MANAGING TRACEABLE SYSTEM FOR ORGANIC FRUIT AND VEGETABLE PRODUCTS IN TAIWAN

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ABSTRACT

Organic agriculture emphasizes the balance of the ecosystem and the sustainability of the environment. If and only if humankind supports sustainable development of the environment, then the environment may feed us with enough and safe food permanently. In the past decades, organic products have become more and more popular around the world as well as in Taiwan. There are 5,951 ha of farmland that were certified organic in Taiwan in 2013. Since the Organic Act enforced in 2007, all steps in the supply chain of organic products and its processed products must be in accordance with the act, and certified by the control bodies approved by competent authority. It not only maintains the integrity of the organic process, but also provides consumers with a convenient and efficient way to trace back to the origins of products they have got. Furthermore, by taking advantage of the well-developed IT industry and cloud computing, QR code system has been incorporated as an easy and quick method for tracing organic products in Taiwan.

Keywords: organic agriculture, QR code, traceability, accreditation, certification

INTRODUCTION

Agriculture is the most basic economic activity as well as the most important food source for humankind. As long as you need to eat, you are unable to keep away from agriculture. Food stuff is all-important to human beings and most of us eat three meals a day even if we don’t like to spend money. You can extend the lifespan of both yourself and our environment simply by following the principle of “paying attention to health and being eco-friendly” when you buy food stuff. World population is expected to reach 8.9 billion by 2050 (United Nations Department of Economic and Social Affairs, 2004). It has always been a big challenge for us to grow sufficient food and so will to be in the future. Basically, agricultural production is affected by factors, such as climate, soil, water and microorganism, etc. which cause unstable yield. Therefore, farmers are forced to use chemical pesticides and fertilizers for protecting crops so as to ensure a stable quantitative and qualitative output. However, most chemical substances are harmful to human health, soil organism, and even the whole environment. We are devouring the resources on the earth regardless of the negative effects of chemicals, which is visible or invisible, sensible or insensible. Each meal of a person costs 800 liters of water, 1.3 liters of diesel, 10 kg of top soil and 0.03 g of pesticides (Julian 2014). It’s really a dilemma, considering food security, food safety and natural resources at the same time.

The International Federation of Organic Agriculture Movements (IFOAM) has defined the term “organic agriculture”. It is a production system that sustains the health of soils, ecosystems and people. It relies on the ecological processes, biodiversity and cycles to local condition rather than the use of inputs with adverse effects. “Organic Agriculture” combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all those involved. Also, IFOAM points out that organic agriculture is based on four principles. These principles are the roots from which organic agriculture grow and develop. First, the principle of HEALTH: Organic Agriculture should sustain and enhance the health of soils, plants, animals, humans and the whole planet as one and should be indivisible. Second, the principle of ECOLOGY: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. Third, the principle of FAIRNESS: Organic Agriculture should built on relationships that ensure fairness with regard to the common environment and life opportunities. Fourth, the principle of CARE: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. Based on the definition
and the core spirit of organic agriculture, it intends to create a world where people and all organisms can live their lives prosperously and permanently, where the environment surrounding us can feed us forever. So, the simplest definition of organic agriculture is that “under no circumstance should chemicals be involved in any part of the process of the organic product supply chain”. This definition and practice should be carried out during the organic operation around the world as well as in Taiwan.

While the economy and information technology have been improving, people are increasingly aware of the safety of agricultural products. Therefore, organic agricultural products have become familiar and popular in recent years around the world. A study shown in the “British Journal of Nutrition” states that organic crops and crop-based foods, including fruit, vegetables and cereals, are up to 60% higher in a number of key antioxidants than their non-organic counterparts. In addition to higher in antioxidants, organic crops contain significantly lower levels of toxic heavy metals (Baranski, 2014).

ORGANIC AGRICULTURE IN TAIWAN

The Council of Agriculture (COA) in Taiwan has established the necessary organic regulations and laws in 2007 in order to facilitate the development of organic farming. These regulations and laws are the basic principles for developing organic farming. COA is the accreditation body and the Taiwan Accreditation Foundation (TAF) has been authorized as the only compliance assessment organization for Accreditation body by COA. TAF manages all organic certification bodies, including production, processing, packaging, and distribution certification, which are approved by the COA. The cultivation area of organic crops in Taiwan has been steadily expanding due to market needs, consumer awareness, health concerns and environmental issues. Till the end of 2013, COA had approved 12 cropping certification bodies and one livestock certified body. The total area of organically certified cropping in Taiwan reached 5,951 ha, which included rice (2,060 ha), vegetables (1,963 ha), fruit (835 ha), tea (448 ha), and others (645 ha) (Table 1). It's more than two times of the area of 2,356 ha five years ago in 2008. It even increased more than five times over the last decade, the area of 1,092 ha in 2003. However, the organic farming area in 2013 occupied only 0.7% of the total arable land in Taiwan. It's relatively low when compared to the percentage of Italy (1,167,000 ha, 9.1%), Spain (1,593,000 ha, 6.4%), Uruguay (930,000 ha, 6.3%), Germany (1,034,000 ha, 6.2%), Australia (12,001,000 ha, 2.9%), Argentina (3,637 ha, 2.6%) (Fig.1). On the other hand, Taiwan also imports certified organic products from other countries which are recognized as one with equivalent standards. For the management of imported organic agricultural products, the Agriculture and Food Agency (AFA) is responsible for accepting applications and for carrying review documents in regard to the issuance of certifications as required by the Imported Organic Agricultural Product and Organic Agricultural Processed Product Management Regulations. Most of the imports are from the USA, followed by New Zealand, Canada, Australia and Germany. The import quantity reached 9,982 tons in 2013, up from 5,056 tons in 2007. It increased nearly two times in this six-year duration. The imported items were mainly cereal grains, processed grain products and drinks.

Table 1. The area of major crops organically cultivated in Taiwan
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<table>
<thead>
<tr>
<th>Year</th>
<th>Rice</th>
<th>Vegetable</th>
<th>Fruit</th>
<th>Tea</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>843</td>
<td>438</td>
<td>258</td>
<td>125</td>
<td>349</td>
<td>2,013</td>
</tr>
<tr>
<td>2008</td>
<td>949</td>
<td>518</td>
<td>296</td>
<td>140</td>
<td>453</td>
<td>2,356</td>
</tr>
<tr>
<td>2009</td>
<td>1,085</td>
<td>913</td>
<td>289</td>
<td>169</td>
<td>504</td>
<td>2,960</td>
</tr>
<tr>
<td>2010</td>
<td>1,317</td>
<td>1,435</td>
<td>462</td>
<td>219</td>
<td>601</td>
<td>4,034</td>
</tr>
<tr>
<td>2011</td>
<td>1,653</td>
<td>1,692</td>
<td>613</td>
<td>263</td>
<td>794</td>
<td>5,015</td>
</tr>
<tr>
<td>2012</td>
<td>1,763</td>
<td>1,779</td>
<td>687</td>
<td>400</td>
<td>929</td>
<td>5,585</td>
</tr>
<tr>
<td>2013</td>
<td>2,060</td>
<td>1,963</td>
<td>835</td>
<td>448</td>
<td>645</td>
<td>5,951</td>
</tr>
</tbody>
</table>

It is convenient for consumers to choose organic agricultural products, which are labeled “CAS Organic”. In order to ensure the safety and quality of locally produced organic products as well as of the imported ones, and also to strengthen consumers’ confidence and protect consumers’ rights, COA establishes examination plans for the safety and labeling of organic products every year. About 2,000 products have been sampled from farms, markets and customs annually for examining pesticides and additives residue. The results showed that around 99% of the examined samples had complied with the Taiwan’s organic regulations. More than 96% of the certified products in Taiwan have in accordance with the national pesticide MRL (maximum residue limit) (Table 2). The competent authority in Taiwan also proposed measures to boost the development of organic agriculture. Measures for promoting organic agriculture include assisting farmers to apply for certification of organic products, enlarging the specialized organic production zones, holding educational classes for farmers, upgrading related cultural techniques, and promoting the use of CAS organic logo. The Agency also encourages the involvement of religious groups, voluntary workers, and business sectors in the extension of organic agriculture production.
Table 2. The percentage of certified products met with the maximum residue limits of pesticide and chemicals.

<table>
<thead>
<tr>
<th>Year</th>
<th>GAP</th>
<th>TGAP</th>
<th>Organic</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>93.3</td>
<td>---</td>
<td>99.4</td>
<td>91.8</td>
</tr>
<tr>
<td>2011</td>
<td>96.4</td>
<td>97.1</td>
<td>99.4</td>
<td>93.8</td>
</tr>
<tr>
<td>2012</td>
<td>96.1</td>
<td>100</td>
<td>99.1</td>
<td>93.3</td>
</tr>
<tr>
<td>2013</td>
<td>95.2</td>
<td>96.5</td>
<td>98.9</td>
<td>92.6</td>
</tr>
</tbody>
</table>

**TRACEABLE SYSTEM FOR ORGANIC PRODUCTS IN TAIWAN**

Ever since the “Agricultural Production and Certification Act” was enforced in January 2007, COA has further finalized nine daughter regulations, including the “Organic Agricultural Product and Organic Agricultural Processed Product Certification Management Regulations”, and “Imported Organic Agricultural Product and Organic Agricultural Processed Product Management Regulations”. This is to increase the international competitiveness of organic products. This provides an environment for further sustainable development of organic agriculture in Taiwan. The promotion of traceability in agricultural goods is one of the main itineraries on food safety projects in Taiwan. Taiwan has a well-developed Information Technology (IT) industry. By taking advantage of the industry, we introduce it to the organic agriculture community for tracing the growers or operators of organic products. A QR code system has been incorporated to the supply chain of organic products in Taiwan. Consumers can trace back origins by the QR code labeled on the products’ containers or packages to know where the products come from immediately.

**Traceability of the imported organic products**

According to “Imported Organic Agricultural Products and Organic Agricultural Processed Products Management Regulations”, once an agricultural product is to be imported and sold as organic, the importer shall complete an application form and attach the following documents in duplicate form and apply to one of the branches of AFA for reviewing prior to sale:

a. A photocopy of a company license or business registration demonstration document;

b. Certification demonstrates that the imported agricultural products or processed agricultural products have been granted as organic; The certification document shall include the following items: (1) The name and address of the agricultural product business operator; (2) The name and batch number of the product, and the percentage content of organic raw materials in processed agricultural products; (3) The weight or volume of the product; (4) The name of the importer or buyer; (5) The name and address of the certification body; (6) The date of issuance;

c. The photocopies of the import certificate slip of the import declaration.

d. Other documents required by the central competent authority.

The branch of AFA shall issue an organic labeling approval document to the applicant when the imported organic agricultural products have passed reviewing. The organic labeling approval document shall state the following items:

a. The name and address of the importer;

b. The name of the agricultural product operator in foreign countries;

c. The name and batch number of the products;

d. The weight or volume of the products;

e. The name of the certification body;

f. The number of the organic labeling approval document.

Before the imported organic products release to market, the language used for labeling shall be standard Chinese, which may be supplemented by foreign languages or commonly
used symbols. The container or packaging of imported organic agricultural products shall include the following statements on the labels at the time of sale:

- Product name;
- Names of ingredients;
- Name, telephone number and address of the importer;
- Place (country) of origin, except for those of which the labeling of production factories’ addresses could signify the place (country) of origin;
- Name of the certification body;
- The number of the organic labeling approval document;

Thus, consumers or anyone can easily know the origin of the product and its certification body by just inspecting the container or package of the imported product. We can also trace back to find the name and address of the importer, certification body and the agricultural product business operator in foreign countries by inspecting the label on the package or by reviewing relevant documents (Fig. 2).

![Image of labeled imported product]

**Fig. 2. The labeling of imported certified organic products which were sold as packaged goods.**

**Traceability of the locally produced organic products**

According to Organic Agricultural Products and Organic Agricultural Processed Products Certification Management Regulations, when an organic agricultural product or organic agricultural processed product is certified, the certification body shall sign a contract with the applicant and issue an organic agricultural product certificate based on the categories of the organic products. The certificate shall state the following items:

- The name and address of the agricultural product operator, and the name of its statutory responsible person;
- Location of certification site;
- The product category and item;
- The period of validity;
- The name of the certification body;
- The certificate number.

The container or packaging of locally produced organic agricultural products shall include the following statements at the time of sale:

- Product name;
- Names of ingredients;
- Name, address and telephone number of the agricultural product operator;
- Place (country) of origin, except when the address of the production factory or certification site is labeled in a way that the place (country) of origin of the product can
be identified;
e. Name of the certification body;
f. The certificate number of the organic agricultural product certification;

By means of the aforementioned labeling and displaying measures for packaged organic products (Fig. 3), consumers are well informed of the products they have got. They are able to know where the products come from and which organization certified it.

![Image of packaged product](image)

**Fig. 3.** The labeling of locally produced certified organic white fungus (*Tremella fuciformis*) which was sold as a packaged good.

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**Traceability of sold organic products in bulk**

In the case of organic products to be sold in bulk at regular commercial places, a photocopy of the organic agricultural product certificate and a sign near the place of display and sale must be displayed to state the product’s name and the place (country) of origin (Fig. 4). Besides, the height and width of the characters for marking the place (country) of origin shall not be less than 3 cm.
Tracing by QR code system

The IT industry and cloud technologies have been well-developed in Taiwan. They were widely used in many sectors, including restaurants, logistics, industries, marketing, etc. Mobile devices (smart phone or tablet) are very popular in Taiwan. Almost everyone has at least one such device on hand. If consumers can get more information about the organic products they bought easily and quickly, they get more detailed information about where the organic vegetables and fruit grow and who grows them. It will impact positively to consumers, subsequently increase the consumers’ interest in organic agriculture, and help boost the development of the organic industry. AFA has set up a simple web page for every certified organic farm under the Directory of Taiwan Organic Farm website (www.i-organic.org.tw). The operator of an organic farm may get a unique QR code from the website and print it on the container or package of their products. Consumers can read the product’s information on the simple web page right after shooting the QR code and connecting to the website (Fig. 5). Furthermore, the farm operators are allowed to offer more detailed information for their farms, such as farm locations and how to get there, how many kinds of crops they grow, when the crops would be harvested, and other information for promoting their farm and its products (Fig. 6). According to the result of a survey conducted by National I-Lan University, the more consumers know about the farms, the more they will love the products. So, it’s not only an efficient way for tracing the sources of the organic products, but also an efficient tunnel for communicating with consumers and promoting their products.

![Fig. 4. The display and sale of locally produced (left) and imported (right) certified organic product which were sold in bulk.](image)

![Fig. 5. The flow chart of QR code tracing of organic products](image)
CONCLUSION

Sustainability of agricultural management has long been a hot issue for governments, scientists and consumers for decades. FAO forecasts that the world population will reach 11 billion by 2050. It has always been a big challenge for us to grow sufficient safe food in the past as well as in the future. However, the agricultural production is affected by factors, such as climate, soil, water and microorganisms, etc. The food supply became more and more unstable due to the impact of the abovementioned factors which are beyond the control of human beings. That is why food prices fluctuate sharply these years. According to researches, food will change more in the next 100 years than it has in the last 1,000 years due to climate change and food shortage. More and more "unrecognizable" menu is going to appear in the future. Nevertheless, agriculture is still and will still be the major source of human food. Also food safety will still be the top priority when consumers choose their daily needs. Henceforth, sustainable and integrated agriculture practices must be adopted to minimize the food hazards and maximize its safety. More and more people around the world pay more attention to the sustainability of our environment no matter where they are from or what they work for. So, organic agriculture is more and more popular in Taiwan as well as around the world. The basic principle for organic operation is that no chemicals, especially the fertilizers and pesticides, are allowed in any part of the supply food chain. The real meaning of organic agriculture emphasizes the balance of the whole ecosystem but not just the need of humans. Taiwan has exploited the cloud and IT technologies on the tracing and promotion of organic products. We think it is the beginning of incorporating modern advanced technology with the development of sustainable environment. We will get much smarter technologies to be used step by step in managing a green planet in the future. Human beings can’t survive and be prosperous forever on the earth unless we manage the environment and all of the organisms properly and sustainably.

REFERENCES

