

Republic of Kenya

Preparatory Survey on BOP business on  
improvement of nutrition for infants, mothers  
and patients by using traditional technologies of  
fermentation in Japan

Final Report (Summary)

November 2016

Japan International Cooperation Agency (JICA)

Kikkoman Corporation

OS
JR
16-117



## Table of Contents

Table and Figures .....	4
1. Overview .....	1
1.1 Background .....	1
1.2 Purpose .....	1
1.3 Survey Method .....	1
1.4 Survey Period .....	2
1.5 Survey team.....	2
2 Survey result .....	2
2.1 Business Feasibility.....	2
2.2 Results of the Business Model Verification.....	3
2.3 Business Plan.....	8
2.4 Operation Plan.....	9
2.5 Resource Plan.....	11
2.6 Environmental and Social Considerations.....	12
2.7 Possible Collaboration with JICA .....	12
2.8 Development impact .....	14

## Table and Figures

### Table

Table 2-1. Possible local business partners .....	11
---	----

### Figures

Fig. 2-1. Production and sales scheme for the "localization of fermentation technique using koji" project	3
Fig. 2-2. "Amagayu starter" product concept and cooking method .....	4
Fig. 2-3. Product examples .....	6
Fig. 2-4. Production and sales scheme .....	9
Fig. 2-5. Outstanding issues and planned action timescale .....	10

# **1. Overview**

## **1.1 Background**

Stunting due to malnutrition in infancy and childhood is a major issue in Africa. In Kenya, stunting is still prevalent, affecting around 26% of children aged five or under. A cause of this problem is nutritional imbalance, chiefly as a result of an insufficient intake of protein and micronutrients, and amino acid imbalance. Overconsumption of sugar through daily diet, soft drinks and imported confectionaries also appears to be a common issue.

Japan boasts a unique set of traditional food processing methods that involves fermenting; fermented food made using the koji mold – a species of *Aspergillus* fungus – is particularly common in Japan. The digestive enzymes produced by the koji fungus accelerate the digestion of nutrients and are thus thought to have a nutrition improvement effect. For this reason, we set out to examine the feasibility of a business model based on the use of our food processing techniques centered on fermentation that contributes to nutrition improvement in East Africa.

## **1.2 Purpose**

The purpose of the survey was as follows:

To identify nutrition issues affecting East Africa to which our food processing techniques might be applied as solutions; and

To look into the following aspects relating to those issues:

- Development of products and/or techniques to solve the issues
- Review of the value chain involved, including material procurement and logistics
- Assessment of impact on the environment and the society
- Assessment of impact as a BOP business
- Exploration of the possibility of collaboration with JICA

## **1.3 Survey Method**

A range of surveys and reviews were conducted, mainly in Kericho County in the Republic of Kenya.

In order to identify nutrition issues affecting the area, a questionnaire survey was conducted in Kericho Country on the local residents' daily diet, along with interviews and a literature and data review with the Country administration and hospitals.

On the question of value chain, visits were made to food companies and related organizations mainly in Nairobi and Kericho Country to conduct interviews.

Technical development work on cooking/processing was conducted in our laboratory in Japan.

Cooking tests and taste tests were conducted in Kericho Country on the food samples and processing techniques developed.

Interviews were conducted with farmers in Migori Country regarding the state of soybean growing in the area.

## 1.4 Survey Period

The survey began in December 2013 and was completed in November 2016; the survey team visited Kenya five times during the survey period.

## 1.5 Survey team

Kikkoman organized a survey team, which consisted of the following four organizations:

- Kikkoman Corporation
- HANDS (Health and Development Service) (non-profit organization)
- Organic Solutions Japan Ltd (agriculture and food processing company in East Africa)
- E-Square Inc. (consultancy)

# 2 Survey result

## 2.1 Business Feasibility

The "localization of fermentation technique using *koji*" project based on the initial feasibility study specifications was able to identify and establish a cooking technique involving fermentation that could be reproduced locally.

However, the cooking process requires the end user to maintain strict temperature control in order to prevent spoiling, and the risk of food poisoning, which would be outside our control, could not be eliminated. For this reason, the survey concluded that it would be difficult to develop this project into a locally run business model.

At the same time, the survey identified the business potential of puffed soybeans for nutrition improvement.

Puffing is a food processing technique whereby raw cereal grains or pulses are heated in a pressure cooker, then the pressure is released rapidly to cause the kernels to expand into a sponge-like structure. The process is commonly used to make breakfast cereals. Kikkoman Corporation also manufactures and sells puffed soybean and brown rice products.

A local food budget survey revealed a dependence of the local residents, including the BOP population, on cereals such as maize, millets and sorghum as well as sugar, resulting in a carbohydrate-heavy diet. In order to solve the problem of protein deficiency resulting from this diet, there was an evident need for the supply of cheap foodstuffs that are high in protein and easy to prepare.

In order to correct the nutritional balance of the local diet, especially for pregnant women and children, increasing the use of soybeans and other legumes in daily diet would be an effective measure. Puffing would remove many of the issues associated with pulses as food, and puffed pulses scored well in taste tests. The proposed business would not only improve the lives of the BOP population but also benefit soybean growers.

Therefore, a decision was made to develop a business model for the manufacture, marketing and sales of puffed beans, especially puffed soybeans.

## 2.2 Results of the Business Model Verification

### 2.2.1 Localization of *koji* fermentation technique

The original business model considered at the beginning of the project was to adapt *koji*, a traditional Japanese food fermentation technique, for application in developing countries as a nutrition improvement solution.

The project started from the outset as a social contribution initiative; the objective was to contribute to the effort to improve nutrition in developing countries, with an added benefit of winning the trust of the local communities and gaining brand recognition. Profitability, therefore, was not an important factor. Furthermore, it was felt essential that in order to ensure the sustainability of the operation, the business model should be designed to be run by local business partners and residents.

The diagram below shows the proposed production and sales scheme based on the initial feasibility study specifications:

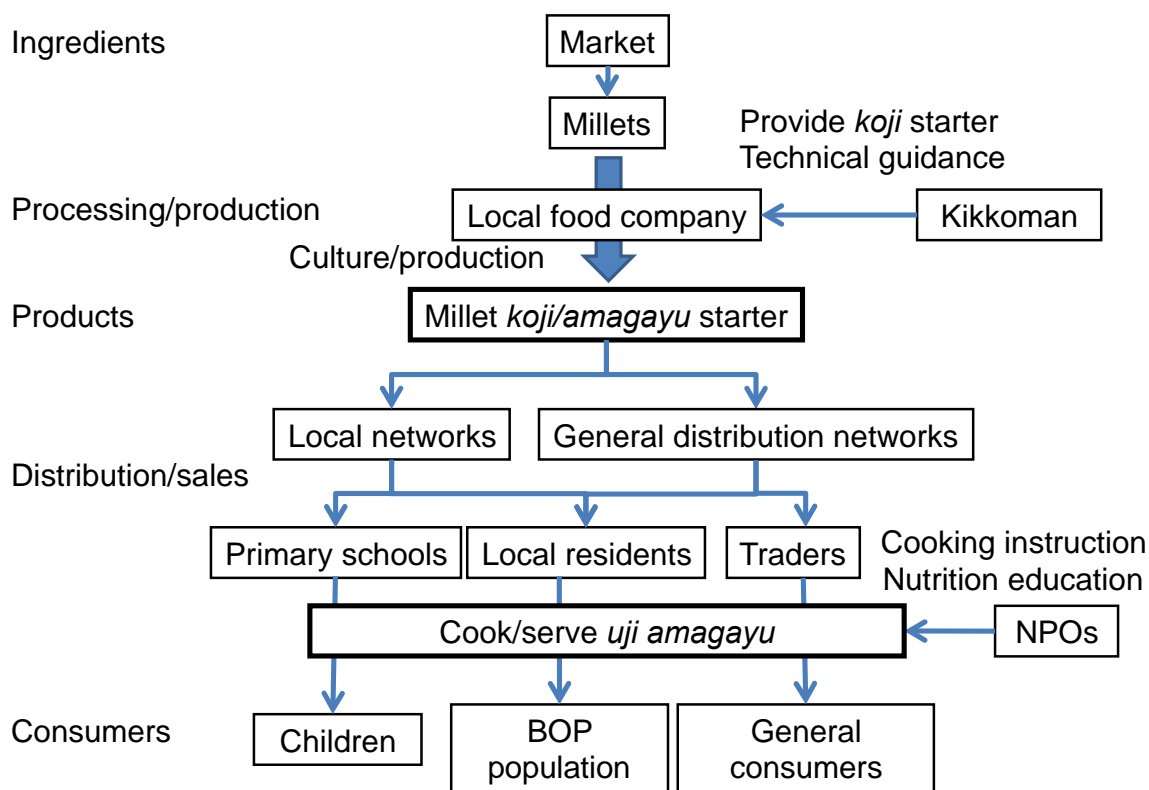


Fig. 2-1. Production and sales scheme for the "localization of fermentation technique using *koji*" project

Although our survey and technical development work established a cooking method that would suit the local conditions, it became apparent that it would be extremely difficult to assure food safety, namely preventing food poisoning, and that the nutritional improvement effect of the product would be limited. For these reasons, much to our regret, the idea of establishing a local business operation based on this scheme was abandoned.

The following aspects were considered in the reviewed process:

### Review point (1): Identifying needs and market conditions

A food budget survey revealed an overconsumption of carbohydrates, particularly sugar. The local BOP population also consumed a large amount of sugar. People were aware of the problem of their sugar-heavy diet and were keenly interested in our sugar-free *uji-amagayu* offering.

It became clear that, if we were to develop *uji-amagayu* using our fermentation technique, there would be a certain level of local demand as it would be economical and nutritious and help reduce sugar intake while satisfying the local taste for sweetness.

### Review point (2): Development of product as a solution

We looked into the feasibility of producing and selling an "*amagayu* starter" product as a means of meeting the local demand for an inexpensive way of adding sweetness to *uji* through *koji* fermentation. Our technical development work established a safe method of cooking that could be employed locally and confirmed that it would add the level of sweetness as adding sugar.

However, it became apparent that its cost-reducing effect would be marginal, and that the risk of food poisoning when cooked by end users would make it difficult to offer the product to the general public.

The product concept and cooking method of the proposed "*Amagayu* Starter" product are shown below.

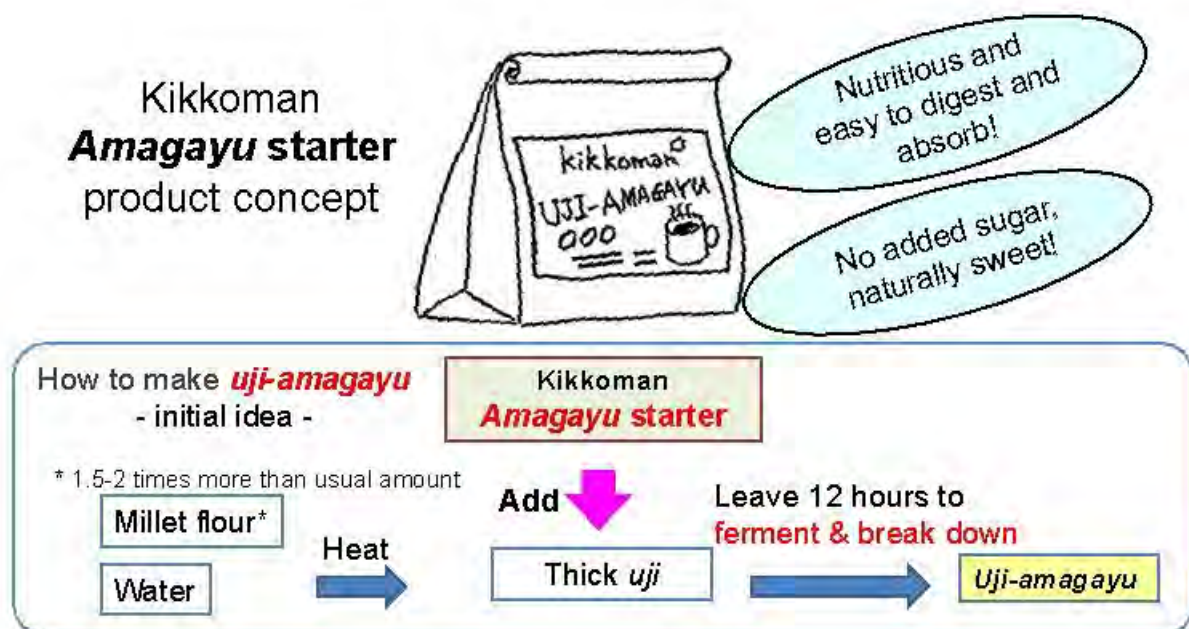


Fig. 2-2. "*Amagayu* Starter" product concept and cooking method



### **Review point (3): Competitions and local market offerings**

In the local area, *uji* flour products and baby food that contained pulses, vegetables, dried fish, etc., added to millets to boost nutritious values are on the market. However, we found no competitive offerings that used fermentation as a means of improving nutritious values.

### **Review point (4): Business operation framework**

Our survey identified commercial bread making, which used cultured yeast for fermentation on an industrial scale, offered the closest match in terms of facilities that could be adapted for *koji* culturing. However, we were unable to find viable local partners to whom *koji* culturing could be outsourced, which meant that either such an operation would have to be run by Kikkoman, or *koji* would need to be imported from Japan.

### **Review point (5): Risks and solutions**

The biggest risk in the proposed business scheme was the possibility that the product might be spoiled during the end-user cooking process. Since this cooking process was hitherto unknown to the local residents, it might be considered too complicated or difficult to integrate into the daily routine; there was also a chance that the correct cooking process might not be adhered to.

The following points were taken into consideration in the design of the cooking process:

- Ensure the degrading enzymes is highly active (to minimize the time required for the breakdown process)
- Use a heat-resistant enzyme (so that the breakdown process could be started at a higher temperature)
- Use an insulating material (to slow down cooling)

In the end, in tests conducted in a school kitchen at a local primary school, it was confirmed that degradation and saccharification could be achieved safely. However, whether or not the local residents would adhere to the strict temperature control regime required during cooking was beyond our control, and this left the business vulnerable to safety assurance issues.

It was concluded, for this reason, that it would be difficult to establish a business model of locally supplying the "*amagayu* starter" product as a form of "localization of the *koji* fermentation technique" project within the duration of this review/survey period.

#### **2.2.2 Promotion of soybean use**

Our survey discovered protein deficiency as one of the main nutrition improvement challenges in the region. We found that, therefore, the nutrition improvement effect of *uji-amagayu* alone would be limited.

A search for potential sources of protein that are inexpensive yet rich in amino acids, which are essential for the health of growing children, identified legumes as good candidates and, in particular, soybeans. Soybean growing is on the increase in Kenya as the government is encouraging farmers to grow them as a cash crop, and the locals are now aware of its nutritional merits.

However, there are also a number of obstacles to increasing the consumption of soybeans, such as the unpleasant smell, long cooking time and possibility of indigestion.

We looked at a range of processing options that could solve these issues and identified puffing, which

is a commonly used processing technique in Japan, as a promising option.

Cooking tests and taste tests with puffed soybeans produced very favorable response from local residents. Consequently, we devised a number of possible business model hypotheses for the local production and sales of puffed soybeans and other puffed pulses, and studied their feasibility.

The business model hypotheses were based on the following nutrition-enhancing soybean products:

Hypothesis A: Product modeled on protein powder

Puffed soybeans in powder form to be sold as a protein supplement for school meals etc.

Hypothesis B: Product modeled on instant rice or precooked soybeans

Puffed soybeans to be sold as precooked convenience food for daily meals.

Hypothesis C: Product modeled on breakfast cereals

Puffed seasoned soybeans to be sold as healthy, oil-free snacks.

Figure 2-3 shows examples of these products.



Puffed soybean protein powder



Precooked dry puffed soybeans



Puffed soybean snack

Fig. 2-3. Product examples

### Review point (1): Identifying needs and market conditions

Our food budget survey identified protein deficiency in the diet of the local BOP population.

On the other hand, we found a growing awareness of soybeans as a high-protein health food.

However, soybeans were not used as part of daily diet. Even though only a small minority of people ate soybeans on a regular basis, it was found to be used in baby food both in Migori and Kericho Counties. In Migori County, roasted and powdered soybeans and peanuts were added to baby food, and local consumers were aware that soybeans were useful for enhancing the nutritional value of baby food.

### Review point (2): Development of product as a solution

Puffing soybeans could eliminate the unpleasant smell and reduce the cooking time drastically. A taste test on local residents produced favorable response to *uji* made with added puffed soybean flour and to

puffed soybean snacks.

We also discovered that making *githeri*, a local staple food, using puffed soybeans cut down the cooking time significantly, and puffed soybean *githeri* was received more favorably than *githeri* made with unprocessed soybeans, both for flavor and smell. It would seem that puffing had a good potential as a method of reducing cooking time not only for soybeans but for any beans, which would also reduce cooking fuel cost for the entire value chain as well as for end users.

### **Review point (3): Competitions and local market offerings**

We found powdered roasted soybeans sold at local markets as a caffeine-free alternative to coffee and tea and also as an enriching additive for chai and other drinks. Soybean-based meat substitutes (sold under brand names such as Sossi and Proya) were also offered as inexpensive sources of protein. However, we found no products that were similar to our proposed offerings, i.e., quick-cooking products that retained the form and texture of beans.

There were a number of puffed foods on the market such as breakfast cereals, but most were imported from Egypt; no Kenyan products were found at the markets we looked at, indicating that puffing was not a common food processing technique used in Kenya or East Africa as a whole.

### **Review point (4): Business operation framework**

Our business proposition is to establish a joint venture with a local food company (the strongest candidate identified in the survey being Soy Afric which is a major manufacturer of soybean products in Kenya) to make and sell the products locally. For production, Japanese puffing machines would be used. Kikkoman would provide technical guidance and carry out product development work, while production and sales would be handled by the local food company, using their existing factory and distribution network.

Wherever possible, soybeans produced in Kenya would be used to make the products. Furthermore, the existing network of NPOs, CHVs and JOCVs would be used to sell the products to the BOP population and provide nutrition education in order to ensure that the products reach the segment of the society that is most in need of nutrition improvement.

### **Review point (5): Risks and solutions**

The soybean as a food has a negative image: it has an unpleasant smell; it takes a long time to cook; and it causes indigestion. In order to counter this, we would provide nutrition education in partnership with NPOs, CHVs and JOCVs to raise awareness of the importance of protein and amino acids in diet, as well as organizing community cooking and tasting events to promote the products.

Since soybeans are readily available from markets as raw ingredients and a local food company, Soy Afric, uses soybeans grown in Kenya and imported from nearby countries for their products, a supply of raw materials could be secured through collaboration. Notably, there is already an established supply channel through which soybeans from small farmers, who are part of the local BOP population, are distributed via intermediaries. Giving preference to these Kenyan soybeans in the business operation would help boost the local commerce.

## **2.3 Business Plan**

### **2.3.1 Business model**

Our business proposition is to produce puffed soybeans locally and use them to produce and sell a variety of products, such as seasoned puffed bean snacks, precooked soybeans as cooking ingredients and puffed soybean flour, which could be added to *uji* as well as chai and other drinks.

The raw materials would be procured from local BOP farmers via intermediaries wherever possible. Promoting soybeans by developing and selling soybean-based food products would boost the soybean market and increase consumption; it would also benefit local soybean farmers through stable sales of their produce.

The processing of soybeans would be handled by a joint venture set up with a local food company (such as Soy Afric), with the necessary equipment installed in the local JV partner's factory. The products would be supplied to local supermarkets and kiosks along with the partner's own existing products. In addition, the products would be supplied at reduced prices, via NPOs and CHVs, to the local BOP population, which is harder to reach through the commercial distribution network. We would also work with the NPOs and CHVs to provide nutrition information and education.

This would enable the local BOP population to buy cheap and tasty high-protein food products, which would also have an added benefit of shorter cooking time, thus saving fuel cost.

Puffed soy and other beans could also be sold to the government and aid organizations such as WFP and UNICEF, on the strength of their ease of cooking and the time and fuel saving merits, for use at schools in poorer areas as well as refugee camps, where cooking might be difficult.

Figure 2-4 shows the production and sales scheme of this business model.

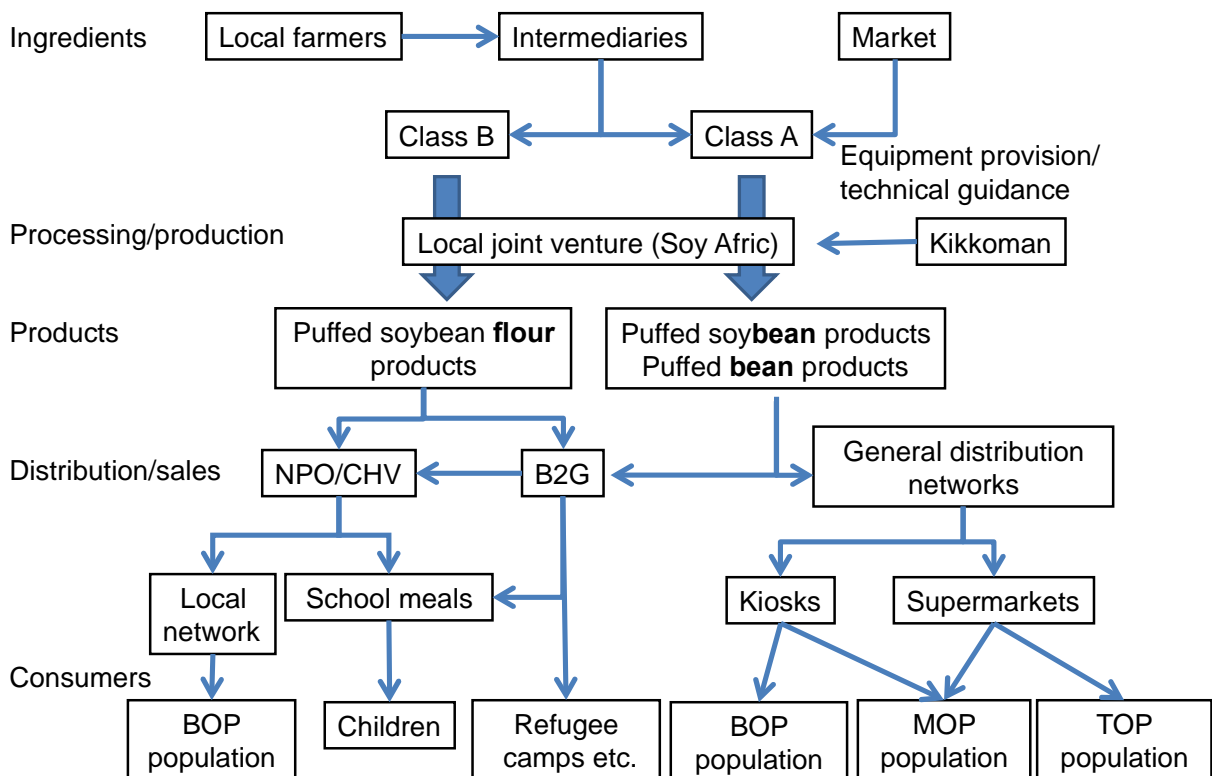


Fig. 2-4. Production and sales scheme

## 2.4 Operation Plan

### 2.4.1 Business implementation schedule

During the preparation period of 2017-2018, product development work would be carried out in our laboratories in Japan along with pilot export and local sale exercises, as well as cooking/taste testing in partnership with NPOs. We would also make the necessary preparations to set up a local joint venture and obtain KEBS certification and any other operating permits required. A puffing machine would be installed on a trial basis to conduct local processing tests.

The business could start operating at full scale from 2019, at which point the joint venture would be incorporated and the production facilities would be set up, including a multiple number of puffing machines, and efforts to expand distribution channels would start.

The initial production and sales volume is expected to be around 200 tons per year. The viability of the business would be reviewed from time to time and the operation could be expanded if judged reasonable.

### 2.4.2 Remaining challenges and solutions

This survey and study initially began with the aim of "localizing the *kofu* fermentation technique", but it was concluded that the project was not workable as a business model due to the difficulty in providing

microbial safety assurance. Consequently, the remainder of the feasibility study survey focused on an alternative objective of promoting the use of soybeans, but the proposed business model still requires further work on the following challenges:

- Development and test-marketing of puffed soy and other bean products to suit the local taste
- Entry into a collaboration agreement with a local food company (e.g., Soy Afric) and finalization of production arrangement
- Action to tackle the negative image associated with soybeans
- Establishment of a distribution network targeting the BOP market
- Promotion through nutrition education and demonstration of the products' nutrition improvement effect
- Review of the possibility of supplying aid organizations

Figure 2-5 shows the outstanding issues and action timescale.

Outstanding action	16	FY 2017				FY 2018				FY 2019			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Develop/manufacture/improve test products													
Test marketing (e.g., through AfricaScan)													
Discuss/agree on collaboration with Soy Afric													
Install puffing machine at Soy Afric for testing													
Technical guidance on puffing machine													
Pilot production at Soy Afric factory													
Obtain KEBS certification and other operating permits													
Pilot sales through Soy Afric channels													
Install production puffing machines at Soy Afric													
Manufacture products at Soy Afric factory/distribute													
Campaign to promote soybeans													
Discuss/agree on collaboration with NPOs/CHVs													
Supply (export) test products to NPOs/CHVs													
Supply (export) puffed soybean flour for school meal													
Supply puffed soybean flour (from Soy Afric) for school meals													
Collect local feedback/ improve products													
Proposal to/exchange info with aid organizations													
Develop products/technologies for aid organizations													
Sell puffed soy & other beans as food aid products													

Work/operation in Japan  
 Work/operation in Kenya

Fig. 2-5. Outstanding issues and planned action timescale

### 2.4.3 Product development plan

FY 2017: Develop products that suit the local taste by conducting test sales and local cooking/taste test exercises using samples produced in Japan.

FY 2008: Install puffing equipment at a test plant, conduct local trial production and identify and solve issues arising from it.

#### 2.4.4 Raw materials and equipment procurement plan

Soybeans should be purchased from local farmers, particularly of the BOP communities, via intermediaries or else imported from neighboring countries to secure the required quantities. Collaboration with Soy Afric should enable us to utilize their existing supply chain for the procurement of soybeans, both domestically and from other countries. Soy Afric buys Kenyan soybeans from BOP tenant farmers through intermediaries, and this supply should be used preferentially provided that the price is acceptable.

For the puffing process, a Japanese puffing machine would be installed in FY 2018 for pilot production; the number would be increased prior to the start of full-scale operation to increase production efficiency.

#### 2.4.5 Production, distribution and sales plan

2017: Conduct test sales of sample products made in Japan

2018: Install a test puffing machine, conduct local trial production and test sales

2019: Establish a joint venture, start full-scale production using five puffing machines, start sales and sales channel expansion

### 2.5 Resource Plan

#### 2.5.1 Workforce plan / human resource development plan

FY 2017- FY 2018: 1 x Kikkoman employee, 2 x local employees (employed by Soy Afric)

FY 2019- : 2 x Kikkoman employee, 4 x local employees (employed by local joint venture or contractor)

#### 2.5.2 Local business partners

Table 2-1 shows a list of possible local business partners and their expected roles.

Table 2-1. Possible local business partners

Possible local business partners	Type	Expected role
Soy Afric	Food manufacturer	Manufacturing/distribution of products; JV partner
NPO (e.g., HANDS)	NPO	Providers of diet and nutrition education to local (BOP) communities
CHVs	Local residents	
JOCVs		
AfricaScan	Marketer	Test sales/market research in Kenya
Matoborwa	Food manufacturer	Test sales/market research in Tanzania
Local soybean traders	Intermediaries	Supply procurement/distribution of class-B produce/etc. - providers of benefit to local farmers

### **2.5.3 Fund procurement plan**

The funds required for the development of the business would be provided internally.

This project started as Kikkoman's social initiative. The business would be operated at a scale that could be run locally, and cost savings would be made, for example, by minimizing the initial outlay and by producing only enough quantities during test production and sales so as to avoid making losses. Ongoing funding for the business operation would be kept to the minimum.

### **2.5.4 Operating permit acquisition plan**

In order to produce and sell products in Kenya, certification by the Kenya Bureau of Standards (KEBS) must be obtained. In order to avoid the administrative complications associated with the application process, we plan to outsource production to Soy Afric, a local food company that already has a factory and are producing and selling soybean products. As the company has experience with the KEBS certification process, it is envisaged that the application work would also be outsourced to Soy Afric.

## **2.6 Environmental and Social Considerations**

### **2.6.1 Environmental considerations**

The proposed business model is not expected to create any new burden on the environment.

### **2.6.2 Social considerations**

No specific considerations are thought to be necessary as regards to the promotion of the use of soybeans.

In the case of the original project to "localize the *koji* fermentation technique", there was a possibility that leaving saccharified *uji-amagayu* at room temperature might allow the growth of wild yeast, which might result in the unintended production of alcohol.

Chemical reactions during the fermentation of food are often not visible, and it is possible that the local residents might be concerned about this phenomenon on religious grounds. Proving that alcohol is not present would require tests using analytical instruments, which would not be feasible in a localized business operation.

If we were to produce and sell any fermented food or condiments – including soy sauce – in the region, it would require a disclosure of the production process and provision of information, on which basis the local residents could make their own informed decision on whether or not to consume these products.

## **2.7 Possible Collaboration with JICA**

### **2.7.1 Possible project schemes**

The following three project schemes are considered possible options:

1. Use of JICA's volunteer scheme
2. Introduction of new varieties and provision of cultivation guidance by experts sent to the region



3. Collaboration with the Smallholder Horticulture Empowerment and Promotion Project for Local and Up-scaling (SHEP PLUS)

### **2.7.2 Expected benefits of collaboration**

#### **(1) Use of JICA's volunteer scheme**

JOCV nutritionists could provide nutrition education and raise awareness of the health benefits of soybeans among the local citizens. This could be achieved by JOCV nutritionists adding information about the health benefits of soybeans in their nutrition education program and providing cooking tips, which would help the general public accept the idea of including soybeans in their diet. As the citizens (especially mothers) gain knowledge of nutrition, their awareness of the need to include protein (especially derived from soybeans) in their daily diet would grow. This would indirectly boost protein intake among pregnant women, children and infants.

In addition, the use of the Private-Sector Partnership Volunteer Program, JICA's private-sector partnership initiative designed to nurture globally-minded talents, could be considered, through which Kikkoman personnel responsible for this business operation could be sent to Kenyan (on secondment in food processing industry). Sending the personnel assigned to this business to Kenya would help them gain awareness of the local culture and business practice, understand the current technical level and the local needs, and build a network needed to operate and expand the business.

#### **(2) Introduction of new varieties and provision of cultivation guidance by experts sent to the region**

The introduction of new varieties and provision of cultivation guidance would help farmers increase their productivity and yield, which would encourage more farmers to take up soybean growing. It would also ensure that soybean farmers secure a better and more stable income.

#### **(3) Collaboration with the Smallholder Horticulture Empowerment and Promotion Project for Local and Up-scaling (SHEP PLUS)**

This would incentivize farmers to grow the varieties of soybeans that meet the market demands, which would result in a better and more stable income.

## 2.8 Development impact

### 2.8.1 State of BOP population targeted

The challenges faced by the local BOP population targeted in this business model are as follows:

Raw material procurement	Local farmers	Low disposable income Low soybean production volume
Distribution/sales	CHVs	Living under the poverty line
Consumers	Pregnant or breast-feeding women	Low birthweight, deaths during pregnancy/childbirth and stunted growth due to malnutrition (protein and iron and other micronutrient deficiencies)
	Infants and children	Malnutrition (as above) resulting in stunted growth, infectious diseases and deaths due to complications
	Adults	Malnutrition (malnourishment and obesity)

### 2.8.2 Development challenges and development effect evaluation indicators

Once the business operation is up and running, it would contribute to the efforts to tackle the following development challenges:

#### (1) Prevention of chronic malnutrition and lifestyle-related diseases through nutrition education and dietary habit improvement

Indicators of development impact:

- Knowledge of nutrition among mothers and childcarers
- Full breastfeeding rate
- Balanced diet (protein / sugar)
- Micronutrients intake (through food or increased access to health service)
- School meal supply rate, pupils' attendance rate
- Stunting / obesity rates

#### (2) Poverty reduction by increasing the income of small farmers / contribution to food provision through promoting soybean growing

Indicators of development impact:

- Number of farms supplying soybeans to the business; soybean purchase quantities
- Disposable income of soybean farmers
- Number of soybean-growing farms and soybean production output

#### (3) Contribution to fuel cost savings at home and schools / reduction of environmental impact

Indicators of development impact:

- Cooking time burning charcoal, wood, gas, etc.; fuels used; fuel cost