. Sharon Munyaio	Kitui County Government
0930-1000	Pop cereal project, Background and objectives of meeting	Dr Yasu Morimoto	Bioversity International
1st Session: Experience of fabricating pop cereal machine in Kenya			
1000-1030	Including 10 minutes Q and A	Mr. David M. Nderi	Engineering Workshop, Jomo Kenyatta University of Agriculture and Technology (JKUAT)
1030-1100	Including 10 minutes Q and A	Mr Daniel Kikori	DK Engineering LTD
2nd Session: Experience of producing and selling pop cereals			
1100-1230	Presentation and demonstration, sharing experiences (challenges, success)	Ms Peninah Mwangangi/ team Mr. Charles Mogeni Mr. Elizaphan G. Mahinda (each 20 minuits)	Syokinilyi Selp Help Group. Embu entrepreneur Okonyo Migori Self-help group
1230-1300	Wrapping up the discussions. Summarise the experiences. Identify advantage and disadvantage of this intervention.	Facilitator, Mr. Dominic Tumbo/ Mr Patrick Maundu	All participants
Tea and coffee brake 1300-1330.			
3rd Session: Discussion on Group Way Forward including advice from the participants and visitors. (Group work A and B).			
1330-1500	(Facilitator, Dominic Tumbo, Patrick Maundu)		

	Use cards, pins etc.
1500-1530	Presentation by group (15 minutes each).
	Wrapping up. Closing remarks.
Late Lunch 1530-	

Detailed workshop minutes

1. Opening message by Mr. Shinichiro Nishino, JAICAF.

Mr. Nishino gave an overview of the project. He mentioned that the work of the project was to improve local food nutrition through consumption of local foods. This is to be encouraged by processing the local foods, adding value to them and then using local businesses to sell the products. He said that they had observed the project so far and have successfully evaluated the project to be positive and that it may help the locals both economically and nutritionally. He gave the purpose of this workshop as to determine the way forward for the project. He then encouraged the participants to suggest various ideas on what they thought should be the appropriate way to move forward.



Photo 1. Opening message. Mr. Shinichiro Nishino, JAICAF.

2. Opening message by Ms Sharon Munyao, County Representative, Kitui County.

Madam Sharon gave the mandate of the county as to provide an enabling environment for companies to grow and thrive on, mentor upcoming entrepreneurs and ensure sustainability. To achieve this, they work closely with several groups, give them several platforms to showcase their products and train the members on various business management skills. She promised to work with the group and support them where possible. She then officially opened the workshop.

3. Background and Objectives of the Project by Dr. Yasuyuki Morimoto, Bioversity Representative.

“CHISAN – CHISHO” means “local production local consumption” literary. It is a successful local movement in Japan using local food products. It also links up with “One village One product movement” and supported by various public and private institution including governments. The Japanese government wants to explore sharing this successful experiences to Africa starting with Kenya.

This project is aimed at increasing use of local food resources, diversify farmers’ income sources and promote dietary diversity through consumption of the local food resources. The first pop cereal activity started in 2006 in Busia County. Over time it has spread to Kitui, Migori

and Embu through this project. These places have been selected due to their geographic uniqueness and existence of previous partners.

The main objectives of the project were as followings.

- i. To increase the use of local food resources through food processing.
- ii. To improve the livelihoods of the local communities through diversifying the source of incomes (new income options from selling local foods).
- iii. To diversify the locals' diets.
- iv. To facilitate in local foods and ecosystem conservation.

The activities undertaken by the project included:

- i. Fabricating pop cereal machine in Nairobi
- ii. Developing and selling the popped cereals products
- iii. Creating public awareness
- iv. KEBS training in hygiene and health. KEBS certification ensuring no infection on bacteria and fungi.

Conducting researches on how to improve the business included;

- i. Nutrition analysis (before and after the popping).
- ii. Documentation of traditional foodways of target crops (in Kitui only).
- iii. Development of community products e.g kashata which has three times more profits compered to ordinal popped snacks.
- iv. Value addition for underutilized food materials e.g broken rice and bitter sorghum and making flours for porridge, "kinaa" from waste millets and use local flavor plants to add value e.g "lunguyu", Tamarind, Accacia, *Zamthoxylum* species.

Since all these activities have been completed, the way forward for the project will be exploring new potential stakeholders like county governments, institutions and universities, NGOs/UN habitat (potential markets including the refugees to be considered) to be contacted to join the project.

In conclusion, the project will improve the income of the locals, create new diets inform of snacks from the local foods, create more business especially for women and children, promote local cohesion, produce supper foods through popping cereals and include climate smart farming techniques.

4. Experience of fabricating pop cereal machine in mechanical engineer workshop in JKUAT. Mr. David M. Nderi.

The popping machine can pop various types of cereals like maize, rice, sorghum etc. at different pressure ranges. JAICAF project team brought JKUAT Engineering workshop a previous prototype machine which was locally assembled in 2006 in Sotik Polytechnic by a Japanese engineer. The main responsibility given were;

- i. Redesign and perfect previous machine to overcome challenges and to meet the required standards.
- ii. Identify the challenges witnessed by the local users and identify the areas requiring redesigning.
- iii. Investigate the materials used in the original machine.



Photo 2. Mr David Nderi, presents their experiences and challenges of fabrication showing their popping machine.

The Major challenge experienced was during testing of the machine at different pressure levels for different cereals. Maintaining high pressure in also high temperatures was a real challenge.

Also they had challenges included;

- i. The initial pressure gauge supporting shaft was bending upon heating and rotating of the popping barrel.
- ii. Fabricating the machine using what we thought ideal for this machine was proved problems and eventually costed time and resources.
- iii. The heat resistance material on the lid of cylinder had pressure loss.
- iv. The pressure tight adjustment screw bent and yielded with multiple testing.
- v. Gate valve fitted to prevent back pressure during the opening of cylinder broke down often.
- vi. The pressure gauge fitted without the gate valve in place upon a set of test could not resume it zero state.
- vii. Welding was an issue during making of the cylinder. A large sized shaft had to be used.
- viii. The pressure gauge was initially getting stuck due to high pressures.
- ix. Despite all this, The workshops staffs assigned for redesigning the machine overcame much of the challenges that resulted with a working model. Testing of the new modified model also worked perfectly for lower pressure types of cereal popping. However, higher pressure resulted still challenges of the pressure loss. They required additional management of time, resources and hence funds.

JKUAT Recommendation:

- i. For effective production of a good quality and marketable machine, funds should be set aside for research.
- ii. More technical details from original manufactures need to be provided for faster production of the popping machine locally.
- iii. The engineers should also consider sub-contracting parts production but do the assembling themselves.

5. DK Engineering LTD. Mr Daniel Kikori.

DK engineering team also had similar challenges what JKUAT faced. At first, welding methods was an issue making of the cylinder. Large sized metal shaft had to be used for preventing occasional bent due to strong shock by releasing high pressure like explosion. Casted steel technology with En9 metal, the problems of cylinder and lid sections have been sorted out now. DK also sub-contracted some parts then they assemble them it is important steps for mass production. No problem so far with the pressure gauge since they used oil pressure gauge. Operator of the machine need to be careful when cleaning, making sure pressure gauge is not blocked by the remaining of the cereals. Need to clean and remove obstacles, it making sure pressure goes to valve. It should be well lubricated at the bearings. Without the wooden shock absorber at the stove, center shaft will bend by strong forth opening the pressure release. They will make more research to make sure they sort it out.

After both the engineers had given their presentations, the participants were then given a chance to pose their questions in regards to their experiences with the machine.



Photo 3. Mr Daniel Kikori explains his success and challenges of fabrication showing his popping machine.



Photo 4. Broken piece of the lid section (cast iron).

6. Q and A from participants, mainly from community groups.

Design of the machine, mechanical problems

- i. Collection cage was getting stuck forcing one to shake it and remove but at same time pouring out the popped cereals. Need some improvement, make it easy set and remove and collect popped cereals.
- ii. Stand will be useful. Can the stand modified to be detached? It will be mobile.

- iii. Space between handle and center shaft is small.
- iv. Safety valves often breaks and stopped using it. What was the course?
- v. Popping sound is too loud. Is there a way out for reducing the sound? One member popped in house and cracked the walls. Solutions for other members contributed as 1) Use of ear muffs. 2) Sound is even beneficial in that it attracts people, 3) use a blanket to cover when popping.
- vi. Materials of the stove made of soft material hence are getting broken being thrown away due to pressure.
- vii. A wooden peace at stove is not stable and it keeps breaking it. Try use heat resistant rubber?
- viii. Nuts to open gauge should be increased in size. However this was refused since it would increase cost of machines.
- ix. A longer cage is good. There are cereals falling off from the collection cage during removing it. It is considered a lot of waste. Can it be made in better way?
- x. Firewood space is small and too low. Can the length of stove increased? Easy to put firewood.
- xi. Story of IEDA confectionary LTD in Japan, Ms Kaoruko IEDA, doing commercial production hence uses gas for her machine. Using gas and electricity instead of firewood. It is still safe but since this is a community based project firewood was cheap and accessible in the contexts of the community groups where we operated. Soundproof walls.
- xii. The machines should be in standard. Nuts, bolts, shaft, lid, all spares should be in uniform size and shape for convenience for both engineer and customer.



Photo 5. Mr. Elizaphan Gichangi, an entrepreneur, Embu explains potential modification points of the machine to the fabricated engineers.

Maintenance of the machine

- i. How often it required lubricate at the bearing?
- ii. Which oil should be used? It there specific one? for food?. Migori machine was rained on bearing started having noise.
- iii. Cleaning inner part of the cylinder? Liquid oil is used by putting it in a cloth n wiped on the cylinder. Migori once got stuck it couldn't remove it easily. Use oil and have it whole night. Challenges is group members' not concentrating maintenance of the machine hence during training those who were trained don't share knowledge to their members.
- iv. About collection cage and bag, instead of metal cage Gichangi modified his cage. It will be good have more than one bag at least 3.
- v. Is some of the spare parts available e.g. center shaft, pressure gauges?

Others

- i. Due to lack of awareness, a fanny rumor raised, by consuming these popped rice and maize (white corn) will bring cancer problems (Migori team). Some answers from the participants as, 1) People need to see processing and compare it to normal popcorns, 2) Important to communicate e.g. microwave machine used to be considered as dangerous, 3) due to competition, people discourage a new ideas.
- ii. The group need to reduce dependency on the project. Don wait for additional inputs by the project if you have some idea and plans to improve e.g. blanket for reducing the noise. The group needs to plan and getting these potential options by themselves as the project is ending.
- iii. Operational manual needed.

Experience of producing and selling pop cereals by the various Groups

7. Syokinili Self Help Group, Kitui. Mr. David Malombe.

This is a group based in kitui that has been popping since the project inception. However, due to mainly in-house wrangles, the group has not managed to reap much profit. In terms of the actual popping, there are some specific members were trained on it. The group is facing challenges when some of the said members are not available on the popping days.



Photo 6. Mr David Malombe, Syokinili Self Help Group presents their experiences and challenges on product development and marketing methods.

This group has researched on various ways to pop different cereals including amaranths and cowpeas. They were successful in popping the amaranths. However, the cowpeas and beans did not pop properly. They were however asked to maybe soak the beans overnight and the pop them in low bars. They promised to try that the next time they were popping. They have also tried making the Kashatas and it's getting them some good money. They also make kina from waste products and sell hence supplement their income.

They then tried marketing their products locally and though there is much to be done, they are moving in the right direction.

The members are also grateful for the machine as they have seen its potential to earn them an income if well utilized. Roughly, this group makes 125 shillings per kg of maize popped, 200 shillings per kg of sorghum popped, and 160 shillings per kg of rice popped.

They have also noted that the business helps them in promoting local culture and introducing the young generation to the said cereals. This has helped the young generation appreciate the local foods and hence improve their nutrition.

The main challenges experienced are:

- i. Poor processing infrastructure. A standard infrastructure facilities required by KEBS and MoH. If the county could help with the two certifications, they would really be grateful.
- ii. Poor branding, packaging, labeling resulting in pessimism from customers.

- iii. Their machine is a loan that they are required to pay up. They don't have those funds as of now. But they committed themselves to work hard to pay it up.
- iv. Poor marketing skills.
- v. Honey used for flavoring is getting too expensive for them.
- vi. Coloring of the popped grains to make it appealing (positive idea).

8. Okonyo Migori Self Help Group. Mr. Charles Mogeni.

The group based in Migori town. Since the beginning of the project, they have been taken to various towns and markets including Kitale organizing popping demonstrations and product sales. In each of these areas, they were able to make some substantial amounts of money. However, the group has not been able to sustain itself ever since. If anything, its noted that they have been making losses due to high production, transportation costs.

They have tried various ways of flavoring including using blueband (margarine) but had to stop due to several concerns from customers (fattening). They also mix their products for maximum nutritional benefit to meet customer needs. She has also tried grinding this mixture to flour and making porridge. The result was that it was really sweet and they enjoyed. They also experienced a worry of cancer as a result of their products. However, this was noted to be just negative publicity from the competitors.



Photo 7. Mr.Charles Mogeni and Lonah Ochaka show their products and explain marketing methods.

The following are their challenges:

- i. Poor packaging and branding papers and stickers. Lack of clearly market labels. Branding the products to be eye catchy.
- ii. Her products like the rice balls require too much sugar which most consumers do not like. They have been tried to reduce amount of sugar used.
- iii. Group wrangles resulting in members leaving.
- iv. Lack of proper business management skills, record keeping skills and accounting skills.
- v. The difference in colour and taste of their final product was also noted as a problem. But after proper deliberation, it was noted that the difference in colour was to



Photo 8. Mr.Charles Mogeni shows one of their best product, rice balls.

be seen as a pro to the business instead of a con. Proper awareness is required for this. The difference in taste, on the other hand, was as a result on the popped cereals burning. They were then asked to make sure they pop at the right bar to make sure this doesn't happen again.

- vi. The cost of machine is also a challenge to them.
- vii. Their collection container is quite small and the popped cereals end up pouring. They need a modified one.
- viii. The lady was quite innovative in her thinking. She would like to make something like Sossi Soya from the popped cereals. However, this may not be possible because the popped cereals can't be cooked again with water. They dissolve immediately in water.

9. Gichangi- Entrepreneur, Embu. Mr. Elizaphan Gichangi. He was introduced to this popping business last year in November. He then received the machine on 18th Jan and started popping on 20th Jan. On the first day of business, they managed to pop maize, sorghum, rice, pearl millet and wheat and made around 4000 Kenya shillings. This encouraged him to work more and recover his cost.

He had the following remarks:

- i. He first used to use. But after several customers complained, he reduced the sugar and now uses honey. This way new customers have had no problem with the sugar levels in his products.
- ii. About the colour of popped maize, he encouraged others to take advantage of this difference since it sets him apart from the rest in the business
- iii. He has also noted that his consumers appreciate his product because it has no fat.
- iv. A main advantage is that so many cereals are being popped. These included foxtail, Amaranths, finger millet, brown rice, which is most preferred, white rice, processed coffee which is first popped then grounded, and soya which is cooked before popping.
- v. He noted that the needed harder plastic for packaging.
- vi. His label include the ingredients, the producer, nutrition label, the direction of use, contacts, storage, expiry and date of packaging. The advantages of declaring ingredients are to let others avoid their allergies and save him on lawyer's fees just in case of a lawsuit.
- vii. The business is able to sustain him and his employees though the expenses are too high
- viii. His children have been his first customers and they enjoy the products a lot.
- ix. Mostly used in terms of market, pearl millet, sorghum, wheat, maize, rice.....



Photo 9. Mr Elizaphan Gichangi explains his developed products.

The following are the challenges he has experienced:

- i. Lack of proper markets
- ii. Lack of capital. He had to take out a loan to buy the machine.

- iii. Pearl millet is mostly preferred. However it grows on sandy soils. Separating it is before popping is quite a hard task.
- iv. Lack of proper premises to set up his factory.
- v. Lack of awareness from customers.
- vi. Bulkiness of the machine stop him from taking it to the markets for demonstrations
- vii. After packaging, there is some dust that settles at the bottom of the packet. This is an issue that has been raised by quite a number of customers.
- viii. Training should not stop on proper business management skills. It should also include ways of calculating costs and determining prices.
- ix. He is currently on arrears on barcodes since they are renewed annually. Barcodes may be very vital in marketing as they determine how genuine one's product is.
- x. They have not been mixing the popped cereals yet some customers have been asking for them.
- xi. Documentation of sales and productions.
- xii. His machine has been breaking down quite often hence increasing his costs
- xiii. The machine is being placed on the ground. Could it be raised a little, like maybe a stand?
- xiv. The distance between the handle and the pot is quite small. Once a worker knocked it off and has an accident.
- xv. He had an issue with the collection bag. However he managed to sort this out and now has a collection cloth instead. Cleanliness is now the issue.
- xvi. He finally encouraged the other groups to work hard and gain from the project. He also encouraged them to take advantage of the noise and get customers as a result.
- xvii. Lastly, he thanked everyone for this opportunity and invited them to talk to him in case they needed help or even to find markets for him.



Photo 11. Operating popping machine.



Photo 10. Demonstrating tasting and flavoring process.



Photo 12. Ms Lonah Ochaka from Migori, right hand side, is demonstrating how to make rice balls and Mr. Elizaphan Gichangi from Embu tries to copy it.



Photo 13. A member of Syokinili group, left hand side, advising Mr. Elizaphan Gichangi from Embu, how to make 'kasheta'.

Discussion on the project success, challenges, solutions and, future activities.

The project successes were the following:

- New business and increased income to locals.
- KEBS training was helpful. Obtained KEBS food handling and hygiene certification
- Nutrition information available.
- Fabrication of the machine succeeded.
- Value addition to foods like sorghum and rice.
- Mr. Gichangi's business model is a success.
- The following were given as the challenges:
- Handling of the machine and its maintenance. The machine has a delicate part that requires extra attention when handling it.
- Prior design information- the engineers had a real hard time duplicating the machine. The initial design was quite hard to duplicate. More time and funds needs to be allocated for this.
- Research funds- more funds are needed for the engineers to continue their research on this machine.
- Quality of raw materials- an issue was raised on the quality of raw materials used as it was not getting cooked.
- Sound- this was a major issue raised. To some it was a big con in that unprepared persons were getting alarmed. To others, however, they chose to see its positive impact to attract potential customers.
- Overall design of the machine- the machine is quite heavy and delicate hence an issue
- Machine standardization- the parts used in the machine are quite specific to one machine.
- Spares- availability of spares and in good time is quite an issue
- Quality of materials used- too much sugar is used especially when making rice balls.
- Packaging and presentation- both groups have had a rough time creating quality and attracting packages

- Weighing final products- it was noted that the groups were not weighing again after popping. Hence poor record keeping
- Lack of KEBS mark
- Colour of product- the popped corn is said to be darker than the one currently in the market hence not eye-appealing
- Popping beans- its proven to be difficult to pop some cereals like beans
- Lack of proper popping premises.
- After packaging, some dust settles on the packet that customers are weary about.
- Due to lack of proper packaging skills, moisture gets through to the popped cereals at some point making it difficult to sell.
- Poor marketing skills.
- Lack of awareness from potential customers.
- Poor business management skills
- Negative publicity from competitors- one group said they encountered a claim that their products would cause cancer.
- Poor group participation by members
- Poor documentation
- Unable to determine the exact time of expiry dates in the labels.



Photo 14 and 15. Identified challenges. Mr Dominic Tumbo, a local coordinator of the project use cards to facilitate the discussions.

The following were given as solutions:

- The engineers were encouraged to use the right materials when making the machines.
- The Groups were encouraged to used sound dampening materials like ear plugs
- It was noted that operating manuals may be created and sold together with the machine to enhance easier use.
- The engineers were asked to make sure that spares were readily available
- When packaging, it was encouraged that the silica gel may be used.
- The groups were asked to work hand in hand with food science personnel in institutions like JKUAT to help in analyzing the nutrition statics on the labels.

- The trained machine operators were asked to train others to ensure smooth working of the machine by the members.
- Use of natural colour- for flavoring, the groups could use natural color flavors to encourage customers to buy the products.
- The groups were asked to buy and use weighing scales even when packaging
- Diversify flavors
- Use aggressive marketing skills to sell the products
- Mix various products for maximum nutrition benefits
- Balancing size and cost while pricing their goods.
- Turning some waste products to cereal flour e.g. “kinaa” (grinded pearl millet).

The following were the requirements as at this point in the projects:

- Good working environments
- Health certification for the workers
- KEBS mark for each group
- The following was the way forward as suggested by participants:
- Move towards products like kashatas and balls.
- Turning wastes into flour.
- Better work plan for groups.
- Good market links.
- Training on marketing goods.
- Aggressiveness in groups.
- Groups to cater maintenance costs of the machine.
- Proper network between engineers, groups and county governments.
- Engineers to create an MOU and work together.
- They would also standardize the machine and its spare parts.
- The machine manufacturers are to apply for KEBS mark.
- Groups should focus on nutrition sensitive popping.
- Groups to have only serious members.
- Reduction in machine breakages.
- Members to contribute money for group project.
- The groups should create proper by-laws.
- The groups would keep the machine but pay up for it.
- The people handling the machine would get protective gears.
- Research is to be conducted on pulse popping.

Discussion on Group Way Forward

The participants were also placed into two groups (A and B groups) to discuss the way forward given the challenges and solutions suggested during the meeting. They had a few minutes of intense discussion. The following was tabled out by both groups after their discussions.

- Engineers to improve machines n reduce breakages.
- Link between engineers and county people to be established.
- To engineers, they are to work closely together to improve machines.

- The groups should work to promote machines in other areas through products differentiation.
- Proper coordination n linkages among different groups like those preparing nutritious juices.
- The members should own the project.
- Contribution by members to enable proper branding n packaging.
- Members to create interest in the business.
- Members to plant raw materials to reduce cost of inputs.
- Organize only serious members.
- Have a time limit on when to improve whatever is needed.
- Train group on business plan, proper record keeping, and work plan.
- We should have better market linkages to penetrate market.
- Link with county government, national government n institutions.
- Group to look for proper ways to implement by laws for strength.
- Groups to have proper business plan
- About KEBS, have county government link them up and KEBS train them to get that mark.
- County government to link them on fairs n exhibitions.
- The County can also train groups on marketing skills
- Groups will stay with machine but officials
- The members are to buy the products from the factory at the wholesale price then go sell it at their won convenience and price.
- Non-members are to get the same products at a slightly higher price.
- The factory should pay up labour, venue and materials costs
- Inactive members are not to share in the profits.



Photo 15 and 16. Mr Shunichro Nishino, JAICAF, hands KEBS certificate to the training participants for celebrating their deep commitment and hard working.

Closing Remarks by Dr. Yasuyuki Morimoto

The closing remarks were given by Dr. Yasu Morimoto. His remarks included:

- i. The project team will use this findings to develop way forward.
- ii. Creating awareness. The team now had the duty to go out and create awareness on this popping cereals business.

- iii. Popping some cereals like beans and soya is a challenge. However, the groups would go and try out various ways to see if they could still be popped.
- iv. The project will not support same activities. It is time to stand by its own and view expanding the interventions through having other activities based on the finding obtained in this project.
- v. The one of our next activity would be to sit down with the groups and find out the ways of recovering the money of the machine. This way other community groups like you will get similar opportunities. And it would help to make sure the groups would be able to won the project and hence the machine as well.

Closing Remarks by Mr. Patrick Maundu

Mr. Patrick Maundu thanked JAICAF and MAFF for funding this project and seeing it through. He noted that this business was a profitable venture but only to those willing to go out and work on it. Like any business, it needs patience and proper marketing skills. He encouraged the groups to work together in harmony and ensure its success.

He also thanked the participants for their patience throughout the meeting. He thanked them for the progress they had made so far. He then challenged them to take on this business as a personal responsibility to make it a success. He finally echoed Dr. Yasu Morimoto's remark on paying up the machine asking them to start meeting and discuss how they would go about that.

There being no any other item on the agenda, Mr. Patrick Maundu officially closed the meeting and asked one of the participants to close it with a word of prayer.

Conclusion

The participants think this is a very viable business idea. However, it can be noted that the groups are not doing as well as they could. This can be blamed on maybe lack of training on group dynamics or lack of group experience that is difficult to deal with many people in a group. No matter what it is, these two groups (Kitui and Migori) showed that they were willing to overcome the various obstacles that came their way and hope to gain from this project. One of the common challenge for all the groups were marketing as popping cereal is still a new to the most of the people in Kenya. Like any other business, it needs thorough creation of awareness to potential customers to create markets. Adverts, billboards and even social media should be considered as potential solutions. All in all, this business as shown by Mr. Gichangi and rests of participants need dedication for the work and it will grow and prosper.



Photo 1620. Mr. Elizaphan Gichangi's local factory and shop in Embu.

Result of the questionnaire survey

Date of survey: 13 February 2017.

	No of participants
Male	3
Female	10
Total	17

Question: From your own experience / workshop participation, do you think this popping cereal technology or intervention **will contribute to improve or decline followings?** And why or how?

Question	Improved↑	No change→	Decreased↓
1. Income	17 (100)	0	0
2. Local use / demands of local foods	17 (100)	0	0
3. Local cohesion.	17 (100)	0	0
4. People attitude on local food crops	17 (100)	0	0
5. Working opportunities for women.	17 (100)	0	0
6. Environment conservation	13 (76.5)	1 (5.9)	2 (11.8)

(percentage %)

Question 1. Income. Why?

Improved↑

- The producer and farmer will have a steady source of income.
- It improves day to day life financially
- It will contribute to improve local business and income.
- It will improve because the popped cereals at a stable price.
- It's a new product in our country with health benefits.
- People know these local cereals are healthy and nutritious.
- Popping local cereals will create the demand for snacks. This will promote the demand of the cereals from the farmers and also to the popping groups.
- It is a viable business which requires locally available raw materials and has good returns.
- Some women are getting money from the popping exercise.
- There will be an improvement on income as a result or these popped local foods.
- It is so profitable.
- The business gives opportunity to entrepreneurs.
- The cost of production is much less that the profits.
- The popped cereals are sold at a fair price hence it will improve and people will enjoy to buy them.
- Cheap materials make it improve the income levels. More people will enjoy the popped cereals.
- Because it is so profitable. It is good for human health. It adds food value.
- Popping adds more value to the cereals popped hence improve the income to the manufacturer.
- From the sale of the products.

Question 2. Local use / demands of local foods. Why?

Improved↑

- The popped cereals will have more demand than previously.
- People will be serious on local use of cereals like pearl millet, sorghum and other local cereals. Farmers will improve their production if the market expands and see the potential.
- People had forgotten about sorghum and millets (local foods) but since popping machine provided a new opportunity for use, they can be used plenty again.
- It can be used to make porridge, cakes and other products.
- It is an alternative type of food as compared to our usual porridge. Cereal popping will increase demand for supply of millet and sorghum.
- When value is added during the popping, it will create demand which will in turn encourage farmers to put more effort in their farms.
- Converting the local cereals to snacks through popping will promote the demand of the cereal.
- Demand will increase because of the new value added products.
- Both men and women plus their children are eating the local cereals.
- The materials will be sold at a fair price so it will improve and people will enjoy to buy price.
- It creates the demand for local foods from the farmers.
- There will be need for raw materials.
- More people get informed on what exists that is available for consumption.
- There will be improvement in these local foods because they will be gotten from their own crop fields.
- The local foods demands will increase since acquire them locally and it's not expensive.
- It will create high rate in growing local foods.
- More people have started to realize the value of local foods hence more farmers have started planting more local foods.
- It is nutritious.

Question 3. Local cohesion. How?

Improved↑

- The intercommunity link will be developed.
- It is a new technology that enlightening people in the community as whole.
- It is called local food since it is found in the area and cheap to buy these foods.
- This will improve unity among the people due to the products made.
- People from different regions of the country will enjoy a range of varieties such as kashetes (biscuit) and flavor pop cereals.
- To improve the local food can be well since she has seen how to make money.
- Many groups and individuals doing the popping business will result in healthy competition among them.
- Group work will improve local cohesion.
- Group members will improve their cohesion.
- The people enjoy the popping activity together.
- Creates business management.
- It creates income generating opportunity and hence reduce conflicts among members.

- Community involvement improves this as well as interrelation of communities in workshops.
- The group work activity can make people come together and unite.
- It brings unity among them due to the product made.
- Creates business management.
- The popped cereals has created local cohesion due to its uniqueness.
- It creates markets for small holders farmers.

Question 4. People attitude on local food crops. Why?

Improved↑

- Peoples' attitude will increase because popped products are easy to eat, can be consumed anytime as snacks.
- It will increase their consumption due to the flavors added.
- There is a prevailing wave of healthy eating of traditional foods.
- When the popped cereals were tested, they found it was good and sweet.
- People have realized that the local cereals like sorghum and millet can be popped and taken as snacks.
- People will have positive attitude towards local food.
- It will improve their attitude as they eat the local food.
- People are consuming products at a higher rate now.
- People will develop more interest in growing local foods.
- Individuals' perception will change as they appreciate the local foods more.
- Confectionaries change how people consume goods.
- Local people came to appreciate various uses of the local cereals other than just making porridge.
- Because they are acquired locally and used to make various delicious foods.
- Creates more interest in local foods.
- Due to value added on millet and sorghums more people are now much interested with popped cereals.
- People are now aware of the local food crops.

Question 5. Working opportunities for women. Why?

Improved↑

- Women will take part of profits and making their own activities beside household works.
- It will create working opportunities for young women and reduce idleness hence improve general family life.
- This will creating jobs for women and the youth in the area.
- Women will be empowered at a higher rate and they will be able to support their families.
- It will create self-employment and increase their income.
- It will increase the income and hence encourage more popping.
- It doesn't need a lot of man power hence women can do this popping without too much strain.
- It is a viable IGA for women which will provide both direct and indirect employment.
- They will sell the local popped cereals.
- it will create jobs to the women and help them sustain their families.
- The business will keep more women in business.

- In their respective groups, they will be able to generate income.
- This is an easy venture that can be done at home.
- The women will thus be able to improve their living standards and hence reduce poverty in their families.
- Empowered women help their families and support themselves in many ways hence reduce poverty.
- It generates women in business and keeps them busy.
- Popping has created working opportunities for women since they have been trained on marketing process.
- It will create full time employment.

Question 6. Environment conservation. How?

Improved↑

- Minimizes wastage.
- It will help conserving community landscapes and making many farmers to plant local varieties of cereals.
- It helps to conserve our environment and land.
- The final products can be recycled.
- It will minimize soil erosion. Application crop rotation.
- To make the matter wise is to promote our work or business.
- The firewood will help the group get some money.
- Final products will be used to make products.
- It will create more interest in growing sorghum and millet.
- The business uses locally available products and hence no environmental degradation.
- The local food crops will be used to make many products e.g. popping millet, sorghum etc.
- The local cash crops used make the environment rich.
- It creates interest in planting more local food.
- The machine is friendly to environment hence no effects in the environmental conservation.
- Improve when people have alternative source of income, forests will not be depleted through cutting of trees for commercial purposes.

No change→

- The use of firewood will not improve environmental conservation.

Decreased↓

- It causes noise pollution.
- Use of firewood will degrade the environment.
- Decline through pollution from the machines used

Questionnaire used

13 Feb. 2017

Your Sex	Female <input type="checkbox"/>	Male <input type="checkbox"/>
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Please ✓ in the box.

From your own experience / workshop participation, do you think this popping cereal technology or intervention will contribute to improve or decline followings?

And why or how?

Please choose one and ✓ in the box.

	Question	Improve	No change	Decline
1	Income.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Why?				
2	Local use / demands of local foods such as sorghum and millets.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Why?				
3	Local cohesion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How?				
4	People attitude on local food crops such as sorghum and millets.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Why?				
5	Working opportunities for women.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Why?				
6	Environment conservation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How?				

Thank you very much for your information and participating this workshop.

Traditional Foodway of people in Kitui, Kenya

Documented by Tabitha Katee

Study area: Uae village, Kitui County, Kenya.

Major Informant:

- 1) Mrs Agnes Kalunda Mwikya.
- 2) Mrs Beatrice Kathini Joseph.

Target crops:

- 1) Sorghum
- 2) Pearl millet

Date of documentation:

- 1) Planting, large rain season; November 2016.
- 2) Harvesting season; January and February 2017.

Table 1. Traditional dish documented.

	Sorghum (muvya)	Pearl millet (mwee)
1	Ngima ya muvya (Sorghum ugali)	Kitumuki kya mwee Ngima ya mwee (Pearl millet ugali)
2	Uuu wa ukiia (Sorghum porridge)	Uuu wa ukia (millet porridge)
3	Ndua (Sorghum porridge for delivery mothers)	Ndua (Special porridge for delivered women). It is also consumed for normal people.
4	Muluanyo (Sorghum with cowpea).	kinaa kya mwee (mixer of pearl millet flour with sugar).
5		Kimanza (uncooked meal).
6		Ngalamba. (used green pearl millet grains). Mainly maize is used. Pearl millet is used when no option.
7		Ikiie ya mwee Uncooked pearl millet meal, millet soaked and grinded. (USING IVIYA YA UKIA and NZIO).
8		Ngunzakutu (also can use maize flour)
9		Mungamano
10		Ndilango
11		Chapati kya mwee (Chapati made from pearl millet)
12		Pearl millet cake.

Story of Mrs Agnes Kalunda Mwikya

Sorghum (muvya)

Sorghum and pearl millet used to be their main staple food before maize introduced. It was the most important food by then. Many people say that the Sorghum and pearl millet need labours specially children for chasing birds when harvesting. Education also contributed to change of not planting a lot of Sorghum and pearl millet. Children can't do this work nowadays as they normally go schools (modern education). So they changed to maize planting. However Sorghum and pearl millet is more resistant for drought and adapted in dry area. Long time they use sorghum (variety name muthio and mwemba in white colour). These varieties were the best and after moulding, the colour is white as rice and cooked with cowpea. Seldom to see these varieties around the area, but sister in law of the interviewer promised to bring me a sample, from Kanziku area, from her brother in law place. muthio

and mwemba needs a lot of rainfall, because it is tall. If the rain lack gives very little harvest, small grain size and few grains. They plant red sorghum, mutune variety for making porridge. Mutune (red) variety is best for making porridge, especially when mother give birth, they believe it adds blood in their body.

There are few more varieties of Sorghum, e.g. kamungomo (resistant to birds), katengu (white grain variety).

* note: mwemba = mwembe in this group of Kamba from Uae in Mutomo area. This name confuses with Mwembe which is mango (mwembe) tree.

Pearl millet (mwee)

People plant pearl millet because it more resistant to drought. People plant Sorghum and Pearl millet separately because their pollen affects each other negatively when planted at the same field together. Harvest will be reduced. Pearl millet is most important crop during the famine time because it can harvest in short period of time, quickly matured. It can also be processed fast. Just grind grain on traditional grinding stone (mukando) and with tamarind juice and sugar you can eat it and satisfy. It can be used in many ways and it's always accessible and available, cheap in cost. After drying properly and threshing, they put into sack and stored with chemical hence no pest.

Cooking recipe

Sorghum Dish

Long time they remove top skin using the mortar and pestle. After washing the sorghum grain drying in the sun then grinding with traditional grinding stone (mukando). It was easy and normal at that time. Nowadays they take it to the posho mill because it is cheaper and much easier to get their flour.

- 1) Ngima ya muvya (Sorghum ugali).
 - Boil water add the flour and stir until sticking properly together. Cook until ready.
 - Use together with green cowpea, sour milk is the best.
 - Meat stew is not a good dish with sorghum ugali.
- 2) Uuu wa ukiia (traditional porridge).
 - Soak to be soft and grind it and put this mixture in the calabash to cook tomorrow.
 - Take clean pan put water from the calabash which has already settled then boil.
 - Shake the remained and add to the boiling water in pan and stir.
 - After ready put it in the calabash without sugar because some people take sugar in tea but not in porridge.
- 3) Ndua (for delivery mothers)
 - Especially red sorghum, after removing the chaffs from the sorghum take to the posho mill to be grinded to be flour.
 - Boil water, add the right amount of flour and stir until it becomes very stick. Cook until ready.
 - Add sour milk or tamarind and sugar. When ready serve (this one you don't put in the calabash).
- 4) Muluanyo (sorghum with cow pea).
 - Put the dry cowpea in the pan to start cooking, because cow pea takes longer time to cook than sorghum.
 - When is almost cooked you take the sorghum which you have already removed the top skin using Ndii (mortar with pestle). Wash it and then add to the cooking cow pea.
 - After cooked add salt and fat and mix properly until they are mixed together.
 - Then serve, also if you have tea you can enjoy it together.
 - Only cow pea and pigeon pea, but not bean because they don't plant a lot of them.

Pearl millet (mwee) Dish

- 1) Kitumuki
 - Remove the chaffs from the pearl millet, take the pearl millet to posho mill to make flour.
 - Take a cooking pan and water to boil.
 - Add the flour until it sticks like ugali.
 - If I don't have vegetable, add oil and salt.
 - Serve with sour milk.
 - Alternative is grinded cowpea, green gram.
- 2) Uuu wa ukiia (Traditional porridge from pearl millet)
 - The procedure is like sorghum traditional porridge.
 - Remove the chaffs from pearl millet.

- Then take it off from the mould put it back to the very same water she had soaked.
 - She grinds it using a stone.
 - Takes sieve and sieve all the mixer.
 - Let it to settle so that water can be separated from the stuff.
 - Take another cooking pan pour the top water inside and take it to fireplace to boil.
 - When it boil on top make a foam, you remove, you remove and throw it away.
 - Take a stirring stick, first you stir the stuff and add it to the boiling water and you keep on stirring until ready.
 - Pour your porridge in the clean container, wait until cold and add sugar.
 - Serve the amount you like to consume.
- 3) Kinaa (mixture of pearl millet flour with sugar).
- After removing the chaffs from the pearl millet, fry it until brown and it cracks.
 - Take it to posho mill for making flour and regrind it again using traditional stone, if a maize flour posho mill is used, but it is once if pearl millet posho mill is used.
 - Use sour milk and sugar. If you don't have sour milk use tamarind or baobab and mix with water, take the juice put it in the flour and mix.
 - Take a bowl take the amount you to consume add sour milk and sugar stir and then eat. Put sugar it's a must, then serve.
- 4) Ngalamba - kianza (made from green pearl millet).
- Before the millet is dry green millet.
 - Take it to the grinding stone and use your hand to remove the grains so that the grains can be removed.
 - Take the calabash remove the chaffs.
 - Come back again to the grinding stone grind the normal way.
 - Take the tamarind juice mix in and sugar (ndilango)
 - For ngalamba, add salt
 - Use green maize leaves or polythene bag for the dough.
 - Boil the water and put the dough to cook till ready.
 - Serve. (This one never cooked kianza, but ngalamba is cooked.)
- 5) Porridge.
- Porridge can be made from pearl millet. The process is the same as sorghum.
- 6) Ngunzakutu
- Boil cowpea until ready.
 - Add the pearl millet flour and cook like ugali.
 - Put salt and oil and cook till ready.
 - Serve.
- 7) Mungamano
- Cook cowpea, when is almost ready wash the millet mix it with the cowpea,
 - Boil until cooked.
 - Add salt and oil mix with a wooden stick.
 - Serve.
- 8) Ndilango (cooked pearl millet mixed with pearl millet balls).
- Pearl millet (Agriculture type), pounded with mortar and pestle. Local variety, Kikamba type it is easier to remove grains when it is still green through scrubbing on grinding stone. Then remove the skins by winnowing.
 - Grinding it with the traditional grinding stone.
 - 1st round you see lots of top skin. 2nd round bit smooth, 3rd round very smooth. No sprinkling of water when grinding because the pearl millet is still green and it has water in itself. You just rinse off your hands with water.
 - Lit the fire, put on the cooking pan with tamarind juice mixed with enough water according to how much you have grinded your glue.
 - Cut some small balls of pearl millet, put aside, the remaining glue mix with water and add to the boiling mixer. Stirring with a cooking stick.
 - After the porridge starts boiling add in the balls which you had put aside using a spoon to scoop one at time until all the balls are in the mixer. Stirring with a cooking stick also.
 - When almost ready add in sugar and serve.

- Note. The reason why they used to mix this balls in the pearl millet porridge was that when you eat lamps in the porridge you get satisfy and the stomach gets full.

9) Kimanza

Story of Ms Beatrice Kathini Joseph.

Beatrice is a farmer of sorghum (mutune varaety) and mwee (pearl millet). She normally takes her harvested grains to the posho mill and grind it for flour. She mixes her sorghum (mutune) with maize or sometime without and make ugali and enjoy with sour milk (fermented milk; she likes this best), cabbage, cowpea, potato stew. Porridge is flavoured with tamarind fruits and added sugar. This porridge made from mutune (red) variety is good for delivery mother, small baby, even grown-ups, because it adds blood in the body. Mutune variety is not good for making mungamano dish. For pearl millet, she uses for making cakes, kinaa, porridge (usuu wa ukiia), ikkie, ugali (kitumuki), chapatti. She also feed her chicken with these grains.

She demonstrated making pearl millet cake.

Ingredient and recipe.

- Pearl millet flour 1/2 kg.
- Wheat flour ¼ glass
- Baking powder 1 spoon.
- Sugar 3 spoon.
- Food colour tip of a spoon.
- Water pour until like porridge.
- Stir it until soft.
- Procedure.
- Take a clean cooking pan and oil it.
- Sprinkle wheat flour.
- Pour the paste
- Put it on the fireplace
- Seal it with a lid and put burning coal on top and below.
- When start producing smell, you check and put stone under to reduce the heat from beneath.

Traditional Foodways

1) Harvesting pearl millet and sorghum.

28 January 2017 (Harvesting season). This pearl millet was planted in early November 2016.



This is one of the fields of Mr Daniel Kimeu Kanywa in Uae village. The yield was affected by the less rain which they received this year's long rainy season and also they are vulnerable to the wild monkeys whom walking around looking for something to eat.



Unfortunately, In last planting season, Sorghum performed poorly. This is because they planted the seeds late. They were given in a condition that 2kg of sorghum seeds (Gandam type) by the beer making company through Kangundo based NGO and replacing with 4kg (double amount of seeds) after harvesting so that the company continue distributing to the other farmers hence encouraging seed chain distribution. By the time they planted sorghum the millet was much bigger because they planted immediately the rain started thus the reason they have at least to harvest. Since they planted the rains never came back.



The sorghum grains did not do well in this season. The rains were very limited, and also they were given the sorghum seed very late by the NGO. At least they are going to harvest some but not much.



Mary, a daughter to Mr Daniel Kimeu Kinywa and her brother and Mrs Kisengese are harvesting the pearl millet in his 14 acres field.



The family of Mr Daniel Kimeu Kinywa normally use this pail when harvest the pearl millet because after its field up it is easier to transport it the stone where they gather all of harvest together, wait till it's completely dry and separate they pearl millet from the panicles by biting with a long strong sticks and take it to the granary and store it. They prefer this place (middle bottom) because the peal millet is clean is not affected by the small stone.



This is the field of the mother of Mr Daniel Kimeu Kinywa, She prefers cultivating maize which she keeps her own seeds (local Kikamba varaety). This varaety is not a high yealding types but at least she will get some of the harvest (maize).



This is green gram from the mother of Mr Daniel Kimeu Kinywa, they are some in the field but most of them dried up because of prolonged drieness. This is the pods from the cowpea plants, they were able to enjoy the cow pea leaves and green ponds. Also they have harvested the dry ponds of cowpea.



This is the granary where harvested foods like maize, pearl millet, sorghum, cow pea and green grams are stored.

11 February 2017, Uae village



This is Mr. Daniel Kimeu Kanywas field in Uae village in Mutomo District, Kitui County. They have already harvested, and these are some of the remains in the field. The field is approximately 14 acres. With properly maintained terracing. The yield had been attacked mostly by fowl and monkeys since he is the one who had such crop that is the pearl millet in the area.



Harvest from Mr Daniel Kimeu Kanywa farm. Actually waiting to be separated from the panicles so that it can be stored (left). Ms Esther Wayua Kanywa the mother of Daniel Kimeu kanywa and is holding a basket which she made long time ago. The basket is used for harvesting pearl millet. She was born in 1928 (Middle). Cowpea field where they enjoy their green leafy vegetables and pods (right).



Ms Esther Wayua Kanywa crop field where she had planted her maize. She is going to enjoy some of it but not quite much. Since they were affected by the rains (Left). Mr Shadrack Kanywa Rebbeca (middle and right). He is mixing the pearl millet using his feet, because this is the way they normally do it. He is the nephew to Mr. Daniel Kimeu Kinywa.



Shadrach is harvesting the pearl millet which helped by Mrs. Mukai Kisengese.



Traditional granary (kitaa) used when one is watching over the field to make sure no wild animal attacks the yields. Photo (right) shows the view of Mr. Daniels field from off above the field.



Nyamai Kimwele (12yrs) is holding a pistil and helping is to remove the pearl millet from the husk (left). Ms Agnes Kalunda Mwikya is putting the pearl millet in the mortar (right).



Agnes is working while Shadrack is watching. Removing the pearl millet the mortar.



The 1st round crushing is done and is ready to be removed the top residue. Agnes Kalunda is removing the residue (right).



This is how the ready removed residue pearl millet look like.



This is the second round of removing the husk from the pearl millet.



Agnes is concentrating on the cleaning the pearl millet.



Agnes Kalunda Mwikya farm. Cowpea is almost drying because of the droughtiness.



Agnes Kalunda Mwikya is winnowing the pearl millet.

Documented 15 Nov 2016 (Planting season, large rain season).

2) Pearl millet preparation



Removing the top skin using mortar and pestle (ndii na muthi). No water added in mortar. After crushing the grain properly to remove the top skin in the mortar, put it in a large sized calabash and start shaking it bit by bit to another large size calabash container to remove stones (de-stoning). Before removing the stones, this is the way of making sure that the stones cannot hide under the cover of the millet. The reason why they crush the millet before removing the stone is that, so that the stone can come out without sticking on the top skin.

Photo 1 (left). Victor Kisengese Titus (a boy) is crashing pearl millet using mortar and pistil (ndii na muthi) to separate skin of the grain. A girl, Charity Mukai Titus is helping her brother to do that.



Mrs Josephine Mukai Kisengese checks mwee (millet) on her hands if it is cleaned.

Victor and Charity are Grand children to Mrs Josephine Mukai Kisengese in Photo 1 (left).



After crushing properly, remove it from the mortar photo 1 (upper left), Photo 2 (upper middle), Mrs Josephine Mukai Kisengese winnows to remove top skins of the grain using her two large calabashes (nzele). Her chickens enjoy fallen grains and removed skins. This process of cleaning, removing skin of the millet takes approx. 20 minutes.



Put it in a large calabash and start shaking it bit by bit to another calabash to remove stone (de-stone). As you can see the pebbles in the calabash in the photo (right).



Mrs. Josephine Mukai Kisengese put the pearl millet into the container ready to be soaked, and Victor Kisengese Titus (grandson to Josephine) is helping put the right amount of water inside. Soak after one hour or so. She takes it again to the mortar and pound it until it becomes soft. This process makes easier to grind the grains. The pearl millet is kept in the store to sit for sometimes (right).



Mrs. Kisengese asked her son Mr Mwanzia to cut the calabash for her. Mwanzia is using the saw for cutting it.

3) Ngima ya mwee or Kitumuki kya mwee (Ugali made from Pearl millet).

Demonstrated by Mrs Josephine Mukai Kisengese.



- This is pearl millet flour from posho mill (left). Light the fireplace, put a pinch of salt, put a pan to bring it to boil. She scoop some water to adjust the water in the right quantity. She kept water aside.



Josephine adds the pearl millet flour into the pan then stir the mixture.



If it is hard you add the water to make it soft. The mixture it's a bit sticky on the pan. Cook until it ready. The right photo shows it is ready now.



Serve with fermented milk or mukauwu/mukauwi, a local vegetable dish below.

4) Cooking Mukauwu/Mukauwi (wild vegetable dish), a side dish of pearl millet ugali.

Demonstrated by Mrs Teresia Titus, a daughter in law to Mrs Josephine Mukai Kisengese.

This is a shrub tree.



Puts water into pan and put pinch of salt and bring it to boil.



Mrs Teresia Titus, is checking the vegetables to make sure they are clean. She does not normally wash this vegetable. They say that it cannot cook well if you wash them. They say that if washed, it will be rough taste and cannot be soft and nice. Add the mukauwu leaves and stir vegetables.



Cook it until very soft (a girl Charity Mukai, right side, daughter to Teresia).



While cooking vegetables, she removes red skin of onion and cut it into small dice size. If she has tomatoes, she also cut it separately and add into the pan together (in her case she did not have tomato at this time). She separates water from the vegetable (right).



Fry the onion with oil (left). After the onion changes colour to golden brown, add the mukauwu vegetable into the pan.



Continue mixing together until it is properly mixed. Serve with vegetable with pearl millet ugali.

5) Ndua

Demonstrated by Mrs Veronica Nzambi Kioko.

Ndua is porridge used normally but it is believed good for both by delivering mother.



Photo shows ingredients she used for cooking Ndua.

- Pearl millet flour.
- Sorghum flour.
- Muthokoi (maize which top skin is removed).
- Nzumula (tamarind fruits)
- Sugar
- Fresh milk (iiya ya thile).
- Margarine (Blueband) In case you have it. She likes put it in.



This is Mrs Veronica Nzambi Kioko, step daughter in law of Mrs Josephine Mukai Kisengese and her little son Brian Mwangangi Kioko (3/5month, years old). Veronica's kitchen where she cooks her meals (right).



Veronica puts water in the clean cooking pan and bring it to boil.



Making Tamarind juice. While she waits water to boil, Veronica removing the top skin off tamarind fruits, and put the hot water into the bowl and wait for some time and juice of tamarin comes out. Stir it and colour of water changes to brown (left bottom). Veronica is mixing properly the tamarind juice so as to use it.



This is the mixer of the pearl millet, sorghum, muthokoi-crushed (maize which the top cover has been removed) flour (left). Use cold water and mix the flour (middle) and adding the mixture into the boiling water, stir with cooking stick (right).



If the mixture is not thick enough, add more mixed flour through the same method. After boiling like 5 minutes or so, add tamarin juice, milk and sugar together then stir. The tamarind juice is being put in the porridge.



Veronica add sugar and flesh milk (0.5L) in Ndua (porridge). Veronica likes to mix her porridge with it. Wait like 2-5 minutes and its done.



She serves it as hot and consume it as hot.

6) Usuu wa ukiia (Traditional pearl millet cold porridge)
Presented by Mrs Josephine Mukai Kisengese.



Pearl millet is ready to be worked on. Before you start you wash and clean large grinding stone (iviia ya ukiia) and small stone (nzio).



Set aside water in a cooking pan and to be touching/cleaning your hands as you grind like photos.



She grinds all soaked pearl millet.



After the grinding, she sieves the top flouted remains and give it to chickens.

Mrs Josephine Mukai Kisengese takes her beautiful big calabash adds water in the mixer stirs using her hands and she starts sieving the glue (mixture of flour and water).



This is the second round. The glue after the 1st grinding process. There are still some particles remain. She repeats grinding it again for 2nd round grinding.



She adds more water and sieves again. As you can see in the photo (right), the container of 10ltr (yellow container) is ready to be put completed glue.



She put the glue in the container. The grinded glue can be left outside the sun to ferment faster or just be taken in if by living it outside is not safe because of the animals intruding against it.



After 6-7 hours, the glue is separated. Water comes on top and the glue settle at the bottom of the container. Then she removes only the water on top of the container.



After the water removed, this water to be boiled in a cooking pan, and if quantity is not enough you can add water. Mrs Josephine Mukai Kisengese, adds lunguyu stem (wild plant used for sweeping) for makes the porridge to ferment fast (right).



Now Mrs Josephine Mukai Kisengese shakes the left bottom glue and put it into the container.



She scoops out the foam on the surface of boiling water. The Foam is not good taste.



Then she adds the glue into the boiling water. As she mixes with a stirring stick.



She checks if the porridge is ready. Then after putting the glue you cook like 3 minutes and then removes the porridge from the fireplace.



She puts the cooked porridge into the container to let cool slowly. Remember she has not added the sugar. When the porridge is cool that is the time is ready to be served and consumed and you can add sugar just before consuming it.

6) Ikiie ya mwee (using IVIIA YA UKIA and NZIO). Uncooked pearl millet meal.



Used pearl millet soaked and grinded. Mrs Kalunda Mwikya, removes the stones (de-stone) from the pearl millet (left) taking the pearl millet off the bag. Photo 2 removing any unnecessary thing in the pearl millet (upper middle). Winnowing process (right).



Mrs Kalunda Mwikya washes her grinding stone (nzio).



Use large grinding stone (IIVIA ya ukia) and small stone (nzio) for grinding grains.



1st round grinding, pearl millet grain. As you grind you sprinkle some water.



2nd round, repeat the same process of 1st round, sprinkling a little water as you grind.

3rd round- put water on your hands and grind. No sprinkling water. Water is already enough. It is already in the paste form.



4th round- continue grinding. 5th round – becomes very soft and fine paste form. Mrs Kalunda Mwikya licks her finger to confirm the texture after she has finished grinding. The millet paste is eaten as raw.



She goes to fetch Tamarin fruits in her compound/home garden. Unpeeled tamarind fruits (right).



Peeled tamarind fruits (right) and she puts water in order to get juice. She mixes properly so as to get juice.



Sugar in the cup (left). She takes off the juice and puts into another bowl photo 4. Photo 5 is the picture of the separated tamarind juice. Photo 6 she takes the grinded wet pearl millet. Photo 1. is Grandmother (Mrs Kalunda Mwikya) adds the wetty millet in the tamarind.



Add sugar to tamarind juice and tastes it. She put the tamarind juice into the pearl millet paste.



She mixes and serves.



Mrs Kalunda Mwikya serves it for her husband, Mr Mwikya and eat together at in front of her Kitchen.

7) KINAA KYA MWEE (Kinaa made from pearl millet)
 Demonstrated by Mrs Kalunda Mwikya.



Mrs Kalunda Mwikya adds firewood in her fireplace, preparing to roast pearl millet grains. Also she lits the firewood ready to begin cooking. Photo (bottom middle shows inside her the kitchen and kitchen utensils).



She puts the cleaned pearl millet in the pan to roast.



Immediately the pearl millet start to pop and turns to brownish and now is ready to be grinded using traditional stone for grinding (livia na nzio). The roasted flour can stay long and will not become bitter in taste. Sit it a while to be cold before grinding it (right).



Grinding takes 3-4 times. 1st round grinding- crushing the grains. Mrs Kalunda Mwikya takes the pearl millet grains to stone to begin the work. This process here, there is no water to mix with flour. After this it becomes forms of nzenga (rough grained grains).



2nd round grinding-). As you can see in the photo both 1st and 2nd round use large grading stone (nziio).



3rd round grinding- the flour looks like vale brown.



4th round- the flour is very fine, this the last process. Now Mrs Kalunda Mwikya has finished grinding the flour. And start to make the mixer of tamarind.



She stirs the tamarind juice and confirm it taste of sourness. If not enough she adds more of tamarind juice and sugar to adjust the taste.



Mrs Kalunda Mwikya puts tamarind juice into the pearl millet flour and mixes. Photo (right) shows how it looks like after is completely mixed. Ready for eat kinaa.

7) CHAPATI KYA MWE (Chapati made from pearl millet flour)



Mix together pearl millet flour and wheat flour and make a dough for chapati. The same way ordinal chapatti is made. Mrs Beatrice Kathini Joseph is checking her pearl millet grains.



She winnows grains and then to take it to posho mill in her village.

This is one of the posho mill service in Uae village where the villager's grinds there grains. Need to grind it two times. Because this machine is for maize. She needs to pay 10-20 shillings for this. Otherwise she needs to grind it through traditional stones that takes long time.



Beatrice puts the water in a cooking pan and warms it to start making chapati. She adds bits of salts into the warm water.



She puts the pearl millet flour and adds some little wheat flour to make it sticky.



Add warm water and mixing dough. Add little oil in the dough.



She starts rolling and applying some oil on top. The chapatti is ready. Serve with desired stew or vegetables.

8) MULUANYO (Meal of cowpea and sorghum)



Mrs Teresia Titus is removing the stones from the cowpea. She washes it and puts them in the kitchen to start boiling.



She adds washed cowpea into the boiling water. She prepare cowpea first because it take long time to cook. The cowpea is boiling while she start preparing the sorghum.



Mrs Josephine Mukai Kisengese takes the sorghum off her stored bag and winnows it.



She puts the sorghum into the mortar to start crushing it. You use water together when you are pounding the sorghum to remove top skin.



This how you crush the sorghum grains. Using mortar and pistil (ndii and muthi).



She takes off the sorghum from the mortar and then the sorghum is wet so she can't winnow it immediately. She spreads the grains under the sun for some times.



She takes the sorghum from the sun and proceeds on for winnowing.



She washes the sorghum and takes it to her kitchen. If cowpea has already cooked, boil the sorghum separately then mix together later. The drained water from the washing of the sorghum can be given to goats they love it.



Ms Josephine Mukai Kisengese puts her sorghum grain into cowpea and boil together, mixes and puts salt and oil. It is then ready to be served.



Mrs Josephine Mukai Kisengese serves Muluanyo, mixer of sorghum and cowpea for her family. Her son Mwanzia Kisengese and Mr Kisengese Kioko (Brother to Brian Mwangangi), Victor Kisengese, Charity Mukai (F), Borniface, and Brian (Mwangangi), Catherine Mweni Titus.

9) Ndilango 1 (cooked pearl millet mixed with pearl millet balls).



Mr Victor Kisengese Titus helps to remove top skin of tamarind fruits and soaks for making Ndilango.



This shows the first round of grinding (left), the second round (middle), the third round (right).



Mrs Agnes Kalunda Mwikya is finishing her grinding. In the third Photo this is finished grounded pearl millet.



Mrs Agnes Kalunda Mwikya cuts small balls of pearl millet by hand, preparing for cooking Ndilango.



Mrs Agnes Kalunda Mwikya, mixes the glue in the boiling tamarind juice and stirs with a cooking stick.



Mrs Agnes Kalunda Mwikya is taking the sugar puts it in the Ndilango. She is showing how Ndilango looks like while stirring it. She puts the Ndilango in the mixer (of pearl millet and tamarind juice) in the boiling pan.



Mrs Agnes Kalunda Mwikya shows cooked Ndilango while in the pan and also serving the ndilango she has cooked.



Left photo shows, hosting homestead and family (right) in Uae village. Mrs Agnes Kalunda Mwikya (right side), the young boy left side is Victor Kisengese Titus, Tabitha Liza Katee (interviewer), Mrs Josphine Mukai Kisengese (center).

10) Kimanza 1

Similar to kinaa dish but It doesn't put tamarind juice or milk. Just sugar, you feel harsh in your mouth and throat after you eat. Its save to eat though. Eaten especially when there was famine, nothing to eat.



This is Ms Agnes Kalunda Mwikya separating the green pearl millet from the shelves of the pearl millet. Using Ndii (mortar) with muthi (pistil), With Victor Kisengese Titus helping.



Mrs Agnes Kalunda Mwikya removes pearl millet from the mortar.



In Photo 1 and 2, Mrs Agnes Kalunda Mwikya is shaking the pearl millet with the small basin she is using for winnowing so that the millet grain goes up and separate with the unwanted remains and she casts them away.



Mrs Agnes Kalunda Mwikya winnows the pearl millet grains.



Mrs Agnes Kalunda Mwikya preparing the stones by arranging it well first, washing it and starting to grind the grains.



Mrs Agnes Kalunda Mwikya is grinding the pearl millet, actually she grinds 3 times for it to be smooth.



The pearl millet has been already ground and is smooth enough for mixing with sugar. In Kimanza you only add sugar and then stir it properly and then consume. Its bit of harsh in taste.



Mrs Agnes Kalunda is tasting her work to see how it is tasting.



Victor is served with Kimanza which he is very much enjoying and Mrs Agnes Kalunda Mwikya is commenting on Kimanza saying its very good.



This are the dishes I was served by the hosted family, a cup of tea and green cowea mixed with rice.

Kimanza 2



Ms Agnes Kalunda Mwikya preparing the traditional stones to start off the work of making kimanza. The traditional grinded pearl millet eaten without being cooked.



1st round grinded millet (left), 2nd round (middle) and 3rd round (right).



Once it is ready, removing it from the grinding stone using the spoon to scoop. All the pearl millet is removed from the stone.



Agnes takes the sugar and adds the sugar to the mixer which is called kimanza.



Agnes Kalunda Mwikya tests if the sugar is enough. She is chewing it and saying is good.



Tabitha Liza Katee (interviewer) is also eating the kimanza.

Right photo shows, Ms Annastacia Mwikali Wambua (15yrs, class 7, Catherine Vaati Kimwele (16yrs, class 8), Nyamai Kimwele (12yrs, class 6), Amos Kamoo Kimwele (7yrs, class 3), Mathew Kilonzo Kimwele (6yrs, Nursery), Richard Kimwele Mutuku (5yrs, nursery) all are enjoying kimanza meal. It is interesting because this was their first time eating of it.



Mr Mwikya Kitunguu the husband to Agnes Kalunda Mwikya is enjoying the kimanza also. Note, kimanza has a harsh taste, this is because its grinded when its yet green not dry one.

11) Ngalamba 2 (mixed with salt).

This meal is mainly cooked with maize. Pearl millet is also used when no other options.



Preparation of grinding grains.



Ms Agnes Kalunda Mwikya is grinding pearl millet. 1st round (left), 2nd round (middle), 3rd round (right). Add salt for ngalamba making.



Amos Kimwele (a boy) holding the tamarind fruit which are going to be used for ndilango. Soaked tamarind fruits (right).



Amos is cutting the leaves from the maize plant to be used for ngalamba cooking. They use polythene bag instead of maize leaves nowadays because it cooks faster.



Ms Anastacia Mwikali Wambua preparing the cooking pan for making the ngalamba. Putting the water in the pan and preparing the fire (right).



Anastacia puts a cooking pan on fire.



In the calabash, there is water which Agnes used to rinse off her hands while grinding the mixers. The leaves asides used for wrapping the mixer for ngalamba for boiling it. Finished 3rd time grindings, ready for putting in the bag for boiling.



She puts grinded glue in a polythene bag and ready to be boiling. Maize leaves used to be use for wrapping it.



Ms Agnes Kalunda Mwikya gives the wrapped Ngalamba to Anastacia to put it in the cooking pan for cooking it. Anastacia put in the ngalamba and she covers it to continue boiling.

12) Ndilango 2 (lamp porridge mixed with Tamarind juice and sugar).



While ngalamba is in processed, Ms Agnes Kalunda Mwikya starts making the ndilango. 1st round grinding pearl millet grain (right).



1st round grinding (left), 2nd round grinding (right).



When Agnes is working on the 2nd round grinding, Ms Catherine Vaati Kimwele is taking stones to make 2nd fire place for cooking ndilango outside her kitchen.



Catherine takes the shovel and scoops the charcoals from the fire place to prepare for making ndilango outside of the kitchen. The traditional kitchen is ready (middle). Put it in the outside fire place.



Amos is helping with the firewood to be used in the outside kitchen. Photo 3. The firewood is placed on the charcoals.



Catherine cuts firewood, while Angnes finishes the 3rd grinding round and ready to cook.



Ms Agnes Kalunda Mwikya returns back the traditional stone and puts some water in a cooking pan.



Agnes puts a cooking pan on the fire place. She takes tamarind juice and adds to the water in the pan (middle). She strains the water from the tamarind and puts it in the pan (right).



Agnes takes the grinded pearl millet and separates the dough into two bowls.



Catherine checks the ngalamba at the 1st kitchen, if it is ready. She brews the coals to continue fire. Ngalamba still cooking.



Agnes is mixing the dough from the other bowl with some water to put in the boiling tamarind mixer.



Agnes shows pearl millet glue (left) how it looks like (not fully mixed). She continues mixing the glue using her clean fingers. Now it is ready (right).



Agnes starts cutting the ndilango into small balls from the 2nd bowl.



Agnes puts the glue first in pan to start cooking (left). She adds the sugar in the already cooking porridge. She stirs the porridge.



Nyamai Kimwele is putting together the firewood to continue cooking the ngalamba.



Agnes puts the ndilango (the small balls) one by one in the boiling porridge. You can see how ndilango looks like in the pan (right).



Agnes continues stirring the mixer (upper photos).
Agnes takes off from off the fire place and starts serving it.



She serves it (left). Ndilango balls remains in the pan (middle).

Mwanzia the son of Mrs. Mukai Kisengese who is the grandson to Agnes Kalunda Mwikya, Matthew Kilonzo Kimwele and Richard Kimwele Mutuku enjoys the ndilango meal.



This shows how ndilango looks like in the bowl (left and middle). Ms Mary Kavutha Kimwele, the mother of the above Kimwele children also enjoys ndilango.



Ms Agnes Kalunda Mwikya takes off the ngalamba and backed to her kitchen and check ngalamba inside the pan. Agnes starts serving the ngalamba.



Mary starts grinding her green grams for making stew using the traditional stone.



Agnes cuts the ngalamba into pieces to be able to serve without any trouble.



She tastes the ngalamba and ready for serve it to all.



A piece of ngalamba (left). Mzee Mwikya Kitunguu is served with ngalamba (middle). Mary also enjoys eating it (right).



Agnes and Mary enjoy the ngalamba.

13) Environment of Uae village, Mutomo district, Kitui County.



Goats and surrounding environment of Uae village. A man grazing cattle, goats and sheep in Uae village.



A crop field in Uae village.

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