Project III: Local vitalization through the use of canola and biodiesel

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Executive Summary

The aim of this study is to present two cases of local oil production in small communities and draw lessons from them for the communities of farmers and producers. The organizations visited were Biolife located in Ryugasaki and Green oil Project in Tochigi, both established as Non-profit organizations. At Biolife it was possible to observe and learn about the process of the oil production, and at Green Oil Project we learned about the use of crops oils for soil remediation and also as an alternative crop to rice cultivation. From both places visited we could appreciate the high quality of the oil obtained.

The specific objectives of this study are: i) study and analyse the local production of canola, soybean and sunflower oil at a small scale under a social and an environmental scope), ii) identify the main problems that the organizations are facing and suggest possible solutions to them.

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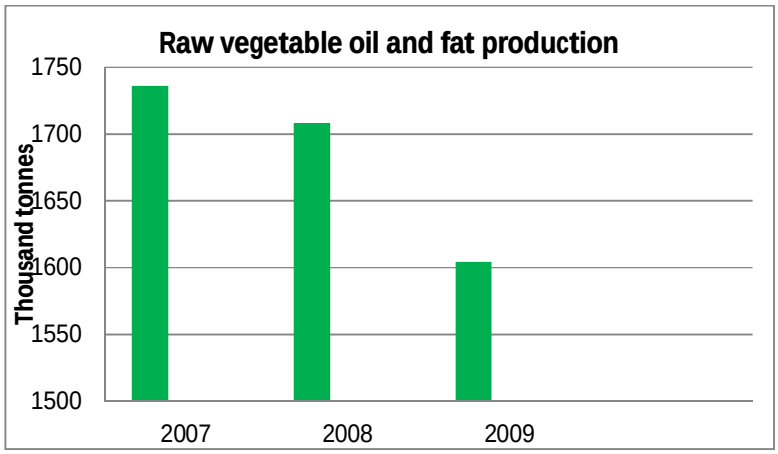
1. Introduction

Vegetable oils are used in Japan for very popular dishes such as Tempura and are produced from diverse plants like canola, soybean, oil palm, corn, rice, sesame, coconut, sunflower and olive. The total amount of soybean oil consumed in Japan was about 385 thousand metric tonnes; 1,095 thousand metric tonnes of Rapeseed oil and 30 thousand metric tonnes of sunflower oil by the beginning of the market year in 2013.

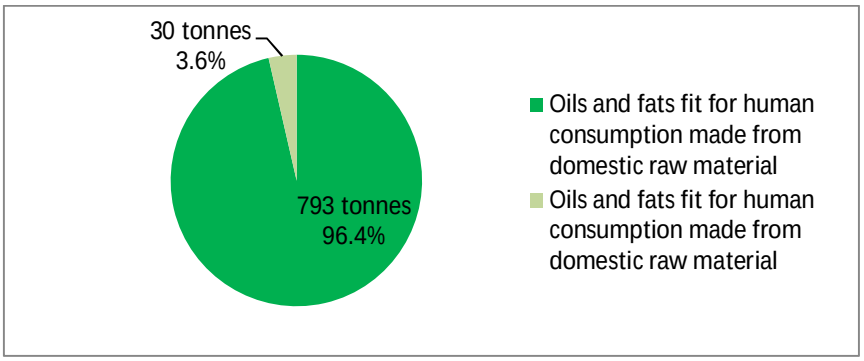
In 2009 1,601 thousand tonnes of raw oils and fats were produced in Japan for domestic human consumption. Inter-temporal changes of the production volume are shown in Figure 1.1. However, due to the changes in the government's agricultural policies and various other reasons the domestic production of vegetable oil dropped dramatically. Moreover, the largest part of oil was produced from imported raw materials (Figure 1.2). In 2009, 62 thousand tonnes of raw vegetable oils and fats fit for human consumption were produced from domestic raw materials and 1,537 thousand tonnes from imported raw. Overall, Japan's self-sufficiency ratio for vegetable oil is very low.

Figure 1.1: Inter-temporal changes of raw vegetable oil and fat production volume in Japan, 2007 to January-June 2010



Source: General Food Policy Bureau, Ministry of Agriculture, Forestry and Fisheries

Figure 1.2: Production of raw oils and fats by types of raw materials, January-June 2010



Source: General Food Policy Bureau, Ministry of Agriculture, Forestry and Fisheries

A large quantity of waste oil is generated from businesses (restaurants, shops etc.), home kitchens, schools etc. In the past, most of these waste oils were directly discarded to the waste water stream, causing water pollution which was a reason for the decreased water quality and degrading habitats. Today, oil waste is usually collected as combustible garbage after being absorbed in newspapers and coagulant products at home. Initiatives to convert waste vegetable oil into vehicle fuel have been spreading. Collecting cooking oil waste and convert it into "biodiesel" for own consumption and for sale is one of the best way to reduce the water pollution, air pollution and amount of garbage. At the same time, it will increase the Japan's energy self-sufficiency.

Today, an increasing numbers of people are interested in producing their own cooking oil locally by cultivating their own raw materials such as rapeseed and sunflower. Further, creating recycling systems to collect and convert waste cooking oil into fuel is becoming popular among local people because biodiesel is already finding a number of uses in Japan. The projects which are involved in such activities have great potential to promote local, small-scale recycling, leading to an increase, even if only slight and gradual, in Japan's self-sufficiency ratio for both food and energy supply. Therefore, these Projects are attracting keen attention as opportunities for regional revitalization, environmental education, and collaboration among citizens, governments, and companies.

The devastating earthquake and tsunami that struck Japan in March 2011 caused a nuclear disaster which left high quantities of radioactive Cesium and other toxins in the soil in Fukushima prefecture. It has been proven that some plants have an ability of absorbing radiation with its root from soil. Sunflowers, especially, show a high rate of absorption. The benefit is evidenced in the tragedy at the Chernobyl nuclear reactor leak in 1986. When most of the water in the region showed radioactive contamination, planting sunflowers on a floating raft had the capability of reducing the impact of radiation in the water up to 95 percent. Therefore, recent campaigns have been launched by civil servants and independent entrepreneurs focusing their efforts on the use of sunflowers to clean contaminants from the fallout zone.

2. Case study 1: Sunflower and rapeseed oil production in Ryugasaki, Ibaraki

2.1 Introduction and analysis of Case

Biolife is a non-profit organization (NPO), established in 2008, that focuses on oil production from grains such as rapeseed, sunflower, and canola and also biodiesel. It is located in Ibaraki Prefecture, Ryugasaki City.

Our group visited the place on October 24, 2013 where we visited the NPO's different facilities and observed the production of oil cake from the oil extraction machine (described in the following sections). One of the facilities visited was the organization's green house where different grains were laid on the ground in order to be dried. Additionally we received information about the community-oriented organization's activities which main objectives were taking care of the handicapped and enabling them to engage in activities such as baking bread.

We asked questions related to the kind of grains processed, machinery used, techniques used to remove impurities from the grains.

Alternatively, we went to see another crop field near the greenhouse, where another research was been carried out to determine how profitable could be to sow grains of sunflower out of the pre-established sowing season (winter). We could observe that the experiment turned out in poor yield compared to that of normal sowing and harvesting seasons. Unfortunately, this experiment was conducted within sudden rainy and windy weather conditions, categorized as typhoon. For this type of grains the weather conditions could affect greatly not only in terms of the yield but also threaten the normal growth of the plant. In summary, the typhoon that swept crops across Japan during August and September prompted poor results as we can see in Figure 2.1.

Figure 2.1 Sunflower field affected by the typhoon.

In the following sections we describe in detail the oil production process that we observed at this place.

1. Seed Production

a. Sowing and harvesting

An important aspect to consider is the sowing period, we could observe on the field that almost all the sunflowers were damaged by the typhoon meaning that the harvesting operations gave low yields for the subsequent oil production. Basically this was an experiment carried out on purpose with such delay in sowing period that it was then proved that in order to obtain the highest yield from the crops the standard season for growing and harvesting must be followed.

b. Threshing

After harvesting comes the threshing operation. This process is realized by a machine composed by an input for the sunflower seeds. Through this operation the seeds are separated from the stem and other matters. The step before threshing has to do with getting rid of the debris by scraping manually with a wooden hammer, in terms of efficiency the addition of mechanical procedures for this operation is not required. Once the debris were wiped out from the seeds, they are sifted by a large mesh sieve then the seeds can be put into the thresh (Figures 2.3).

c. Drying and Storing

The green house is the place where the seeds are dried by solar energy. It is a space of about 200 square meters in where the different seeds such as canola, barley that is used to produce breads and cookies, is stored (Figures 2.2 and 2.3). Other type of sunflower with different oil extraction rates and an 80% of oleic content are laid on the ground.

However, they are facing some leaking problems due to the conditions of the green house. In contrast, there is the possibility for implementing a dryer but budget is the main issue to overcome for this organization. Furthermore, somehow it could be seen as a solution to shorten the period of drying the purchase of machinery to make this process more efficient in terms of the availability when they cannot meet the demand.

Figure 2.2 Sunflower seeds in the greenhouse.

Figure 2.3 Threshing machine in the greenhouse.

2. Oil extraction

a. Grinding

The first process is the grinding of seeds by a milling machine, imported from Germany with a cost of 1.6 million yen (Figure 2.4). The oil extraction machine is provided from one side then is immediately poured out in a bucket (Figures 2.4). On the other side the product known as oil cake will be kept for other uses. This process has to be carried out twice because of the impurities that still remain after the first grinding operation.

Figure 2.4 Grinding and extraction process

In order to obtain good quality oil in terms of color, the season in which the oil is extracted must be winter season. The extraction during hot seasons could threaten the purity and somehow the appearance of the final product. Especial care must be taken when extracting oil sunflower to ward off contamination. On the other hand, rape seed oil extraction doesn't require such careful treatment.

b. Oil Storing

The oil must be stored for approximately one week for the impurities to come down to the base of the container.

c. Filtering

After the oil is stored, there is a final process to clear the oil or to check the quality that has to do with the content of micro particles of oil. The method is based on the use of high quality filter papers, so the filtering process will depend on this.

Figure 2.5 The oils after the filtering process

If the oil even after a week hasn't been completely filtered, it means that there are still some impurities floating on the upper layer of the oil. Then, this oil is taken out from that process and another filter is placed to continue with the operation for the next oil batch.

In terms of the ripeness degree, those seeds from which we have obtained greenish color oil mean that they have not reached the time required for maturation.

The production rate of the factory is nearly 5000 bottles per year (bottles of 750 ml aprox). Currently the market demand is met with the current production rate.

2.2 Identified Problems and Proposed solutions

The key issues that the organization is facing now are problems related to production like the need of machines in the greenhouse to make the drying process much more efficient.

Since the roof of the greenhouse had holes of different sizes (1cm diameter to 2cm) leaking problems are more likely to occur during rainy season. A proposal to resolve this issue would be to purchase a mechanical dryer.

In order to meet demand, we propose marketing strategies for improving labeling, and making the product more affordable for customers.

Solutions

Change of marketing strategies

- Try to display the product in special or separated shelves just before the cashier at supermarkets even though this strategy could mean higher expenses for the organization (NPO) at least for the first few months. Then, once the product has been displayed and recognized during that period, we can think of another strategy.
- If we strengthen the labeling, we will be able to give the product more recognition among customers. Because a better presentation can make a difference at the moment of purchasing a product.
- After the product has been recognized, we can consider introducing canola oil, rapeseed oil. Therefore, the introduction of another byproduct will not be so difficult.

Decrease price

- Try to sell our product directly to customers by establishing Biolife stores.

Create more awareness

- Advertise using Google AdSense and social media to convey information about the activities the organization is planning.
- Product demos from time-to-time: Organize gatherings for tasting the product by using our own mobile vehicles (kitchen wagons). For this, we should upload on the Web and on our Facebook page the day, time, place where the demos are going to be carried out; and request interested parties to assemble at the mentioned place on the mentioned day and time.
- Participating in community festivals and cooking traditional food using these oils. For this purpose Biolife can use their mobile vehicles (kitchen wagons).

2.3 Conclusions

Despite the social and environmental care approach the organization tries to convey, It might be convenient for the organization to focus on marketing strategies to empower the brand. And it could be a good idea to increase the production rate by acquiring another oil extraction machine that could enable us to somehow decrease the cost of production.

Additionally another possible solution for the organization would be to hire professionals for marketing and supporting the production sector.

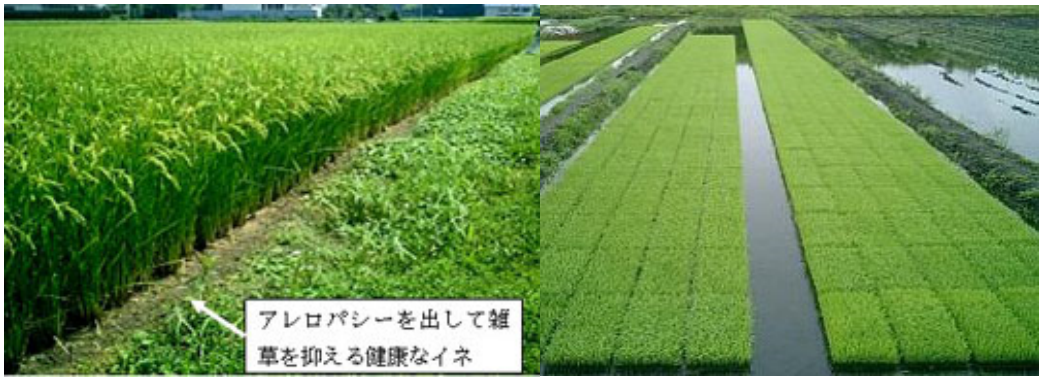
3. Case Study 2: Green Oil Project, Utsunomiya

3.1 Introduction

Before the nuclear disaster of Fukushima, about 20 farmers in Minamisoma Town (within the zone of 20-30km from the power plant), Fukushima Prefecture were involved in organic agriculture by cultivating wheat and Soybean in rotation. One third of this area was directly affected by the devastating tsunami in March 2011 and rest of the land has been contaminated by radioactive Cesium and other toxins. Northern part of Tochigi Prefecture is also considered to be contaminated. Still most of these farmers are living in this area and continue their agriculture. Soybean which was produced in these areas was sold to soya source and miso paste manufacturers in Japan. However, after the nuclear contamination previous buyers of Soybean rejected the products from these areas. Particularly, organic product consumers are very concerned about these aspects and don't tend to purchase such products. In such situation these organic farmers were very much affected. Although they cultivated and contamination was in the safety limits due to bad reputation their harvests were accumulated in the stores. The only option left for the farmers was to give up farming as they cannot sell their products and they received 10 million JPY as a monetary compensation from TEPCO for the damages. However, they couldn't rely on this compensation for longer time and wanted to continue their agriculture.

Organic paddy field (Figure 3.1) and in Utsunomiya Town has 10 ha upland and 8 ha rice field where the farmers cultivated Soybean, Wheat and Rice in 2 years rotation without chemicals, fertilizers and pesticides. This was a stable farm for about 15 years producing organic seeds for other organic farmers in Japan and considered to be the only paddy field in Japan registered by the prefecture as "organic seed producer". Overall this field has produced and distributed about 1.5 tonnes of organic seeds to farmers in the last decade. After nuclear disaster the farmer couldn't cultivate organic rice as the soils have been polluted presenting 275 Bq/kg radioactive Cesium in top 50cm and 994 Bq/kg in top 3cm.

Figure 3.1: Organic Rice field in Utsunomiya before March, 2011

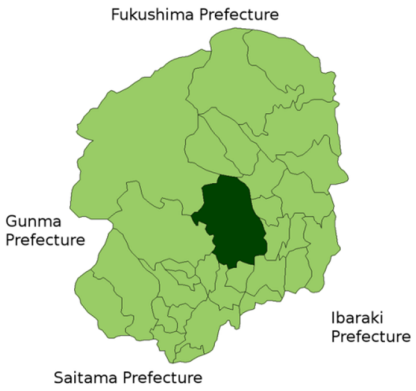


There was information available on rapeseed and sunflower plant cultivation in nuclear polluted Chernobyl area stating that *"such plants tend to absorb more Cesium but do not transfer them to produced oil*". Moreover, there were many research data available related to absorption of radioactive toxins from soil by plants such as Sunflower. In Chernobyl, the farmers practice extensive agriculture in vast areas and oil produced from plants are converted to biodiesel. However, due to lack of that much of extensive agricultural lands in Japan it is not possible to produce huge quantities of biodiesel. Following such information, a trail was carried out by planting Sunflower (May 2011) in the most hotspot in Minamisoma Town. In September 2011 the seeds were harvested to extract oil and analysed plant parts for the radioactivity and oil was checked for its quality. It was revealed that Sunflower was actively absorbing Cesium in the soil which resulted in a significant decontamination of the soil. Further, the oil was tested and showed a good quality. Therefore, the best possible opportunity for farmers to clean the soil and continue their agriculture was to produce oil crops in contaminated land areas and convert them to quality assured oil which fit for human consumption.

3.2 Analysis of Case

Green oil Project started in the organic rice field located in Utsunomiya Town, Tochigi Prefecture (Figure 3.2) was originated with an initiative to restore local agriculture and support farmers after the nuclear disaster in 2011 by a Non Profit Organization (NPO). It suggests one vision of revitalising the community by utilizing contaminated soils to produce oil crops such as canola, sunflower and soybean. In this project, oil crops are planted and harvested from Rice and other agricultural fields which have been contaminated by Cesium. Canola, Sunflower oil and Soybean oil is extracted from the harvest and sell directly to consumers to be used as cooking oil in households. These oils have very good aroma, taste and colour.

Figure 3.2: Location of Utsunomiya Town



The farmers introduced a new two years cropping rotation of Sunflower, Rapeseed and Soybean. Both Rapeseed and Soybean is also shows admirable efficiency in absoping of Cesium. Sunflower and Canola are cultivating as an alternatives to Rice and Wheat in previous rotation. Soybean is cultivating in in order to improve Nitrogen circulation in the soil. Seeds are harvested and transported to the extraction facility.

The establishment of their own oil mill became an essential part of this project as farmers couldn't rely on other commercial oil extraction companies because such companies refused to receive products from contaminated areas. At the beginning, the plan was to establish the oil mill in Minamisoma town where most of oil crops are produced. However, in the feasibility analysis it was revealed that many problems such as health concerns of workers in radiation atmosphere, effect in quality of oil and bad reputation in commercialization are associated with Minamisoma town. Finally, the oil extraction facility was established in Organic rice field in Utsunomiya town with the cost of 7.5 million JPY and help of many people (Figure 3.3). Crops produced in Minamisoma town are transported to the facility in Utsunomiya and oil is extracted (Figure 3.4).

Figure 3.3: Oil Extraction Facility

Figure 3.4: Final products

Then all the plant materials including the weeds are removed from the ground using machines and wrapped by plastics and use for side edges for cows. Some plant materials are collected and burnt to produce Charcoal in a controlled burner with maximum temperature of about 500^0C ensuring that the Cesium (released in 600^0C) is not being released to the environment. Then the ash is store in a safe radioactive facility. By following such procedure radioactivity in top soil is reduced actively compared to the scraping of the top soil (mechanical remediation).

Another vision of this project is to recycle cooking oil waste. They collect cooking waste oil (Figure 3.5), purify and used to generate electricity (Figure 3.6) to their own facility.

Figure 3.5: Collected cooking oil waste

Figure 3.6: Electricity generator from waste oil

This project suggests many elements for sustainable development: recycling, renewable energy use from biomass, soil remediation, food production, etc. This initiative has good potential to improve awareness across the country because the model for sustainable development and effort for remediation can be applicable to other local communities in Japan.

3.3 Identified Problems

Lack of Support

Although it is proved that some plants such as Sunflower actively absorb Cesium from soil (effectiveness of soil remediation) and farmers are willing to involve in such projects (intention of local people) they still don't have enough encouragement and support. Currently they aren't getting any support either from the government to improve such projects or from media to popularize such projects and create awareness among people and other organizations.

Lack of Awareness

Recently, people have become very keen about the presence of radioactive Cesium and toxins in the agricultural and dairy products they consume. Lack of scientific research proving non-transference of radioactive Cesium and other toxins to oil is a drawback which results in less popularity of oil products among people.

There are many local people, organizations and other volunteers with intention of involving in soil remediation projects in contaminated areas. Therefore, lack of awareness, scientific evidence and publicity related to absorption of radioactivity by plants and such projects is another problem associated with the popularity of the project.

Production, Distribution and Demand

At the moment, the whole capacity (20,000 bottles per year) of the oil production facility is not being utilized due to lack of demand. The produced oil is directly sold to the consumers within the extraction facility itself without going through shops or supermarkets which reduce the number consumers and demand.

High Price

Product price is high compared to the oils produced from imported raw materials and imported oils sold in supermarkets. The feasibility of reducing the cost depends on increasing the production and also selling the oil cake as a fertilizer, something that could

reduce the cost up to a 50%. However the head of the organization has mentioned that he wishes to maintain the payment to the farmers.

3.4 Proposed Solutions and/or Recommendations

Japan imports most of its raw materials to produce oil and has very low self-sufficiency in oil. There are many health benefits of using of Canola, Sunflower and Soybean which are very rich in Vitamins and very low in Cholesterol. Therefore, there are many opportunities, to increase the oil production among rural communities in Japan.

Currently if the organization could get more support from the government, people from other communities and the oil buyers they could have an overall positive growth and enter in a more stable phase as an oil business. At the same time they could promote the use of these oil crops as reducers of the soil contamination by cesium within the farmer's community. This could also go hand in hand with creating more awareness.

About increasing the demand as it was suggested in the study case from Ryugasaki it is necessary to have more advertisement and start selling at supermarkets or at food fairs. According to a Mintel's Global New Products Database (GNPD) in 2011, there were 16 new cooking oil products introduced in Japan, showing that the introduction of new oil products is welcomed in the Japanese market.

3.5 Final Conclusions

The researched conducted by this organization showed that use of oil crops as a soil remediation method is very relevant in minimizing the effects of the contamination created by the nuclear disaster of Fukushima. Thus supporting this particular organization and projects alike could be very relevant in revitalizing the farmer's communities affected and also for the local oil industry.

Finally from these two cases we could draw important lessons for the farmer's community and for us as students. We also could appreciate the importance of these projects in terms of their social contributions. Thus it is important to include other aspects of a community into local production projects, as social and environmental care.