

Republic of Zambia

Preparatory Survey on BOP Business on Improving Nutritional Status of Zambia Using Spirulina

Report
(Summary)

July, 2015

Japan International Cooperation Agency (JICA)

Alliance Forum Foundation

DIC Corporation

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Abbreviations

| Abbreviations | Full Name |
|---------------|---|
| AFF | Alliance Forum Foundation |
| BOP | Bottom of the Pyramid |
| CGP | Child Growth Promoter |
| CHP | Child Health Promoter |
| DHS | Demographic Health Survey |
| DWA | District Women Association |
| GMP+ | Growth Monitoring Promotion Plus |
| IGA | Income Generation Activity |
| JICA | Japan International Cooperation Agency |
| JOCV | Japan Overseas Corporation Volunteers |
| JV | Joint Venture |
| LCMS | Living Conditions Monitoring Survey Report |
| MCDMCH | Ministry of Community Development and Mother and Child Health |
| MOAL | Ministry of Agriculture and Livestock |
| MOH | Ministry of Health |
| MOP | Middle of the Pyramid |
| MUAC | Middle Upper Arm Circumference |
| NGO | Non-Governmental Organization |
| NP | Nutrition Promoters |
| PAM | Programme Against Malnutrition |
| SUN | Scaling UP Nutrition |
| TOP | Top of the Pyramid |
| UNICEF | United Nation Children's Fund |
| UNZA | University of Zambia |
| WFP | World Food Programme |
| WHO | World Health Organization |
| VA | Vitamin A |

1 Survey Overview

1.1 Background and Objectives of the Survey

1.1.1 Background

Republic of Zambia (hereafter referred to as “Zambia”) has one of the highest level of stunting¹ in the world, which is recognized as the index of chronic malnutrition. Ratio of stunting among under 5-years-old-children (hereafter referred as “under 5 children”) is the 8th highest² in the world, and 50% of the base of the pyramid (hereafter referred as “BOP”) population is stunted³. Chronic malnutrition is caused by a lack of micro-nutrients including Vitamins and Minerals. It leads to deprivation of physical development and immunity. In the global level, 30% of under 5 children suffer from chronic malnutrition, which causes the death of over 6,000,000 children annually⁴.

This business feasibility study was conducted based on the following three hypothesis as the major cause of chronic malnutrition: 1) insufficient income to secure food budget, 2) poor access to nutritious food (mainly, fruit and vegetables) due to seasonality and distance, and 3) insufficient knowledge about nutrition resulted in unbalanced diet skewed to energy intake. The Zambian government has struggled to intervene by supplementing micronutrient tablets, and distributing fortified processed food given through foreign aids. However, the program sustainability has been challenged, as they are usually left dysfunctional after the withdrawal of international aid. In fact, the statistics show that the chronic malnutrition among under 5 children is still severe, as 54% experiences Vitamin A deficiency, and 53% suffers from Anemia (Iron deficiency) in 2007. In the past few years, the rate of stunting has reduced to some extent, as a result of interventional aid programs. Yet the problem still exists as the stunting level is as high as 40% in 2013-2014 (Figure 1).

¹ Stunting : Lower Height growth compared to the average yielded by a study of World Health Organization (WHO) sampling the same age groups (Selected Brazil, Ghana, India, Norway, Oman, United States. Samples were taken from several countries to take the racial and cultural difference into account) Stunting is used as an index for chronic malnutrition as it is caused by lack of nutrition over a long period of time.

² UNICEF(2013). 「Improving Child Nutrition」

³ LCMS (2010) 「Zambia Living Condition Monitoring Survey」

⁴ JETRO (2010) 「BOP Business Needs Report : Nutrition Field in Ethiopia」

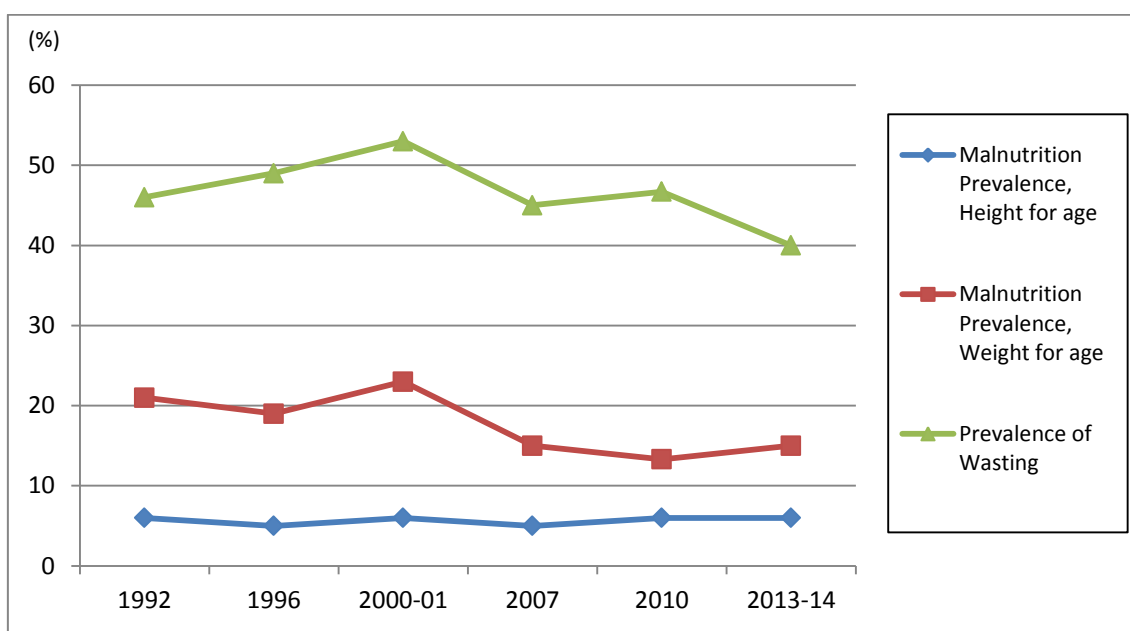


Figure1 : Nutrition Index of Under 5 Children in Zambia

(Zambia Demographic Health Survey 2002, 2007, 2013-14 (Preliminary Report), Living Conditions Monitoring Survey 2010)

In order to solve the situation, Alliance Forum Foundation (hereinafter referred to as “AFF”) proposes to develop an accessible and sustainable supply of nutritious food called “Spirulina”, coupled with a nutrition education especially targeting the BOP population. Spirulina is a type of micro-algae originated in Africa, which is rich in Protein, Vitamins, and Minerals. The business aims to improve BOP’s nutrition status by establishing a local production and consumption system of Spirulina.

1.2 Conclusion of the Feasibility Study

1.2.1 Business Feasibility and the Findings of the Study

Zambia experiences one of the highest levels of stunting in Sub-Saharan Africa. Zambia has received various international supports, especially after the global community collectively defined that more attention shall be paid to the issue of “Malnutrition” in 2008. With these supports, the Zambian government, particularly Ministry of Health (MOH), Ministry of Community Development, Mother and Child Health (MCDMCH), and Ministry of Agriculture and Livestock (MOAL), has cross-coordinated among different sectors to make some impact. *National Food and Nutrition Strategic Plan 2011-2015* stipulated the strategic focus on improving nutrition of pregnant mothers and 0-24 months old infants. *The First 1000 Most Critical Days Programme 2013-2015* embodied the action plans to implement the nutrition supplement distribution program at antenatal, post-natal, and under 5 clinics. As a result,

nutrition fortified food has been distributed in purpose to influence the daily food balance and eating habit, to complement the Vitamin A and Folic Acid and Iron supplement that has been already distributed. For example, UNICEF and World Food Programme (WFP) have been distributing processed food fortified by protein and multiple micronutrients. International NGOs such as Harvest Plus introduced the hybrid technology to fortify nutrition of agro-based food. The Zambian government has implemented awareness raising campaigns for locally produced nutritious foods. As a result, the latest statistics show the stunting ratio among under 5 children was successfully reduced, yet only to some extent. The research conducted by AFF revealed the possible cause of slow progress to be the insufficiency in knowledge, income, and time.

AFF conducted a consumer study in the three selected districts; Lusaka, Choma, and Katete. The results indicated that the access to nutritious fortified food or manufactured food is limited to most Zambians due to income, market accessibility, and knowledge on nutrition. Rather, the locally produced nutritious food plays the major role in improving the national level of nutrition. For instance, groundnuts powder is the most consumed complementary food known to have rich nutrition. It is commonly produced among small-scale farmers, thus accessible. However, the amount of groundnuts powder added per meal was far less than the recommended dosage. This is caused by lack of mothers' knowledge on the right amount to mix, lack of money to purchase sufficient amount of groundnuts powder, or tools to grind into powder, and lack of time to process groundnuts into powder. The underlying cause of stunting can be summarized into the following three "Lacks": 1) *Lack* of mothers' nutrition knowledge, 2) *Lack* of household income, and 3) *Lack* of mothers' time available to nurse infants. Recognizing them as the key determinants of Zambia's high rate of malnutrition, AFF aims to contribute to solving this social challenge.

AFF contributes to improving the Zambian malnutrition situations by supplementing daily meals with nutritious agro-based food "Spirulina". The business will collaborate with the network of under 5 clinics or Growth Monitoring Plus (GMP+) to create a nation-wide system to sell Spirulina, and to educate mothers on the importance of nutrition. Results of the pilot production indicated that the affordable price for BOP customers is achievable. Since Spirulina is in a powder format when harvested, it will save the processing cost at household level. And most importantly, during the acceptability test of spirulina product, mothers from all income levels, urban households in particular, highly appreciated the cost effectiveness of Spirulina supplying multiple nutrients. Based on such positive responses received through the

feasibility study, AFF decided to launch the proposed business in Zambia.

Still, challenges for commercialization exist. Specifically, it is critical 1) to secure a system to locally accumulate the technology and knowledge of Spirulina production, and 2) to build a sales network that is truly accessible by the BOP customers. Localization and sustainability of the proposed business is the key to solve the issue of chronic malnutrition. Unlike acute malnutrition distinguished by significant weight loss, chronic malnutrition arises due to the lack of nutrition over a long period. Therefore, the long-term approach involving awareness raising of the mothers, and shift in daily diet is essential. Development of local human capital that supports the process of localization, and a sales system that can root into everyday life is important, and shall be addressed in the next phase.

1.2.2 Verification Points for Business Feasibility

Through the feasibility study, we concluded that the proposed business of locally producing and consuming spirulina is feasible. It is largely because the seven anticipated bottlenecks identified at the launch of the study have been solved. The list below gives the overview of each bottleneck along with the coping strategies.

1) Probability of transferring Spirulina production technology to local personnel

The climate of southern Zambia suits the conditions of Spirulina production. Raw materials can be procured locally at reasonable prices. Establishing a production system and facility to ensure the Spirulina quality is also feasible. The keen interest shown by the University of Zambia (UNZA) in collaborating on knowledge accumulation and technology development of Spirulina production is also encouraging. All together, the concern on the feasibility of transferring the skills and technology of Spirulina production has been mostly eliminated.

2) Prospect of finding a trusted local partner

AFF has identified a local company with rich expertise on aquatic production, logistics, and product development, as a potential business partner. Discussion is underprocessed to embody the joint ventureship. In terms of the sales to the BOP market, a collaboration with the under 5 clinic is vital. AFF will continue to work on developing a cooperative framework with MCDMCH which has the jurisdiction over local clinics.

3) *Possibility of differentiating with other competing products*

Groundnuts flour seems to be the most widely accepted Zambian complementary food. The advantages are the high recognition, and relatively low price. It is also the most commonly grown crop among Zambian small-scale farmers. However, considering the Zambian mothers' keen interest in child's health, it is possible to take the share, if the benefits of Spirulina in comparison to groundnuts could be demonstrated. The key to the differentiation is educating mothers so that the nutritional value of Spirulina becomes clear.

4) *Acceptability of local customers to green color*

Strategic product promotion combined with supplementation of nutrition knowledge could overcome the color oriented challenge. The strong green color spirulina has, changes the color of the foods easily. Therefore, there was a concern that the color could be an obstacle to be accepted. However, the sample tasting combined with nutrition education provided positive results. Some mothers associated the green color with the image of healthy vegetables. Most mothers said the difference the color makes is not significant.

5) *Probability of realizing prices affordable to BOPs*

Cost reduction can be achieved by substituting test reagents with fertilizer, and the production methodology with a more cost-effective option (e.g. sun drying of Spirulina). The study confirmed the quality was assured even in case of adopting cost effective alternatives. The product design is another key to make the price affordable. Carefully choosing the packaging materials and quantity is important to achieve the price for BOP customers.

6) *Probability of establishing a market accessible to BOPs*

Under 5 clinics are identified as the main point of sales for BOP customers. Clinics do not only provide access to mothers from BOP households, but it also helps to effectively convey the benefits of Spirulina. Most mothers are ensured to take their under 5 years old to a clinic monthly. There are several advantages of collaborating with the under 5 clinics. Clinics are highly valued as the source of information among mothers. Our customer study results indicated that the credibility mothers place to the clinic for the health related information is extremely high. As if to reply to the expectations, under 5 clinics have incorporated programs such as nutrition education and cooking demonstration for the mothers. The effectiveness of Spirulina would be

better understood through the collaboration with the clinics.

7) *Possibility of securing business profitability*

The strategic approach to ensure profitability is consisted of two phases; promotion phase and expansion phase. During the promotion phase, the main focus will be placed on product branding and establishing the sales model. Production scale and variety in products will be kept to the modest, as it is more important to raise the recognition of Spirulina. Production size will expand in the 2nd phase to strengthen the sales model established in the previous phase. Profitability is expected to increase in the latter phase, which ensures both business sustainability and benefit to the BOPs.

1.2.3 Initial Business Model and the List of Verification Points

In this chapter, the business model initially planned at the start of this feasibility study, and the bottlenecks identified to realize it will be explained. Before the study, AFF assumed that the reason of widespread malnutrition in Zambia is caused by 1) insufficient dietary intake caused by limited purchasing power, 2) difficulty of accessing to nutritious vegetables and fruits especially in rural areas during low season, and 3) unbalanced diet disproportionately emphasizing carbohydrate intake due to insufficient knowledge on nutrition. The proposed business aims to solve the above bottlenecks to lower the rate of malnutrition by creating a supply chain of highly nutritious Spirulina specialized to BOPs.

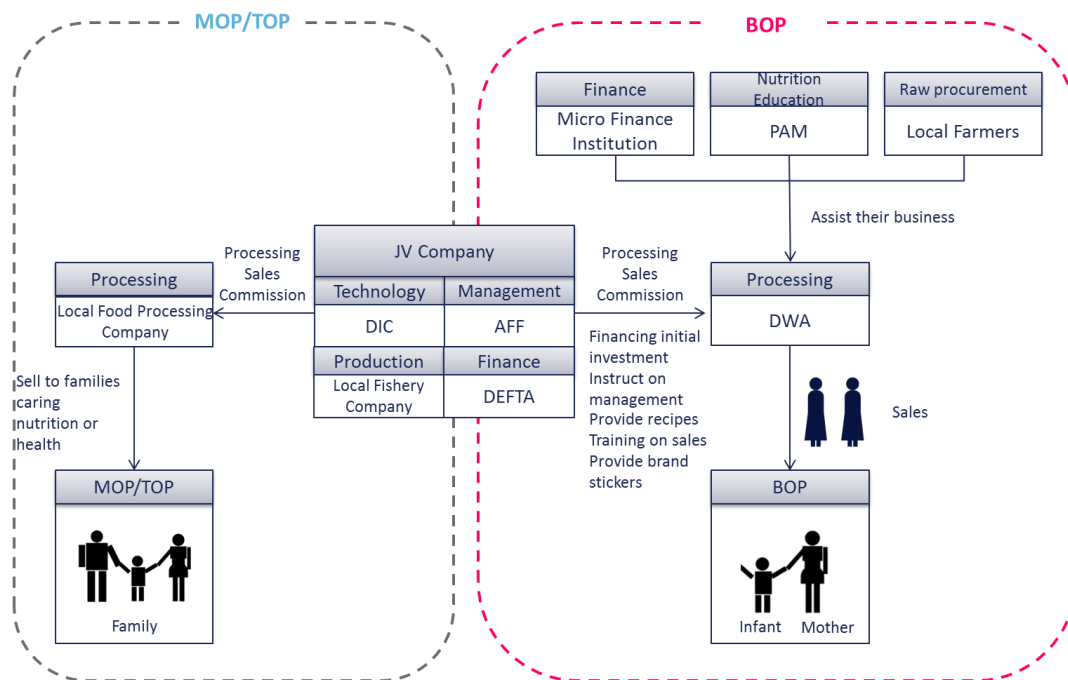


Figure 2: Tentative Business Model

The core of the tentative business model is to establish a joint venture (JV) company in Zambia that produces spirulina locally. The JV company will sell spirulina as the raw material to 1) District Women’s Association (DWA) which aims to process and sell products to BOP customers, and 2) local food processing companies which aim to process and sell products to MOP/TOPs.

Spirulina produced by the JV company will be dried and sold in powder format. DWA which has an agency contract with the JV company produces spirulina breads or other processed foods and sell at pop-up stores opened at crowded places such as Under 5 Clinics, schools, or churches. DWA members will create a sales network using the connection in the neighborhood/community. Differentiation from other businesses will be pursued by giving free measuring services of the Mid Upper Arm Circumferences’ (MUAC) of the children. The measurement will be recorded on a scatter diagram shown in the figure below. Customers can easily identify the state of their children by the color; such as “If below the red line the state of malnutrition is severe”, “If below the yellow line the mother has to be careful”, and “If above the blue line the children is on the right track”. DWA members are trained to provide advices on nutrition and dietary intake based on the result of the measurement. Additionally members will convey the benefit of spirulina and how it can supplement the daily dietary of children. The topics of education will also cover hygiene at households (washing hands, or cleaning cooking

supplies...etc.) so they can provide advices on child health holistically. Since customers can check their child's growth together with handy nutrition advices, there would be more incentive of continuously buying the spirulina products from DWA members. The relationship will lead to building a robust sales network. Financing of DWA will be supported by local micro finance institutions, small business management skills will be supported by AFF, and nutrition knowledge will be transferred by AFF's local NGO partner Programme Against Malnutrition (PAM).



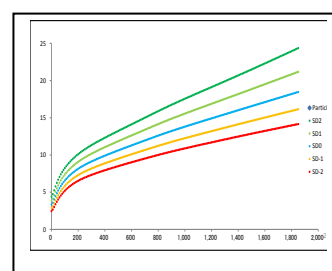
Image of pop-up stores

Stores selling products while mothers wait for their turn at Under 5 Clinic



Scene of measuring MUAC

MUAC can be easily measured



MUAC record sheet

The result can be easily interpreted in sequence.

When growing spirulina, depending on the sun light received, the nutrition value could vary. Therefore, Spirulina with higher nutritional content was planned to be sold to local food processing companies targeting MOP/TOP customers at a higher price than BOPs'. By utilizing their wide sales coverage, not only the JV company's business can be stabilized by having customers with stable purchasing power, but also the benefit of spirulina can be extended. In fact, the rate of malnutrition among MOP/TOP children exceeds 40%⁵. By also targeting the MOP/TOP families, our business can contribute to lower the rate of malnutrition in Zambia as a whole. Promotion will be conducted by putting advertisement in urban cities, or sending sales personnel to retail stores or churches to conduct promotional activities especially targeting mothers.

In order to realize the business model planned in the initial stage of the feasibility study, AFF identified seven bottlenecks to verify as below.

- 1) Probability of transferring spirulina production technology to local personnel
- 2) Prospect of finding a trusted local partner
- 3) Possibility of differentiating with other competing products
- 4) Acceptability of local customers to green color

⁵ Central Statistical Office (2010). "Living Conditions Monitoring Survey Report 2006 & 2010".

- 5) Probability of realizing prices affordable to BOPs
- 6) Probability of establishing a market accessible to BOPs
- 7) Possibility of securing business profitability

2 Verification on the Business Feasibility

2.1 Bottleneck 1) Probability of Transferring Spirulina Production Technology to Local Personnel

2.1.1 Prerequisites for Spirulina Production

Probability of transferring Spirulina production technology to local personnel increases when the following three conditions are found: (i) environment suitable for Spirulina to grow, (ii) workable cost reduction methods of cultivating Spirulina, and (iii) local personnel capable of cultivating Spirulina. AFF already started discussing the possibility of a large scale production with a local partner candidate, as the survey results have confirmed the feasibility to achieve these conditions.

As stipulated in Table 1, a large scale and accelerated production of Spirulina requires (i) water temperature between 30 and 35 degree, (ii) strong sun light over 100,000 lux, and (iii) pure water free of heavy metal contamination. Besides, by adding all the chemical elements Spirulina needs, culture medium with high nutrients needs to be prepared. The pH of the culture medium should be between 9.5 – 10.5 (high level of alkalinity) in which only Spirulina can survive. The culture condition ensures Spirulina to efficiently utilize nutrients within its medium. It is also recommended to find a production site where annual precipitation is less than 1,300mm and monthly precipitation is less than 200mm to avoid over flowing of water from the pool. From the on-site survey and analysis of the climate data, AFF successfully identified the best location in southern part of Zambia.

Table 1 : Appropriate Conditions to Produce Spirulina

| Item | Conditions |
|---------------|---|
| Temperature | Maxim: 30 to 35 degree, Minim: 20 degree |
| Light | More than 100,000lux |
| Water Source | Stable access to safe water which is free from heavy metal contamination |
| pH | 9.5-10.5 |
| Precipitation | Amount of precipitation is less than: <ul style="list-style-type: none">• 10mm per day• 200mm per month• 1,300mm per year |

2.1.2 Bottleneck to Reduce the Cost and the Feasibility of the Solution

Securing a constant demand from BOP customers with market volume and

nutrition needs is indispensable to launch and sustain a large scale Spirulina production facility. Therefore, realizing an affordable price for the BOPs by lowering the production cost is an important factor. Bottlenecks for reducing the production cost can be mainly summarized into the following:

- 1) The possibility to increase the cultivation speed at the same time ensuring the nutritional quality of Spirulina by using affordable agricultural fertilizers as a substitute of laboratory-use chemicals
- 2) The possibility of reducing the dependency on expensive equipment
- 3) The possibility of employing manual operation methods

AFF verified the effectiveness of the countermeasures to overcome the bottlenecks above through a pilot production and site visit to a spirulina producer in Madagascar, who employs a low cost production method with minimum investment in equipment.

1) The possibility to use affordable agricultural fertilizers as a substitute of laboratory-use chemicals

To assess the possibility to use fertilizer, AFF compared the Spirulina grown by test reagents and agricultural fertilizer. The difference in 1) growth speed, 2) nutrition composition, and 3) the quality including existence of heavy metal were assessed. The result of the pilot production confirmed that the Spirulina grown by fertilizer had the same speed, higher nutrition composition, and no concern on the quality.

2) The possibility of reducing the dependency on expensive equipment

In Zambia where most goods are imported, it is necessary to reduce the dependency on expensive equipment in order to achieve affordable price of Spirulina. Simplification of laboratory tools is one of the options. The JV company plans to minimize the cost for equipment by collaborating with UNZA, which already possesses an established set of laboratory appliances.

3) The possibility of employing manual operation methods

The JV company shall strategically select between manual or automated production, depending on the scale of the pool. For example, the plant of DIC Corporation is entirely mechanized as their production size is as huge as covering 1/3 of the world production. On the other hand, the smaller scale Spirulina production plant in Madagascar operates manually, except for agitation of the water in the pool. The most

cost effective mechanization process will be flexibly introduced based on the business stages. During the promotion phase, the production line shall be operated manually. The JV company will gradually mechanize the plant as moving forward to the expansion phase.

2.2 Bottleneck 2) Prospect of Finding a Trusted Local Partner

2.2.1 Spirulina Production Partner

AFF has been discussing to build a joint venture partnership with a private fish farming company in Zambia. The partner was identified after following steps. First, AFF created a long-list of potential production sites with climate conditions suitable to spirulina production by receiving advices from MOAL, JICA experts, and local partner NGOs. Second, AFF identified three short-listed companies who are interested in the proposed business, in addition to satisfying the Spirulina production criterion including climate data, facility capacity, and soil condition. During the short-listing process, AFF analyzed full set of weather data, and visited the sites to meet the owners in person. Production facilities, availability of stable water and electricity resource, access from the town, economic activities in the neighborhood, and surrounding environment that possibly affect the Spirulina production are examined. We also interviewed company's interests in the issue of malnutrition and the involvement to this project.

The short-listed three companies were also verified by the DIC experts through the second on-site research. The experts also checked the facility, and the quality of the water source. As a result of this visit, AFF selected one local company which owns fishery ponds in Siavonga. There are four reasons of choosing this company: firstly, it possesses a high possibility to ensure a satisfying cultivation speed due to its high temperature and little precipitation (Figure 3). Comparing to conditions in Lusaka, where pilot production was implemented, Siavonga's conditions are quite suitable to cultivating Spirulina. Figure 3 compares the monthly average temperatures (highest and lowest) between Lusaka and Chipopo (an area where a metrological observatory covering Siavonga exists). Figure 4 shows climatic zones in Zambia categorized by precipitation. While Lusaka belongs to the Region II with annual average precipitation 800 – 1,200mm, Siavonga is belongs to Region I with less than 800mm precipitation.

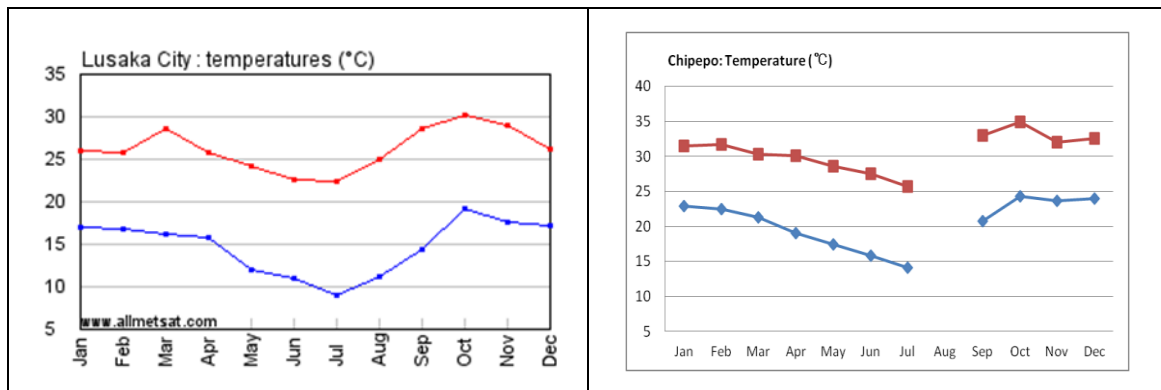
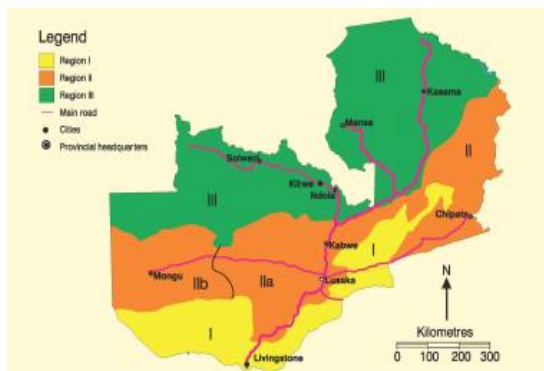


Figure 3: Comparisons of Monthly Average Temperature in Lusaka and Chipepo

(Source of Lusaka’s figures : <http://en.allmetsat.com/climate/zambia-malawi.php?code=67666>)

(Source of Chipepo’s figures: climate data from Zambian Metrological Department)



| | |
|------------|--|
| Region I | Annual Average precipitation : Less than 800mm Temperature may exceeds 38 degrees in summer |
| Region II | Annual Average precipitation: 800mm – 1,200mm Average temperature in summer: 20 to 33 degree |
| Region III | Annual Average precipitation: More than 1,200mm Average temperature in summer 18 to 30 degree |

Figure 4: Agriculture and Biological Map

(Source: ZNFU, 2007, Conservation Farming & Conservation Agriculture Handbook)

Secondly, the president of this company has passion to improve Zambian nutrition situation. Since he is already engaged with cultivation of the Moringa which is employed as pseudo-medicines in Zambia due to high nutritional value, Spirulina also caught his attention. Thirdly, he owns a food processing company, as one of the group-companies. Using the same company’s value chain, production cost can be reduced. Utilization of this value chain is already being discussed, as president is eager to involve his food processing company into the business as well. Finally, the company has staff ideal to work as the Spirulina cultivation manager. He has the experience and knowledge to handle Spirulina, as his previous work place used Spirulina as fish feed.

2.2.2 Partner for Production and Sales of BOP Targeted Spirulina Product

The Spirulina powder was selected as the main product contrary to the initial supposition to produce and provide processed Spirulina food. Results of the acceptability test indicated that a powder Spirulina that can be used for varieties of Zambian dishes has a higher demand. Processed Spirulina product is still a part of the product portfolio, however, mainly targeting the MOP/TOP customers. Powder form product was popular, regardless of the income class, due to its economy and versatility. BOP and MOP customers have particular tendency to prefer homemade food, mostly because there is a budget constraint, and thus no habit to eating processed food. They eat manufactured food only for limited occasions, for example when they have to work outside the house. Therefore, we will provide Spirulina product in powder by small sachets so that is both acceptable and affordable to BOPs

The following figure shows the overview of partnerships in the supply chain. As for the packaging of Spirulina powder, and production of Spirulina processed foods, a local food processing company was selected. It is a group-company of a major fishery enterprise, which is the joint venture candidate for Spirulina cultivation. Continuous partnership throughout the value chain from production – processing – packaging of Spirulina is an advantage. AFF will also collaborate with under 5 clinic network as points of sales. Specifically, we aim to establish “nutrition education + sales” model in collaboration with Nutrition Promoters (NP), Child Health Promoters (CHP), and Child Growth Promoters (CGP) (hereafter, collectively mentioned as “clinic volunteers”) who work for clinics. This is because, a correlation between the level of nutrition knowledge and willingness to buy Spirulina product⁶ was verified through the feasibility study. In addition, many of the BOP attend under 5 clinic where vaccinations are provided for free. However, currently, the nutrition education provided at clinics is not sufficient enough to raise mothers’ awareness on nutrition. Therefore, AFF plans to work with JICA in the area of developing and expanding nutrition education system.

⁶ Acceptability test, by AFF 2015 January

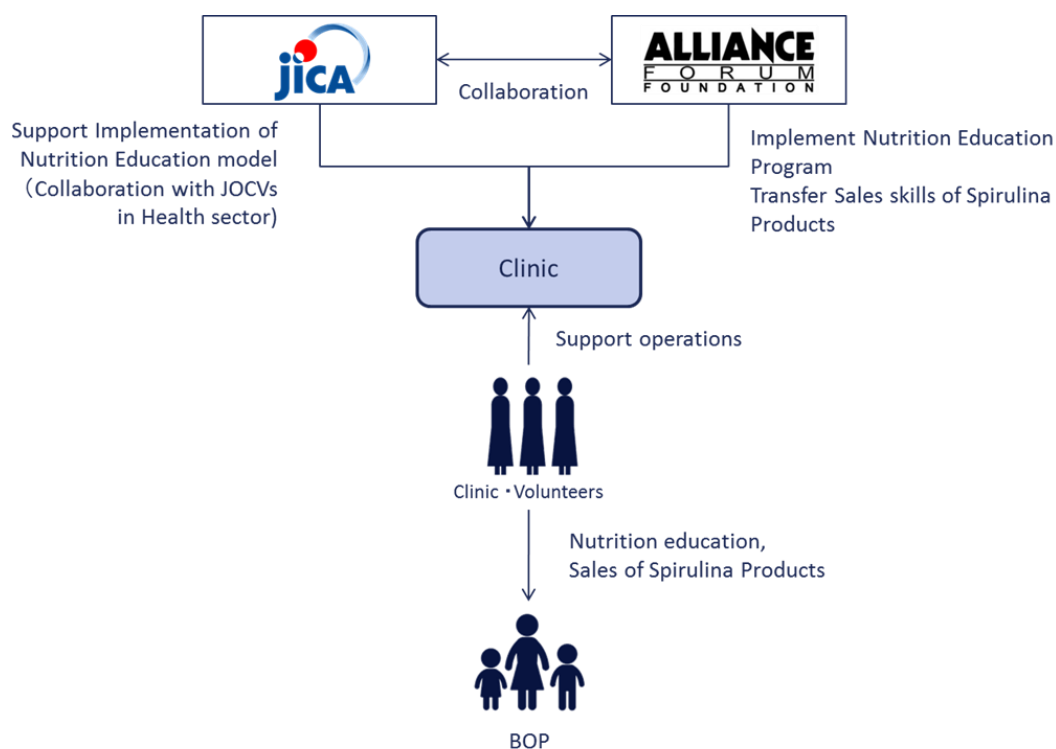


Figure 5: Sales model for BOP targeted Spirulina product

At the under 5 clinic, clinic volunteers provide nutrition education, growth monitoring service by scaling child’s weight, and cooking demonstration to teach nutritious recipes. Many have joined nutrition workshops and trainings organized by JICA or other international organizations such as UNICEF. Clinic volunteers also engage in entrepreneurial activities through Income Generation Activity (IGA) to support their volunteer work. Clinic volunteers possessing both access to target population, and entrepreneurial skills makes them an ideal partner for the proposed business.

Partnership with clinic volunteers will start by selecting the project area (clinic). In order to select a partner, AFF will first conduct a pilot project implementing the “nutrition education + sales” model. Pilot sites will be selected from both urban and rural settings, as the customer survey AFF conducted revealed that how BOPs acquire foods are different in urban and rural. Urban pilot site will be selected from 5 compounds where JICA GMP+ (Growth Monitoring Promotion Plus) program was implemented; namely George, Ngombe, Mutendele, Kanyama, and Chipata. The rural site will be selected from the local networks AFF possesses. Approval of authorized government institutions (District Health Office, Ministry of Community Development, Mother and Child Health) must be obtained beforehand. Support from the department of

Mother and Child Health at MCDMCH is particularly important to properly undertake the pilot project.

2.2.3 Partner for Production and Sales of MOP/TOP Targeted Spirulina Product

The versatility and economy of Spirulina powder product were highly valued among MOP/TOP customers as well. However, they prefer products with larger quantity and stylish packaging design, as their purchasing power is higher. Therefore, the MOP/TOP targeted product will be provided in a larger quantity of 20g in a box, with displays of its nutrition value and sample recipes.

MOP/TOP mothers tend to spend more time away from home for working, and thus they face higher demand for processed take-out food. To meet such demands, we target to supply two types of Spirulina snacks in addition to Spirulina powder; corn snack and maize drink. Corn snack is extremely popular among Zambian children, particularly as school recess bites. Maize drink has an image of “healthy food” since it is made of fermented maize flour and milk. Both types of snacks were ranked among the top of evaluation at the sample tasting AFF conducted, even with relatively high addition of Spirulina.

AFF discussed partnership proposal with four Zambian food processing companies. A group-company of Spirulina production partner expressed keen interest as it specializes in the manufacturing of soy bean based protein rich food. The company also had plans to start selling a corn snack product. AFF has identified this company as a primary candidate, as the company possesses several other attractive features; nationwide retail network and joint product development experience (protein based nutritious food) with an American company. After the plan to form a partnership became concrete, we will move onto developing proto types to refine the business plan.

2.3 Bottleneck 3) Possibility of Differentiating With other Competing Products

Majority of Zambian nutritious food products target infants or school age children. Products are mainly designed for that age group, such as a porridge mix or nutrition mix to fortify complementary foods. Our study on competitive products covered not only the staple diet, but also snacks as they compete with Spirulina processed products for timing of consumption.

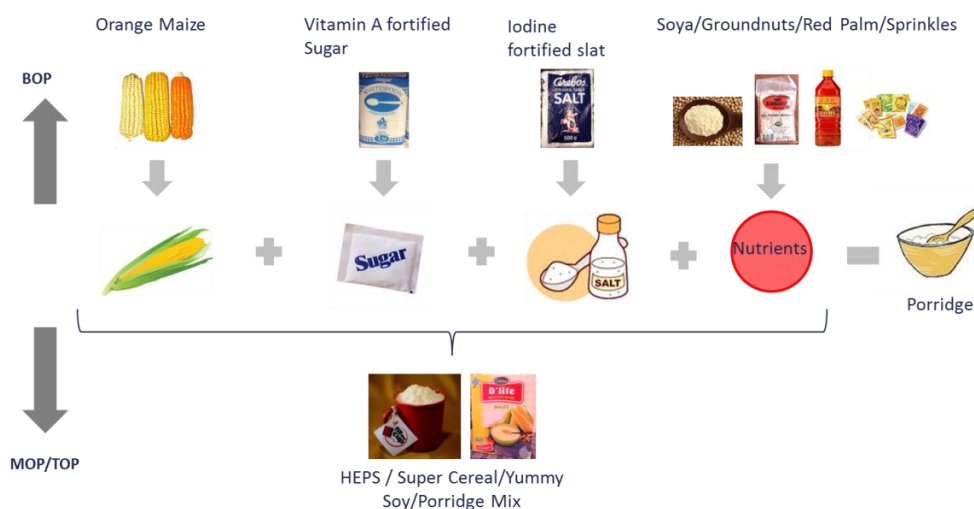


Figure 6: Nutrition Fortified Food in Zambia

The JV company plans to develop two types of products; powder form and processed food. The former competes with groundnuts powder or porridge mix in terms of usage. Still, porridge mix is not yet commonly consumed among BOP as it is as expensive as 11-17 Kwacha (180-280 yen) for 250g. The latter competes with snacks popular in Zambia, such as corn snacks, cream biscuits, maize drinks, and fritters, in terms of the timing of consumption. Although the main consumers of such products are adult male or upper grade students, corn snack is popular among lower grade students as well. Therefore, differentiation strategy of Spirulina against groundnuts powder and corn snack matters significantly.

Groundnuts are rich in nutrition and commonly produced among small-scale farmers. Groundnuts powder is widely utilized as a fortification of the complementary food because of its affordable price as low as 10 Kwacha (170 yen) for 400g. The most common recipe is the maize based porridge with groundnuts powder, with a mixing ratio of 2:1. However, we found that the amount of groundnuts powder mixed per meal was far less than this recommended dosage by the health sector of Zambia. This is mainly due to lack of income, and also lack of time and knowledge of the mothers. Although groundnuts are grown commonly, grinding requires time and money. Additionally, most mothers add 1-2 table spoons of groundnuts powder (15-30 g) to a pot of maize porridge, due to the ignorance of recommended mix ratio for groundnuts and maize flour. Spirulina product is a time-saver as it does not require the grinding process. Also, a small portion (1 tea spoon full) of Spirulina provides almost the same level of nutrition as 60g of groundnuts powder. The recommended dosage of Spirulina per meal can be conveyed correctly by telling mothers “consume 1 sachet per week”

when they purchase. As such, nutrition education combined with product design helping the correct consumption is one way to differentiating Spirulina products from the rest.

Jiggies is a type of corn snack, which is extremely popular among Zambian children, particularly for school snack. As some children consume it almost every day, the negative health impact of food additives the snack contains has been anticipated among health sector professionals and even the mother. Introducing Spirulina processed product in a form of “nutritious corn snack” has a chance to attract health conscious mothers.

2.4 Bottleneck 4) Acceptability of Local Customers to Green Color

The green color Spirulina has is so strong that it will change almost every food into green when mixed together. The green color comes from its natural pigment, chlorophyll, thus not artificial. Still, negative reaction of local customers to its green color was anticipated before the study. However, the acceptability test with sample tasting provided positive feedbacks. Some associated green color with the image of vegetables, and thus thought it was healthy. Most respondents said that the difference was not significant, though some seemed hesitated to try the green porridge at the beginning, as it is supposed to be white. The negative reaction lowered even more after supplementing the participants with nutrition knowledge. Therefore, we plan to combine the Spirulina promotion with nutrition education and cooking demonstration to reduce the color oriented bias.

2.5 Bottleneck 5) Probability of Realizing Prices Affordable to BOPs

Average per meal budget of BOP household is about 5 Kwacha⁷ (80 yen). Health conscious family may spare additional 5 Kwacha to purchase nutritious food for infants. Based on such findings, AFF set the target BOP price range as 5-10 kwacha per package. Comparing price with other baby food such as soya powder or groundnuts powder, it may seem expensive. However, Spirulina has an advantage over the balance of nutrition it can provide to consumers. Whereas groundnuts powder provides mostly mineral, and soya powder mostly consists of protein, Spirulina is a source of vitamin, mineral, and protein (See Table 2). Participants of the Spirulina product acceptability test expressed higher willingness to purchase after understanding the cost effective aspect of Spirulina. Additionally, Spirulina does not require to be cooked. This is considered as an advantage in case for the lack cooking fuel or time, compared to soya and groundnuts which requires considerable amount of time to cook.

⁷ In this report, it refers to Zambian Kwacha (after currency rebasement in 2013)

Table 2 : Nutrition Composition of Model Complementary Food Menu

| Menu | Ingredient | Portion | Protein | Iron | Vitamin A |
|---------------------|--------------------|------------|---------------|---------------|----------------|
| | Unit | g | g | mg | µg |
| Spirulina Porridge | White Maize flour | 20 | 1.4 | 0.4 | 0 |
| | Water | 80 | — | — | — |
| | Spirulina | 1 | 0.63 | 0.874 | 1161.6 |
| | VA fortified sugar | 5 | — | 0.005 | 0.05 |
| Total | | 106 | 2.03 | 1.279 | 1161.65 |
| Groundnuts Porridge | White Maize flour | 11.7 | 0.819 | 0.234 | 0 |
| | Water | 80 | — | — | — |
| | Groundnuts powder | 8.3 | 2.1082 | 0.1328 | — |
| | VA fortified sugar | 5 | — | 0.005 | 0.05 |
| Total | | 105 | 2.9272 | 0.3718 | 0.05 |

(Source: Zambia Food Composition, standard tables of food composition in Japan 2015, AFF customer research 2014, June)

To realize BOP affordable price, packaging cost needs to be assessed carefully as well. Normally, sealed aluminum material is recommended, to preserve the nutrients of Spirulina for a long period. However, it is too costly to do so for the BOP product. The JV company plans to solve this challenge by preparing different packaging between BOP and MOP/TOP products. For BOP customers, normal plastic packaging will be used for the individual sachet, while a box or bag containing such sachets will be protected by aluminum material.

2.6 Bottleneck 6) Probability of Establishing a Market Accessible to BOPs

The revised business model proposes to sell two major different types of products through different channels. The 1st channel is the government owned health clinics channel, and the 2nd is the commercial retail shop channel. As mentioned above, AFF will collaborate with clinic volunteers to increase mothers' awareness on the importance of nutrition to child's growth, then demonstrate the cooking recipes of complementary food using Spirulina. After demonstration and tasting, we will make it so that mothers can purchase Spirulina on spot. In this way, the demonstration will partially serve as the promotion of Spirulina.

Processed Spirulina products will be sold through the retail network. Initially, the distribution channel of the partner processed food company will be utilized. Drugstore sales channel has a high potential as some of the drugstore chains such as Umoyo or Link Pharmacy already market imported Spirulina powder or tablet targeting high income customer groups. Our comparative advantage to the existing product is its low

price, as the imported Spirulina's price ranges as much as 80-125 Kwacha (about 1,300-2,000 yen).

Lusaka has been selected as the sales hub, because of its easy access to the transportation network and high population density. The Spirulina powder harvested in Siavonga will be transported to a processing plant of the potential partner company having its factory near Lusaka. After Spirulina powder is either packaged, or processed at the factory, it will be transported to each sales destination through the existing logistic network. As for the transportation to clinics, AFF intends to utilize the established logistics network MOH or MCDMCH are using to transport medicines or other equipment. The challenging part is the business capacity development of NPs such as inventory management and accounting. Although, some clinics offer IGA platforms to sustain NPs' activities, most of them remain in subsistent level such as farming. Expanding the investment to sales of commercially procured products is extremely rare. A pilot sales project will be conducted to assess the feasibility of Spirulina sales at the clinic after completing the feasibility study.

2.7 Bottleneck 7) Possibility of Securing Business Profitability

To ensure the business feasibility, AFF has set three assessment criteria to achieve; 1) reduce the production cost, 2) attain profitable yet affordable price for BOP customers, and 3) realize consistent sales. As above mentioned, cost reduction at production can be attained through substituting the test reagents to agricultural fertilizer. This, in turn, enabled achieving the affordable price. The product line for MOP/TOP customers with higher profitability ensures sustainability of the business. The sales volume cannot be projected exactly as we have not conducted pilot sales during the feasibility study, however, it can be increased by offering the product with nutrition education.

3 The Projection on the Revised Business Model

3.1 Revised Business Model

3.1.1 The Overview of the Revised Business Model

After conducting market study, customer study, pilot production, and Spirulina product acceptability test, and verifying the seven bottlenecks initially identified, AFF reviewed the business model as below.

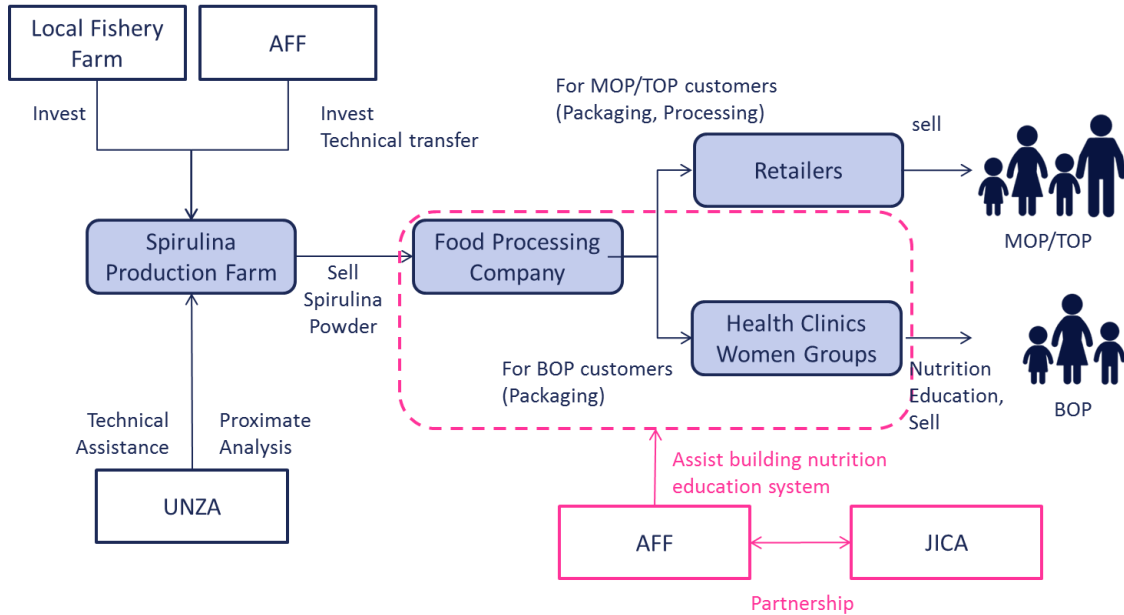


Figure 7: Revised Business Model

Spirulina production will be still conducted by a JV company between AFF and a local fishery company. Technical transfer will be done through an AFF staff who received training by the DIC Corporation, but in the long-run it will be conducted by the researchers at University of Zambia (UNZA) who learned the technology from AFF. Spirulina powder will be sold to local food processing company as raw material, and packaged or processed into products according to the target customers. In the short-run, spirulina will be sold to an affiliated food processing company of the JV partner, however, in the long-run, the sales portfolio will be diversified to other food processing companies.

As explained in Chapter 2.2.2, Spirulina products will be sold to BOP customers through the clinic channel by clinic volunteers. By turning the clinic as the sales point of Spirulina, the activity becomes a group income generation. Therefore, it is important to manage clinic volunteers, who are usually conducting the nutrition education, as a group. Clinic volunteers are assigned to particular areas of the community which are

divided into 10-20 zones. Therefore, volunteers shall be grouped by zones (or by clinics), and collectively manage the Spirulina stock and accounting.

As we mentioned earlier, when developing “nutrition education + sales” model, we expect to work together with JICA, and the clinics trained by them in the past. JICA is also trying to increase the management capacity of local clinics, especially in the central/southern provinces, through dispatching JOCVs. On the other hand, promotion to MOP/TOP market will be sought through conventional marketing strategies, such as putting advertisement or organizing promotional events at retail stores.

3.1.2 Remaining Challenges and Coping Strategies to Launch Business

Though the projection of the proposed business is positive, there are remaining challenges, namely; 1) to secure a system to locally accumulate the technology and knowledge of Spirulina production, and 2) to build a sales network that is truly accessible by the BOP customers. AFF aims to reduce malnutrition sustainably by developing systems for local production and consumption of Spirulina. Therefore, it is more desirable to shift the initiative of the business to Zambian stakeholders in the long-run.

Regarding the 1st challenge, it is important to transfer the Spirulina production technology to a local research institution that can accumulate the skills and knowledge to increase the productivity under the Zambian environment, in addition to transferring the skills to the local production partner. UNZA has been interested, however, the capacity development may take a long time as it currently does not have an algae-specialist. Nevertheless, if UNZA can become the hub of research on Spirulina, it will greatly benefit the business as there is no Zambian company or institution possesses the ability to cover the whole set of Spirulina proximate analysis, partially due to the insufficient inspection/analysis technologies as well as equipment. Therefore, a step by step capacity development at UNZA shall be planned.

To cope with the 2nd challenge, the proposed business model plans to utilize the network of under 5 clinic. However, a constant lack of funding at the Zambian health sector puts limits on the plan. The operational efficiency and effectiveness of the under 5 clinic is lowering because it has to be largely dependent on resident volunteers. In other words, increasing the operational capacity of local volunteer teams is an important factor to assure the sustainable Spirulina marketing. Capacity development shall not be limited to supplementing the knowledge of the volunteers on nutrition, but shall also to implementing a system to generate income to cover the running cost of the under 5 clinic operation. We plan to utilize the funding scheme of JICA or Japanese Ministry of

Foreign Affairs to solve the capacity development challenges, while proceeding onto the technical transfer or Spirulina production skills to the JV company staff.

3.2 Strategies to Establishing the Business

3.2.1 Transferring Spirulina Cultivation Techniques to Zambia

In the early stage of Spirulina production, the JV company plans to assign three personnel, a cultivation manager and two workers, in addition to AFF staff who supervises the production process. Spirulina production techniques will be transferred to a cultivation manager, and afterwards, he is expected to transfer the techniques to other workers. The technical transfer is divided into two stages, namely the indoor production and outdoor production. UNZA will work as the hub for technology transfer, especially during the indoor training, because (i) Spirulina seedling is preserved in the facility of UNZA, (ii) necessary equipment for indoor cultivation such as cultivation room and a spectrophotometer are available, and (iii) there are two researchers who AFF had trained for the pilot Spirulina production. When the amount of Spirulina reaches to the adequate level for outdoor cultivation, the Spirulina culture can be transferred to outdoor pool. During the period, the cultivation team should learn outdoor cultivation methodologies through on-site training.

As mentioned above, AFF plans to implement a long-term capacity building program with UNZA. By doing so, localization of the business becomes more realistic. Discussion with UNZA to develop an in-school capacity development program is already underway.

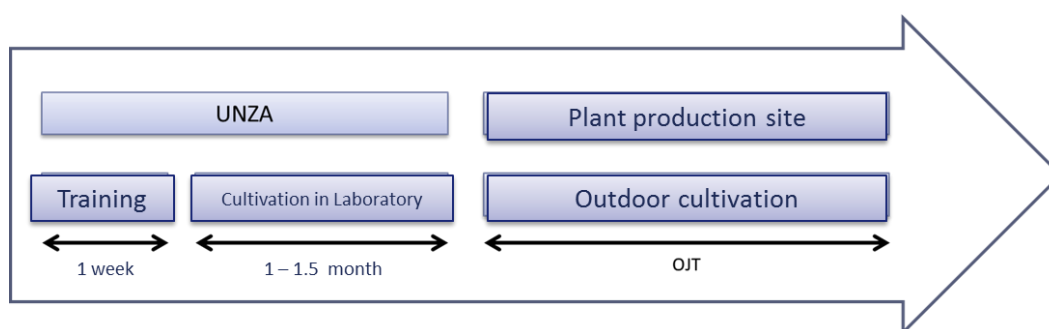


Figure 8: Program and Schedule to Transfer Production Skills

3.2.2 Production Site Preparation

The JV partner candidate, a major Zambian fish farming company, owns fishery ponds in three different locations; Kafue, Chongwe, and Siavonga. Siavonga is our first choice as a production site. Combining with the value chain of the food processing

company, also owned by the same venture, the JV can cover the entire value chain, starting from production, processing, marketing and to retailing. The fish farming company in Siavonga was founded in 2012. The number of the current employees is about 20. The company specializes in farming Tilapia fingerling, and wholesales them to other fish farming companies. In collaboration with a local NGO, the company distributes the tilapia fingerling for free of charge to support small-scale fish farmers.

The accessibility to the production site in Siavonga near the Lake Kariba is good enough even in the rainy seasons. The distance is around 20 km, and it takes around 30 minutes from the center of the Siavonga to the site. The water for fish farming is taken directly from the Lake. The total area the company owns is about 50 ha. The company owns 32 fishery ponds of which size is in 20m x 4m, and 72 in size 10m x 1.5. Including the ones under construction, there are 130 fishery ponds in total. Among the total land, only 4% of it has been cleared. The rest of the space is available for Spirulina production. If we were to construct production pools, the land has to be cleared before. The cost of land clearance will be covered by the capital.

3.2.3 Establishing the Distribution Channel for Spirulina Powder

As above mentioned, there are two phases of production; promotion, and expansion phase. In the promotion phase, priority shall be placed to establishing the “nutrition education + sales” model of the Spirulina products. Completing technology transfer is another component that has the priority during the 1st phase. When establishment of “nutrition education + sales” model and employees training are completed, the business will shift from promotion phase to expansion phase.

Harvested Spirulina is already in powder form, if mechanical dryer was employed. It has to be milled by a home-use mixer when manual drying method was employed. The Spirulina powder will be packaged to be delivered to a processing plant, where it is packaged as a final product. As shown in Figure 7, the supply channel is different according to the targeted customers. The JV company especially has to start discussing with the health sector in Zambia to establish the BOP sales channel. AFF has been in contact with MOH, MCDMCH, and MOAL through the pilot study. For the sales channel development, it will especially work close with MCDMCH as it governs the local clinics. As of today, there are several district level government offices that are expressing interests in working together on distributing Spirulina already.

3.3 Review on Business Feasibility

3.3.1 Sales Projection

The 10-year sales are projected as in the figure below. We are assuming to start generating profits from the fourth year when the production size expands. In the promotion phase, we will focus on transferring the Spirulina production skills to the JV company staff members, and nutrition knowledge as well as sales skills to clinic volunteers. The expansion phase will start from the third year which we assume the technical transfer has been completed. In the expansion phase, we will gradually increase the pool size, and extend the sales network to boost both production and sales.

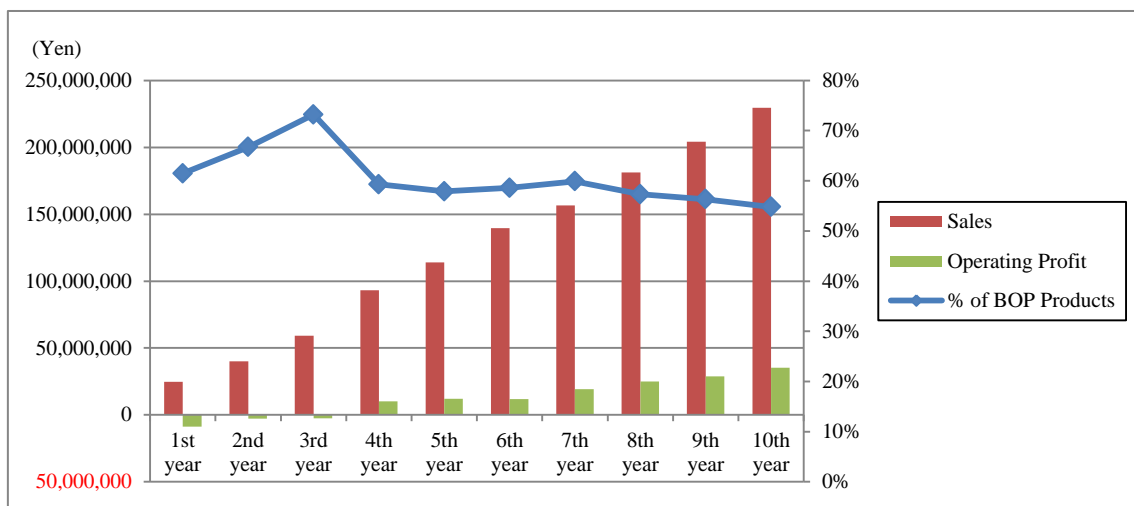


Figure 9: Sales Projection

The pool size has to be gradually expanded by carefully balancing with the density of Spirulina in the pool. If the density becomes too low by putting into an unnecessarily large pool, Spirulina could die. Therefore, pools shall be gradually enlarged every year. In the 6th year, if the demand is enough, there is a plan to mechanize the operation. The profit projection is temporarily stagnant between the 6th and 7th year as a result of the investment into the machineries.

In terms of the product, in the promotion phase, we do not limit the portfolio to only BOP products, but also launch the Spirulina powder product and corn snack product targeting MOP/TOP customers. Maize drink will be introduced from the 4th year. In 8th year, the JV company will try to diversify the account by approaching to those who provide products for school meals, such as WFP. AFF is conducting a spirulina effectiveness test on child's growth by collaborating with Scaling Up

Nutrition (SUN) network led by the international organizations, as well as providing Spirulina school meal at the partner elementary/secondary school. If the effect of Spirulina is proved⁸ through the effectiveness test, AFF plans to promote the use of Spirulina to WFP together with the school meal model developed through its own project.

The BOP supply chain is focused on providing nutrition education and Spirulina at an affordable cost, thus the profitability is relatively small. The MOP/TOP supply channel works as the stabilizer of the business. Therefore, it is important to select a partner food processing company which possesses a nationwide sales channel. It is equally important to build a strategic marketing plan that rightly stimulates the interest of the health-conscious MOP/TOPs as well.

3.3.2 Financing Plan and Analysis

In order to realize the price affordable to BOPs, the JV company plans to keep the initial investment low by applying a labor-intensive production method. The initial capital is about 50 million yen, divided by AFF and the local fishery company (allocation rate is not yet decided). The capital will be mainly used for pool construction and operational running costs. The pool construction cost will not take much since the design could be kept simple by using plastic sheets, at least until the mechanization in the 6th year. However, the operational running cost still has a room to improve.

Among the running cost, fertilizer and labor used for Spirulina cultivation takes up the large percentage. As explained earlier, the cost can be reduced to some extent. However since the industrialization of the country is still in the process of growing, most of the fertilizer available is imported. The extra cost added to import goods is making harder to lower the production cost. However, this can be solved by increasing the growth rate of Spirulina. As for the latter, the risk is harder to project since it can be influenced by political situations. Recently, some politicians are using minimum wage and welfare program as a tool to receive votes. As a result, the minimum wage for even the unskilled labor is relatively high in Zambia. The JV company will consider a method to lower the influence of labor cost by mechanizing the production in the 6th year.

⁸ Expected to be completed in June, 2016

