PROGRESS OF APPLICATION OF GAP AND TRACEABILITY IN TAIWAN

Huu-Sheng Lur
Department of Agronomy, National Taiwan University
No. 1, Section 4, Roosevelt Road
Taipei 107, Taiwan ROC

ABSTRACT

In Taiwan, the recent frequent occurrences of contamination, pollution and blending of products of different origins have raised public awareness on the safety and reliability of food production systems. One fundamental solution to cope with these public concerns is to develop effective good agricultural practices (GAPs) in crop production systems. Taiwan has been adopting the GAP concept since the 1990s, and has launched a basic GAP logo certification system in fruit and vegetable crops. Recently, the concepts of traceability and ecological sustainability have also been recommended in agricultural management systems. Thus, a new integrated GAP system, the Taiwan Agriculture and Food Traceability System (TAFTS), has been developed. The system is a Hazard Analysis Critical Control Point for the well being of humans and the ecology, and it includes an information and communication technology based management and traceability system. TAFTS covers all directions from farming to food processing, delivery, sales and up to consumers’ tables. This report reviews the historical development of Taiwan’s GAP, introduces the schemes of GAP and TAFTS as well as challenges and discusses the prospects of their implementation.

Key words: crop production, GAP, traceability, Taiwan

INTRODUCTION

Contaminations of pesticides, heavy metals and microorganism have been more frequently reported in Taiwan. As well, public awareness on food safety and ecological balance has been more pronounced. Direct effects of these have been the damage of public confidence on crop products and the reduction of economic benefits for farmers and producers. Thus, it is urgent to develop effective crop production systems to meet farmer and consumer requirements.

Advanced good agricultural practice (GAP) systems have been established in developed countries through the years. The advanced GAP systems should provide a prominent solution for the current problems occurring in Taiwan. Since the 1980s, Taiwan has been adopting the GAP concept and applying related practice managements in several crops, mainly fruits and vegetables. Although Taiwan has accumulated certain basic experiences related to the GAP concept, the development and practice of a modern GAP system are still in their infancy.

Recent ideas on sustainability and traceability have been raised in the agricultural management systems of advanced countries. In Taiwan, the traceability system has also been proposed and pilot projects have been performed on several crops since 2004. This report discusses the progress of GAP application, reviews Taiwan’s traceability system and takes on the challenge and future work.

CURRENT STATUS OF CROP PRODUCTION

Taiwan is located in the subtropical area, with the Tropic of Cancer crossing through the southern part of the island. In 2004, the island had 836,000 hectares of cultivated land. Rice is still the largest grain crop, both in area planted and the amount of production, which is about 17 percent of the total agricultural production.
values. Planted area for rice is around 260,000 hectares, with a total production of 1.43 million metric tons per year. The planted area of rice, however, has been decreasing recently due to the fallow-encouraging program for the second crop.

On fruits and vegetables, annual planted areas total to 165,000 hectares for vegetables and 219,000 hectares for fruits, producing 3 million metric tons of vegetables and 2.7 metric tons of fruits per year. The productions of vegetables and fruits fluctuate and are mostly driven by market prices.

After joining the World Trade Organization (WTO) in 2004, Taiwan has imported a significant amount of crop products. Some 340,000 metric tons of vegetables and 420,000 metric tons of fruits (including their preparations) were imported in 2004. Lower prices of imported crop products have significant impacts on the profits and culture interests of farmers.

**CHALLENGES IN CROP PRODUCTION**

**High Cost of Production and Market Prices**

The rapid growth of economic development has led to a higher input in agricultural production, which brought about higher prices of products in Taiwan. The unit price of rice in Taiwan, for example, is around three to five times higher than in international markets. The higher product prices decreased Taiwan’s competitiveness with other countries.

**Aging Farming Workforce**

The average age of farmers in Taiwan has increased along with economic development. Four-fifths of professional farmers are more than 45 years old and more than one-third of professional farmers are older than 65. Lower income from farming is a major obstacle for attracting the young generation. Nevertheless, new management concepts have been incorporated into crop production systems, attracting the young generation to the industry.

One of the new concepts is the input of information technology (IT) and the fast-delivering system that create e-markets of crop products. The integration of IT and fast-delivering system significantly increases market opportunity and reduces costs between farmers and consumers.

Higher benefits and social recognition of organic farming have also attracted the young generation to enter into the farm business.

**Growing Consumer Awareness on Food Safety and Quality**

After the 1980s, the cost of glossy economic growth began to surface in Taiwan. Various kinds of industry-related pollution and agriculture-related pesticide contaminations were reported. In Taiwan, food safety and quality have become major considerations for most consumers.

**Rising Public Concerns on Environmental Sustainability**

Global climate change has been receiving significant public concern. Issues such as agricultural land erosion, wildlife protection, rationing of water resources and sustainability of land productivity are all impacting on crop management systems. More rigid regulations such as limitation of pumping groundwater, higher standards for agrochemical applications and wider and higher frequency of safety inspections tend to be imposed on crop production systems in Taiwan.

In dealing with these challenges, Taiwan has to have an integrated strategy to lower production costs, encourage the young generation, ensure food safety and maintain agroecological sustainability. The emerging advanced GAP system, integrated with modern technology, is expected to be a prominent solution.

**CURRENT STATUS OF GAP IN TAIWAN**

**Initiation**

The original concept of GAP introduced in Taiwan was related to the transition of the development of crop production. Before the 1980s, the major objective of crop production was the improvement of yield. Along with the rapid enhancement of agricultural technology, the amount of crop production gradually exceeded market demands, and product prices
and farming costs surpassed those of other countries. Nevertheless, the rapid growth in industry and agriculture also imposed potential negative effects on human and environmental safety.

Food contamination such as the famous ‘cadmium rice’ detected in southern Taiwan and pollution began to emerge in the late 1980s. These safety issues raised public awareness on crop management systems. Thus, the main objective of crop production has turned into the elevation of safety and quality in the 1990s.

The first GAP system was introduced in the early 1990s and the formal GAP logo certification system began to be implemented in 1994. The logo, in Chinese, is pronounced “Gee Yuan Pu,” meaning fortune and good garden. The pronunciation was taken from the initials and pronunciation of “good agriculture production.” The logo was formally registered in 1993 and patterned in 2003 by the Agricultural Chemicals and Toxic Substances Research Institute, which manages the logo certification system.

Rationale of the Taiwan GAP

The objective of the original Taiwan GAP, a logo-certification system, was to ensure the safety of crop products, mainly fruits and vegetables.

The green leaves of the logo symbolize agriculture, and the three circles refer to 1) suitable planting time, location and genotype; 2) reasonable pest management; and 3) appropriate timing of harvest. The three circles also mean assistance in compliance, inspection and regulation enforcement.

For farmers, the logo represents their commitment and contribution. For consumers, the logo represents a reliable safety index for consumer’s choices. After farmer groups pass the agrochemical inspection and reviewing processes, they are granted the logo and they should use it on their products.

Scheme of the Taiwan GAP System

Fig. 1 presents the whole scheme of the present GAP system for fruit and vegetables. Its components are explained separately, as follows:

Applicant. The certification is based on the principle of stake-sharing. Application is only open to farmer groups. All members of an applying farmer group are stakeholders sharing the responsibility of the group. The logo has only been issued to fruit or vegetable farmer groups so far.

Quality requirement of applicant. An applicant should submit documents of the following: 1) results of agrochemicals inspections; 2) records of attendance to workshops or training courses related to methods of agrochemical application; and 3) records of application of agrochemicals on their farms for at least the last three months.

Regulations and standards of farming process. All the recommended/standard culture and management processes for every fruit or vegetable crop are designed and modulated by the governmental district experimental station. Applicants should attend the training courses and follow instructions of extension specialists. District experimental stations have been designing standard operating processes for each fruit or vegetable crop.

Regulatory institutes. County government is responsible for issuing the certification and for controlling the amount of logo tags released to participant farmer groups. The Agricultural Chemicals and Toxic Substances Research Institute is responsible for the inspection and for the exchange of information among farmers, government offices and consumers, including the maintenance and updating of the official GAP Web site, http://www.tactri.gov.tw/.

Contract. After the final review, certified farmer groups should sign a one-year contract with the county government. The contract may be renewed and continued every two years.
Sanctions. Any non-compliance (or violation) with regulations can result in the suspension of the certificate and logo. Several contamination or pollution events may be charged by the government according to related laws.

Development of GAP in Taiwan

After more than ten years of extension in 2004, out of a total of 4,499 farmer groups, around 30 percent or 1,691 of them joined the GAP logo program (988 fruit farmers and 703 vegetable farmers). The organic system, which, in general, meets the benchmark of GAP standards, has 954 registered farms or farmers. About 1,246 hectares have been under an organic system. The numbers of GAP farms and organic farms are still growing because of higher market prices and the public concern on food safety and environmental sustainability. Regarding specific crops, tea for example, 32 of 1,820 tea farmer groups, accounting for 30 percent of the total area, registered in the GAP program (Fig. 2).

Comparison Between Present Taiwan GAP System and Modern GAP Concepts

As mentioned earlier, our GAP system was established in the early 1990s. Several features need to be reassessed and restructured compared with the modern principles of GAP, as follows:

Incorporating the HACCP operation.

The old Taiwan GAP system was based on the management techniques of the 1980s. It was largely a product safety-oriented management system rather than a process safety-oriented system. The main purpose of the old protocol was to reduce the amount of residues of agrochemicals to a level lower than the requirement of food safety regulations. The application of agrochemicals was a major concern of the management protocol.

Our old system was relatively ‘gross’ compared with the modern Hazard Analysis Critical Control Point (HACCP)-based system. According to the HACCP concept, new process safety-oriented management protocols for every crop should be re-established. New protocols should have higher efficiency and precision on cultural management.
Integrating the concept of agro-ecological sustainability. The current GAP logo certification system focuses mainly on the safety of products, and may neglect the potential impacts on the environment. Advanced scientific studies have revealed the complexity of the sustainability of cropping systems, fields and the environment. The principles for maintaining field/environmental sustainability should be incorporated in the HACCP regulations of our GAP system.

Integrating an ICT-based traceability system. In the old system, which is still used today, only ‘gross’ paper records of management processes are performed and can be traced. It is difficult to pinpoint unsuitable or even contamination steps along the crop culture process. In addition, mutual communication between farmers and consumers is slow and ineffective. New ICT tools should enable the effective direct connections between farmers and consumers, especially on the traceability of product safety and quality. Taiwan holds advanced ICT and is capable of rapidly establishing e-based traceability of its agricultural production system.

**TRACEABILITY SYSTEM OF CROP PRODUCTION IN TAIWAN**

**Rationale**

In general, traceability is not new to Taiwanese farmers. Many of these farmers are used to writing and keeping records of their farming processes. The main objectives of keeping records have been to improve management efficiency, improve culture techniques and...
increase profits. As explained earlier, Taiwan has applied the GAP system since the early 1990s in order to reduce product contamination of agrochemicals and elevate consumers’ confidence.

Since the late 1990s, a significantly higher frequency of food contamination events has occurred in Taiwan and the world (such as mad cow disease). Public awareness on food safety and environmental sustainability has apparently rose along with the rapid social economic growth in Taiwan. The public, thus, expects more transparency on food production processes. Government regulatory units require a more precise and efficient solution to reduce safety risks and maintain environmental sustainability.

Further, after accessing into the WTO in 2002, Taiwan has joined the international exchange of crop products, making market management more complex than ever. The old version of Taiwan GAP can no longer meet these requirements. Thus, the integration of an advanced traceability technology, including the HACCP concept and ICT, is one of the important solutions.

In facing the new challenges on food safety and environmental sustainability, Taiwan has launched an ambitious project called “Safe and Healthy Agriculture.” This is part of the whole national program, “Healthy Taiwan.” With its high prestige in ICT development, the Taiwanese government has decided to construct an ICT-integrated agricultural traceability system, and merge it with a redesigned and HACCP-based modern GAP farming system. The whole concept and perspective of the government can be viewed on its Web site (in English) http://eng.coa.gov.tw/./themes/safety/index.php.

**Traceability System Scheme**

Taiwan Agriculture and Food Traceability System (TAFTS). This is the core structure that integrates the complex components of the Taiwan traceability system. The system connects databases from farmers, farmer groups, inspectors, food producers, supply chains and consumers. The system has recently been opened to the public on the Web site (in Chinese) http://vips.coa.gov.tw/index.jsp. A long-term goal of the system is to build up international quality images of Taiwan’s agricultural products.

Fig. 3 shows the whole coverage and major components of TAFTS, which covers all agricultural products that include crops, animals.
and fishery. The whole system is designed to consist of at least five basic components such as production, food processing, delivery, sales and consumers. It meets the “farm to table” concept. The principles of HACCP are required to be applied in the management processes for all components. All the data records are managed via a modern IT environment, as explained in the next section.

Data management of TAFTS. The data management scheme of TAFTS is shown in Fig. 4. The government is responsible for constructing the hardware and software of core data/record system (dash line box) and helping build the facilities and providing incentives for other sectors. The core system also integrates databases and servers of other components of TAFTS such as food processing and delivery. Servers/PCs of farmer groups are the interface between farmers and the core system. Most important, the construction of the whole system is collaborated with the IT industry.

Traceability of GAP crop production. Crop production is the starting component of the whole TAFTS. Taiwan is updating its GAPs for almost every crop. The scheme of record data management is presented in Fig. 5. The main central processing unit is to be connected to the core data management system, as shown in the previous figure, and is accessible to other sectors such as food processing or consumers.

CASE STUDY IN RICE PRODUCTION

Two major pilot projects were performed in 2004, one on a vegetable farmer group and the other on a rice farmer group. The rice project was conducted with the farmer group Silver River located in eastern Taiwan, a famous area producing high-quality rice. Silver River is an organic farm with 66 farmer-members. All the farmers joined the program. The electronic system was designed and constructed by the
Institute for Information Industry of Taiwan. More than five training courses were held to teach these farmers how to fill lists of cultural processes, including fertilizer and pesticide application. Chemistry inspection was performed by an independent government institute. Data records were transferred to a computer server by the group manager using a PC or PDA. In addition, a monitoring station was installed in the paddy field. The station keeps recorded temperatures, light intensity, humidity, among other data, within the culture period. The station also has a camera recorder to show real-time images of the field.

The system has been open to consumers since late 2004. Using a PC or monitor in supermarkets, consumers can check the records of the cultural process and chemical inspection for every small bag of product with a series number on the Web site [http://www.organic-rice.com.tw/index1.htm](http://www.organic-rice.com.tw/index1.htm). Consumers can even see a real-time video image of the field.

Since the announcement of the traceability system, total sales of this farmer group has soared by more than 10 percent. The fast-delivery sale section of Silver River has risen by 40 percent. Silver River has become one of the most famous rice brands in Taiwan.

**Current Status of GAP Implementation**

After the successful cases in 2004, the government has decided to extend the traceability system to 64 crops. The types of crops and their corresponding farming locations can be found in the official Web site [http://eng.coa.gov.tw/./themes/safety/index.php](http://eng.coa.gov.tw/./themes/safety/index.php). The standard operating process for each crop has been established. Farmers have to follow the standard operating process, fill out various operational records and checking lists and upload the data to the TAFT system. Due to the continuously emerging food safety events...
since late 2004 and 2005, the government has decided to implement the traceability system to the animal and fishery production industries. The traceability system has become prominent in the Taiwanese agricultural industry.

**CHALLENGES AND PROSPECTS**

Taiwan is vigorously establishing its traceability system in agricultural production. Several elements are crucial to the success of this system:

*Reliability of data records.* Only ‘true’ data can ensure real traceability along the complex production chain and build up consumer confidence. Internal and external audit and inspection should be strengthened to maintain the reliability of the data released. Since 2004, intensive training courses and workshops have been opened for various stakeholders such as farmer groups, the food industry, the ICT industry and consumers. According to a recent poll, the present GAP has received less confidence than other agricultural product logos, although it was recognized by a higher number of consumers. This is a potential crisis for the new traceability scheme. Thus, the reliability of records is the most important factor and challenge for the system to succeed.

*Integration among electronic servers and interfaces.* Different types of electronic servers and interfaces have been used in the present system. One should integrate these systems as early as possible to minimize potential overlapped investments and possible chaos in the future.

*Integration with other related traceability system.* The Taiwan government is constructing a whole integrated health and safe system for ‘life.’ Being simultaneously built are several ICT-based traceability systems, from the farm to the table, including crop production, food processing and the food supply chain. Efforts should be done to merge these systems into one efficient and reliable working system.

*Integration of perplexing logos.* To avoid the confusion among consumers and the general public, the government decided to merge all related logos into one logo, as shown below. The Chinese characters in the logo means “good/quality agriculture product” and “CAS” refers to “Certified Agriculture Standards.” The logo certification system will cover all agriculture products, including crops, animals and fisheries. It also includes all process sectors from food processing to sales and delivery. The logo is expected to be attached on the products that meet GAP regulations. All other related logos are deemed expired.

*Increase added value and cost effectiveness.* Any of the GAPs may in turn increase a cost to the whole process. The way to maintain or even increase profits may be a crucial driving force to attract farmers or partners to join the system. A team approach is again necessary to deal with the challenge.

*Connection with other countries.* The traceability system is still in its infancy in Taiwan. It is urgent to make the system compatible with the systems of developed countries such as the EUREPGAP and those of Japan and the United States. The Taiwan government is also building the TAFTS in different languages, including English and Japanese, for international transparency. Connecting the Taiwan GAP with international regulations, with respect to benchmarks and transparency, should also improve the international competitiveness of its agricultural products.

*Self-commitment and assistance from other industry sectors.* From our experience, commitment is crucial for the success of the whole system. In a farming system, for example, the commitment of farmers can significantly enhance the implementation of GAP. Most importantly, the reliability of data records should be ensured in a traceability system. Food safety and environmental sustainability are in fact public affairs, and should be a collaboration of all public sectors. An interesting example is Acer, an electronic company, which recently donated 300 PCs and
has trained women farmers use PCs in crop GAPs and traceability system. The participation of the ICT industry should accelerate the progress of the whole system.

CONCLUSION

We are facing a changing world. With the fluctuations in social economics, climate and environment, new challenges keep emerging. Advancement of science optimistically offers solutions in dealing with the new challenges. In Taiwan, we have learned lessons from the past and we are continuously absorbing new concepts from neighboring countries. Taiwan is integrating its prestigious agriculture and ICT and constructing a new GAP system to effectively and efficiently ensure a safe and sustainable life biosphere and environment for the island in the short term, and for the world in the long term.

REFERENCES


National Taiwan University. 2005. Proceedings of the Symposium on Food Traceability and Food Safety. Department of Horticulture, National Taiwan University, Republic of China.

