MOEA

Overview and Case Studies on Eco-Agriculture in R.O.C. 2013

APO Center of Excellence on Green Productivity

Center of Excellence on Green Productivity
Asian Productivity Organization

About the APO

The Asian Productivity Organization (APO) is a non-profit, non-political international partnership of Asian countries established by its member countries to provide technical and management service to industrial, agricultural and service sectors in order to promote economic prosperity and improve the living standards of people living in those countries.

The APO was established in Tokyo on May 11, 1961. The organization currently includes twenty member countries: Bangladesh, Cambodia, Republic of China(ROC), Hong Kong, Fiji, India, Indonesia, Iran, Japan, Korea, Laos, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam (Hong Kong 1997 suspension). Member countries are represented through each country's National Productivity Organization (NPO). The ROC representatives participate in APO projects through China Productivity Center (CPC).

About the APO COE GP

In 2013 the Asian Productivity Organization established the Center of Excellence on Green Productivity (APO COE GP) in ROC. ROC is a founding member of APO and has been pursuing success in the field of green productivity for a long time. The Government of ROC commits to share with member countries in the pursuit of this aspiration and would like to be a catalyst through hosting the APO COE GP.

We look forward to using this platform to share ROC's experience, contribute to the green growth of other member countries, promote regional innovation and sustainable development, and jointly with member countries to enhance green productivity and competitiveness.

The APO Center of Excellence will ensure ROC's long-term cooperation with member countries in APO projects and domestic and foreign investment experts. Through training exercises and benchmarking visit exchanges, APO will assist Member Countries in enhancing green productivity and innovation to create a sustainable green economy.

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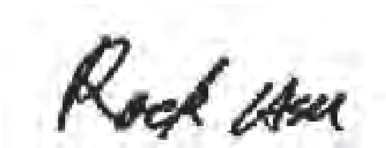
Foreword

The 55th session of the Asian Productivity Organization (APO) Governing Body Meeting in Tokyo in May 2013 approved the establishment of the APO Center of Excellence (COE) on Green Productivity (GP) in the Republic of China. Managed by the China Productivity Center, this center supports the APO in promoting and implementing related projects and is an example of the importance of the GP issue across the world.

At a time when environmental awareness is becoming increasingly important and consumers favor environmentally friendly products and services, this manual looks at ways to support APO member countries in the implementation of GP models in the fields of Resource Recycling, Green Energy, Green Factory and Ecological Agriculture Innovation, including the diffusion of related tools and techniques for GP models.

I would like to take this opportunity to thank the APO and the local implementing organizations for their hard work in making this manual available. My special thanks also go to the R.O.C. government's Ministry of Economic Affairs, Ministry of Foreign Affairs, Council of Agriculture and Environmental Protection Administration for their guidance and support.

The implementation of the COE plan is of great significance in terms of the effectiveness of industrial upgrading and international linkage. We hope to use this opportunity to share the results of the promotion of GP and to promote the sharing of knowledge and cooperation opportunities. It is hoped that through close interaction with APO members, all stakeholders worldwide will jointly improve GP in the Asia-Pacific region.



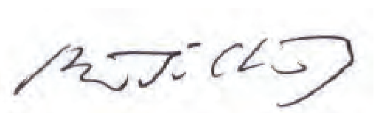
Mr. Sheng-Hsiung Hsu
December 15, 2013
Chairman of the APO Center of Excellence on Green Productivity Advisory Committee
APO Director for Republic of China (R.O.C.)
Chairman of China Productivity Center

Message

As an important link in the global economy, agriculture plays a crucial role in ensuring food security, resources and ecological conservation, and rural development. Due to climate change, extreme weathers and rapid population growth, food security and sustainable development have become urgent issues in recent years.The safety of agricultural production and its multifunctional values have also been taken more seriously. Moreover, many countries are facing different kinds of serious agricultural challenges under the impact of regional economical integration; Asian nations in particular are affected severely due to their small-scale production and aging farmers.

To meet the challenges above, Asian countries have been searching for strategies for enhancing the scale and competitiveness of agricultural production and resource utilization in an environment-friendly and sustainable way. Eco-agriculture has been identified as one of the most important concepts in agricultural development. Eco-agriculture means producing products with less pollution and damage to the environment and ecology. With diverse consumer demands and increasing environmental awareness nowadays, it is essential to adopt new technologies for utilizing recycled resources, in order to ensure environmental and ecological protection. Furthermore, it is also important to conduct cross-industry integration and strategic alliances to open up new markets and opportunities. These will enhance the agricultural role in food security and ecological conservation, increase the competitiveness of a high-quality agricultural industry and ensure its sustainable development.

To strengthen international cooperation and the regional integration of green resources, the Republic of China has established a Center of Excellence on Green Productivity of the Asian Productivity Organization (APO) and organized the "Seminar of Ecological Agriculture Innovation and Management Model " on November 4-8, 2013. Best practices and innovative management models presented in the seminar are systematically cited in this technical manual, in order to share successful experience in the Republic of China with other APO members and to contribute to agricultural development in the Asia-Pacific region. Through the introduction of ecological agricultural development to the farmers, government entities, and industrial parties of the APO Member States, we hope there will be innovative business concepts to achieve the goals of innovative operations, sustainable development and food security, thus making agriculture a healthy, vibrant and highly competitive industry.



Dr. Bao-ji Chen
December 2013
Minister, Council of Agriculture, Republic of China (R.O.C)

Message

Against simmering concerns over climate change and energy resources, the world is being driven to go green. Governments across the world now promote low-carbon economies and industrial upgrades while fine-tuning domestic energy and trade policy decisions. It remains to be seen how the world facilitates the synergy of industrial growth, improvements in entrepreneurship and leverages competition in the name of sustainable development.

As one of the Asian Productivity Organization (APO) founding members, the Republic of China (R.O.C.) is active in relevant events and has witnessed the socioeconomic development of member countries for five decades. The APO Center of Excellence (COE) on Green Productivity (GP) symbolizes the arrival of a new era in green technology, one in which R.O.C. and other APO members will play key roles in the green economic development of the Asia-Pacific region.

The Industrial Development Bureau (IDB) is proud to have received the affirmation of the APO and its members by having the APO COE GP established in R.O.C. and has given its full support. We aim to use this platform to engage in close cooperation with the APO Secretariat and APO members, especially in the fields of Resource Recycling, Green Energy, Green Factory and Eco-Agriculture. It is also hoped that these publications encourage businesses worldwide to work together to promote green productivity for future sustainable development.

We would like to express our sincere thanks to everyone who has been involved in creating this manual and we appreciate the invaluable support from APO and R.O.C.'s cross governments. In the near future, the IDB looks forward to bridging the cooperation opportunities with member countries and working closely with industry to jointly promote green productivity for industrial development.

Industrial Development Bureau
December 15, 2013
Ministry of Economic Affairs, R.O.C.

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This manual was made possible by the vision of individuals in both the public and private sector, who recognize the importance of ecological agriculture development in emerging economies of Asia. In particular, we would like to express our deepest gratitude to the following corporations and organizations that have granted us interviews and site visits: Agriculture and Food Agency, R.O.C.; Association of Taiwan Organic Agriculture Promotion; Hualien District Agriculture Research and Extension Station and its Lanyang Branch, R.O.C.; International Cooperation and Development Fund; Lu-Kang Farm; Ming-Dao University; College of Environmental Studies, National Dong-Hwa University; Organic Center, National I-Lan University; Tea Research and Extension Center Wen-Shan Branch, R.O.C.; Tse-Xin Organic Agriculture Foundation; Xing-Jian Village Duck-Rice Farm and Yin-Chuan Sustainable Farm. We would like to thank those who nourish this manual with their precious knowledge and experiences: Dr. Chi-Tsun Chen, Dr. Chang-Ju Huang, Dr. Chia-Chang Wu, Mr. Ming-Zhou Lin, Mr. Wen-Hwa Lin, Mr. Hsing-Jung Liu, Mr. Markuz Arbenz, as well as who worked tireless on editing this manual: Dr. Shih-Hsun Hsu and Ms Lilian Lin.

APO and Agriculture Innovation Department of China Productivity Center co-hosted the *Workshop on Development of Model project for Green productivity* in Taipei during Nov. 4-8, 2013. The presentations and insights from the workshop were invaluable to this study. We are also grateful to all the foreign and local speakers who contributed to the discussions.

Finally and most important, we would like to thank Council of Agriculture, R.O.C. and Industrial Development Bureau, R.O.C. whose generous support helped make this project possible.

1. Introduction

The Republic of China (hereafter referred as “R.O.C.”) is recognized as a global leader in sustainable development and has been awarded the honor of hosting the Center of Excellence on Green Productivity (COE GP) by the Asian Productivity Organization (APO). The COE GP was launched in June 2013 with the mission of enhancing, demonstrating and sharing with other APO member countries the experience of the R.O.C. on green productivity. In order to fulfill this goal, a series of activities including workshop learning, dispatch of expert delegates and research have been and will be implemented from 2013 to 2015.

The COE GP is charged to prepare manual containing technological information and applications of four separate themes: Resource Recycling, Green Energy, Green Factory and Ecological Agriculture. The manual includes the global situation, technological development and corresponding policies of the individual themes. The current 2013 manual is based on independent study by leading research institutes of R.O.C. The case studies therein demonstrate the best practices on policy implementation and technology application of public and private establishments of R.O.C.

With the publication of the 2013 manual on Ecological Agriculture, COE GP wishes to convey its utmost sincerity in leading the international community toward a more productive and sustainable future.

2. Global Situation and Trend on Ecological Agriculture Innovation

In November 2013, Super Typhoon Haiyan slammed into Tacloban city, the Philippines, ravaged the city to ground zero, with no building escaping from the hit. The death toll could reach to 10,000 for the city alone according to the officials. By seeing the aftermath images of this devastating storm, we all come to a reality that we are not only confronting climate change, but living with it! Cutting emission and making adaptation is no longer propaganda but actions that matter for the survival of mankind.

Damages caused by natural disasters are not only about the casualties in short run, but about the foreseen severe food security issues. According to National Disaster Risk Reduction and Management Council (Philippines), the striking of Typhoon Haiyan caused USD 447 million damage in infrastructure and USD 432 million damage in agriculture, accordingly 153,495 hectares of rice paddy, corn, cassava, and vegetables in an initial estimation[1]. When an extreme weather happens in a particularly high frequency, the quantity of our food loss is significantly rising.

Though agriculture is responsible for 7.3 to 12.7 billion metric tons of carbon dioxide equivalent (M_tCO_2e) per year—about 80 to 86 percent of food systems emissions and 14 to 24 percent of total global emissions (Vermeulen, 2012), unfortunately, the latest Climate Change Conference/COP19 held in Warsaw in November 2013 gave neither a concrete outcome nor furthermore consensus in agriculture emission reduction. However, we have had no other option but to pursue an agriculture system with higher risk management ability and resilience.

As natural disaster issues became more and more important and widely discussed, people started to rethink if current agricultural strategies are harmful to the environment that lead to climate change that caused tragic like typhoon Haiyan. The international literature on climate change impacts and vulnerability in the agricultural sector is increasingly recognizing the important role of adaptation. Therefore, sustainable agriculture has become a topic of interest in the international policy arena, especially with regards to its potential to reduce the risks associated with a changing climate and growing human population.

▶ *Sustainable Agriculture*

Sustainable agriculture is the act of farming using principles of ecology, the study of relationships between organisms and their environment. The phrase was reportedly first coined by Australian agricultural scientist Gordon McClymont[2]. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term. " According to Gold (1999), its content includes: (1) satisfying human food and fiber needs, (2) enhancing environmental quality and the natural resource base upon which the agricultural economy depends, (3) making the most efficient use of non-renewable resources and on-farm resources and integrating, where appropriate, natural biological cycles and controls, (4) sustaining the economic viability of farm operations, and (5) enhancing the quality of life for farmers and society as a whole.

Altieri, et al (1995) mentioned that although air and sunlight are available everywhere on Earth, crops also depend on soil nutrients and the availability of water. When farmers grow and harvest crops, they remove some of these nutrients from the soil. Without replenishment, land suffers from nutrient depletion and

❶ Data gathered from the last update by National Disaster Risk Reduction and Management Council (NDRRMC) as of March 14, 2014.
❷ Gordon Lee (Bill) McClymont, AO (8 May 1920 – 6 May 2000), was an Australian agricultural scientist, ecologist, and educationist. The originator of the term "sustainable agriculture".

becomes either unusable or suffers from reduced yields. Sustainable agriculture depends on replenishing the soil while minimizing the use or need of non-renewable resources, such as natural gas (used in converting atmospheric nitrogen into synthetic fertilizer), or mineral ores (e.g., phosphorus). Possible sources of nitrogen that would, in principle, be available indefinitely, include: (1) Recycling crop waste and livestock or treated human manure. (2) Growing legume crops and forages such as peanuts or alfalfa that form symbioses with nitrogen-fixing bacteria called rhizobia. (3) Industrial production of nitrogen by the Haber Process uses hydrogen, which is currently derived from natural gas (but this hydrogen could instead be made by electrolysis of water using electricity (perhaps from solar cells or windmills), or (4) Genetically engineering (non-legume) crops to form nitrogen-fixing symbioses or fix nitrogen without microbial symbionts. The last option was proposed in the 1970s, but is only recently becoming feasible. Sustainable options for replacing other nutrient inputs (phosphorus, potassium, etc.) are more limited.

More realistic, but often overlooked, options include long-term crop rotations, returning to natural cycles that annually flood cultivated lands (returning lost nutrients indefinitely) such as the Flooding of the Nile, the long-term use of biochar, and use of crop and livestock landraces that are adapted to less than ideal conditions such as pests, drought, or lack of nutrients. Crops that require high levels of soil nutrients can be cultivated in a more sustainable manner if certain fertilizer management practices are adhered to. Common practices of sustainable agriculture are **Climate Smart Agriculture (CSA) and Organic Agriculture:**

►2.1 CSA

Responses to the major problems caused by agriculture sectors, such as land degradation, water depletion, global warming, etc. are in numerous worldwide sustainable agriculture campaigns advocated by several international organizations, such as Food and Agriculture Organization (FAO) of the United Nations, International Federation of Organic Agriculture Movements (IFOAM), Consultative Group on International Agricultural Research, The World Bank etc., and vice versa regarding the problems faced by agricultural sectors (Bio-technology oriented development, the unfriendly global economic framework towards small farmers, and unequal land distribution) (Khor, 2002). Apparently, there is no single solution for the problematic modern agriculture system; multifaceted factors have been identified for every indispensable point for linking up a solution net, including (1) increasing biodiversity on farm, (2) growing trees on farm (agroforestry), (3) practicing low-till agriculture (conservation agriculture), (4) cutting down chemical fertilizers but organic compost, (5) applying integrated pest management, (6) recycling on farm resources rather than depleting continuously, (7) emission mitigation, (8) landscape conservation, etc. All factors could be boiled down to a package called CSA, which, according to The World Bank, CSA is a triple win for agriculture, the climate and food security. Supported by FAO and The World Bank, CSA has been put in place worldwide, for instance, in Burkina Faso, Ethiopia, Kenya, Malawi, Niger, and Rwanda, as well as in Yemen, China, Brazil, and Mexico (WorldBank, 2012). By putting CSA in practices, the results showed us crop yield could often increase by 30% or sometimes more; by protecting watersheds and controlling erosion in Loess Plateau in China, more than 2.5 million people are protected from food insecurity. That is the reason why CSA is also recognized as a "triple win" for agriculture, the climate, and food security (Figure 2-1). When the world population was estimated to reach 9 billion by 2050 (Arbenz, 2013), whereas extreme climate could be the doomed enemy to our food security, especially vulnerable in tropical area, CSA shall be a smart choice for human beings on earth.

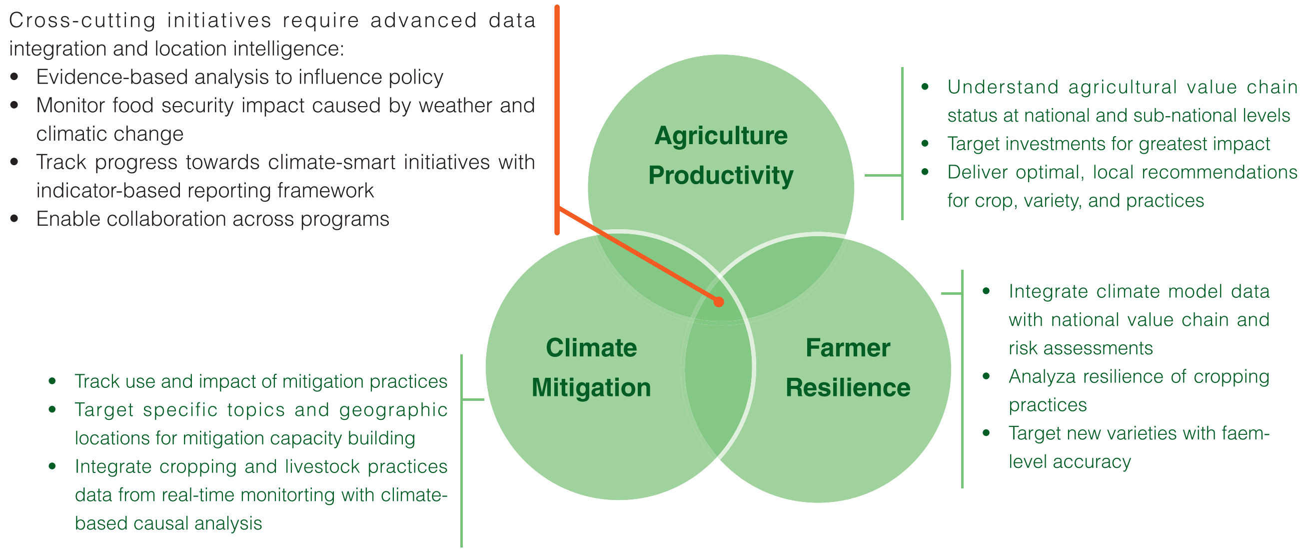


Figure 2-1 Climate smart agriculture sketch map.

(Source:www.awhere.com Website.)

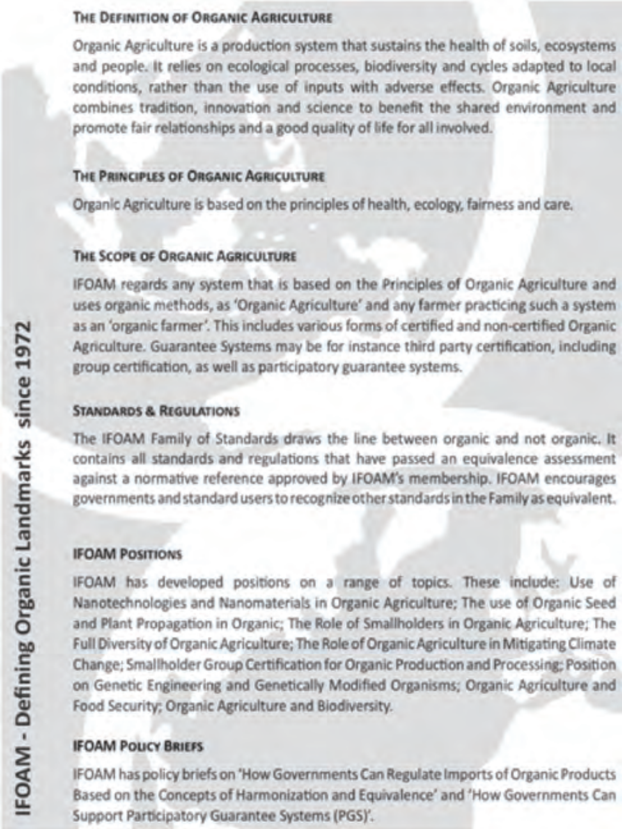
▶2.2 *Organic Agriculture*[3]

While global recognition of the need for sustainable agriculture is now greater than ever, however, industrial agriculture is expanding at an ever-greater pace. Millions of hectares of land around the world, including species and carbon rich ecosystems, are being converted into industrial plantations to meet the rising demand for animal feed and agro-fuels. Lands being acquired in the Global South by food insecure countries are for highly mechanized industrial production systems that often displace local communities and smallholders. IFOAM is an international umbrella organization – legitimized, backed, and supported by its membership, the global organic movement in 120 countries – that advocates for an alternative paradigm and supports implementation through value chain facilitation, programs, capacity building, and global organic governance.

According to IFOAM, Organic Agriculture is defined as a production system that sustains the health of soils, ecosystems, and people (See Figure 2-2). It relies on ecological processes, biodiversity and nutrients, and energy and water cycles adapted to local conditions, rather than on 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 involved. It includes certified and non-certified organic farming that is in line with the organic principles.

To see the facts that there are 1.6 million farmers practicing organic agriculture and 80% out of them are living in developing countries, 80 million ha land is organically certified and consumer purchases sum up to over USD 60 billion every year; the organic world is no longer a niche, but a well-developed market, thanks to innovations launched by scientists and practitioners, through institutional developments and through the driving force of all stakeholders along the value chain including the support services. Also, behind these

❸ This section is adapted from the notes of the speech given in Taipei, R.O.C., in November 2013, "The Organic Paradigm for Sustainability in Agriculture" by Mr. Markus Arbenz, Executive Director, IFOAM.



IFOAM - Defining Organic Landmarks since 1972

The Definition of Organic Agriculture

Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, 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 involved.

The Principles of Organic Agriculture

Organic Agriculture is based on the principles of health, ecology, fairness and care.

The Scope of Organic Agriculture

IFOAM regards any system that is based on the Principles of Organic Agriculture and uses organic methods, as 'Organic Agriculture' and any farmer practicing such a system as an 'organic farmer'. This includes various forms of certified and non-certified Organic Agriculture. Guarantee Systems may be for instance third party certification, including group certification, as well as participatory guarantee systems.

Standards & Regulations

The IFOAM Family of Standards draws the line between organic and not organic. It contains all standards and regulations that have passed an equivalence assessment against a normative reference approved by IFOAM's membership. IFOAM encourages governments and standard users to recognize other standards in the Family as equivalent.

IFOAM Positions

IFOAM has developed positions on a range of topics. These include: Use of Nanotechnologies and Nanomaterials in Organic Agriculture; The use of Organic Seed and Plant Propagation in Organic; The Role of Smallholders in Organic Agriculture; The Full Diversity of Organic Agriculture; The Role of Organic Agriculture in Mitigating Climate Change; Smallholder Group Certification for Organic Production and Processing; Position on Genetic Engineering and Genetically Modified Organisms; Organic Agriculture and Food Security; Organic Agriculture and Biodiversity.

IFOAM Policy Briefs

IFOAM has policy briefs on 'How Governments Can Regulate Imports of Organic Products Based on the Concepts of Harmonization and Equivalence' and 'How Governments Can Support Participatory Guarantee Systems (PGS)'.

Figure 2-2 Position Paper of IFOAM

(Source: IFOAM website)

figures, there are countless livelihood success stories of individuals, families, and communities. The One World Award (http://www.one-world-award.com/) celebrates some of them as inspirational achievements showing how powerful personal initiatives can be. In the past five years, around twenty initiatives from Bolivia, Brazil, Burkina Faso, Cuba, Egypt, Germany, India, Kenya, Nicaragua, Philippines, Republic of China (Taiwan), Sri Lanka, Switzerland, Tanzania, Turkey, and United States have been awarded and encouraged.

Nevertheless, the recognition of the importance to make proper adaptation to our changing planet from the governmental powers, aid, and loan agencies are essential to make a forward leap on achieving sustainability. Small-holder farming is the backbone of agriculture and food security in developing countries as well as in developed countries, not only in rural areas but in urban settings as well. Ninety percent of farms worldwide are less than two hectares and they provide employment to 1.3 billion people. Ironically, small-holder farmers are among the poorest and hungriest people worldwide, having insufficient access to resources and lacking support to build capacity. Increasingly, over the past two decades, the least developed countries have depended more on food imports. Only 4% of official international aid for development is assigned to agriculture and governmental investments in research are decreasing. Many national governments prioritize investments in large-scale agricultural development including land grabs or allocate the least amount of resources in their budgets to agriculture even in countries whose economies are agriculture-based. The sponsorship for studies on ecological solutions should be encouraged, and the crucial topics related to agriculture should be considered within the framework of studies are: energy efficiency, use of inputs, outputs of all the different crops, products and activities and the relationship between them, also the nature and use of agriculture biodiversity (Khor, 2002).

It must continue to demonstrate that the principles of organic agriculture or say ecological based farming system - health, ecology, fairness, and care – when integrated into policy decisions, business relationships and individual choices create the most credible pathway forward for food security and the empowerment of all, especially the poor and marginalized.

►*Conclusions*

Converging trends in climate change, population growth, and use of resources threaten global food security and environmental sustainability. As Beddington, et al. (2012) suggested, widespread use of sustainable agricultural practices can help by reducing risks to food production and farmer incomes and by decreasing green house gas emissions and resource degradation. Governments should take sustainable agriculture into consideration and popularize it nationally not only for adapting current climate-change situation but also for our future generation.

3. Innovative Management of Ecological Agriculture in R.O.C.

The strategy of the Ecological Alternative is based on the concept of **eco-functional and social intensification (eco-intensification)** (Arbenz, 2013). Eco-intensification is the process of increasing agriculture productivity through the enhancement of biological processes, ecological knowledge, ecological practices, and ecological functions rather than through intensification of finance, chemicals, energy, and waste. It aims at building the resilience of the farm itself rather than outsourcing resilience to companies through the purchase of fossil fuel intensive chemical inputs.

Council of Agriculture (COA), R.O.C. started to conduct feasibility assessment for organic agriculture in 1986. Subsequently, the government has also developed and implemented the “Agricultural Production and Certification Act” since 2007, as well as "Exquisite Agriculture Health-Excellence Program” from 2009 to 2012. The incentives provided by the government did encourage farmers in R.O.C. to invest more in organic agriculture sector. Until now, arable land under organic management in R.O.C. have reached 5,849 hectares (ha), increased by 148% compared to 2,356 ha in the end of 2008. Several innovative management methods have been deliberately set up, nevertheless, it takes efforts from all sectors within the whole supply chain to make the industry possible. In the sense that the stakeholders of this industry should be composed by the government, the agronomic researchers, the producers, the certification bodies, the consumers and etc. Based on the supply-and-demand theory, the importance to increase the productivity is equals to rising up consumers’ awareness.

Three main topics related to organic agriculture developments are covered in this chapter, respectively “Production Technologies”, “Organic Certification and Accreditation”, and “Dissemination Platform”, those three describe accordingly the developing progress on farm, in farm gate, and the communication between production site and the market (Figure 3-1). The topics will be introduced through successful cases in R.O.C.

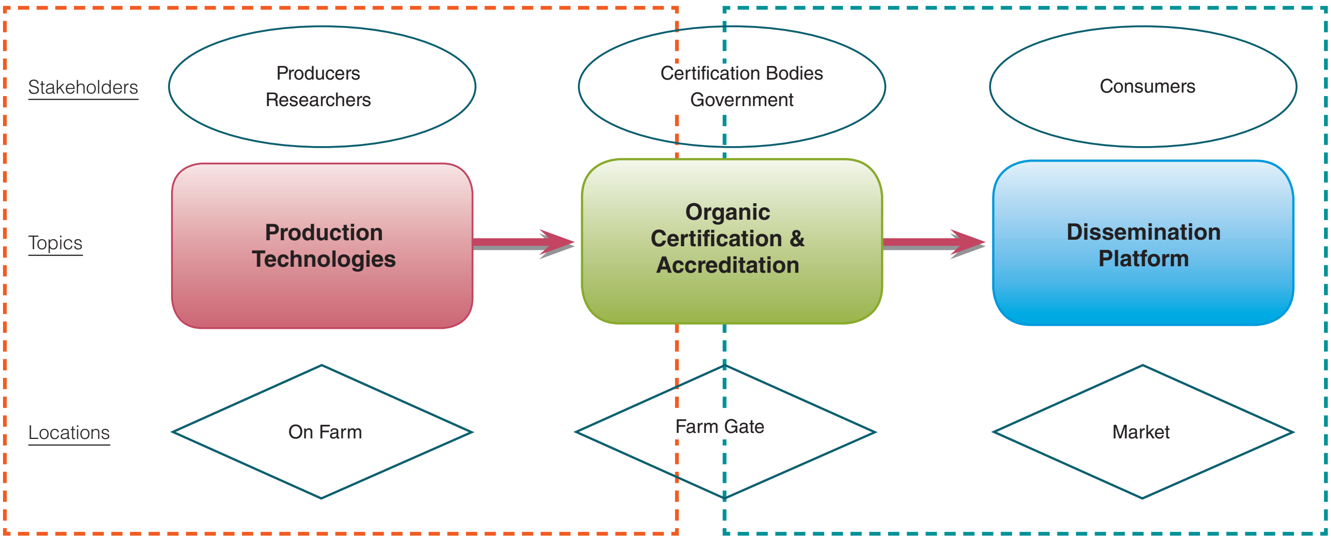


Figure 3-1 Three topics related to organic agriculture development and corresponding stakeholders and locations.

▶3.1 Production Technologies

3.1.1 Rice-Duck Symbiotic Farming System[4]

1. Background

In the past, there were no chemical fertilizers or pesticides used in traditional agriculture. Crop productions relied on organic composts and natural enemies. Thus fish, shrimps, clams, escargots, loaches, and Asian turtles were often found in the fields. They were not only good helpers for pest control but also frequent rural cuisines. In some areas, they also involved in the symbiotic farming system and provided extra income besides major crops. (Peng, 1987; Chuang, 2002; Laio, 2003; Halwart and Gupta, 2004 and Yzerman, 2004)

Since 2000, Hualien District Agricultural Research and Extension Station Lanyang Branch (HDAIS-LYB), R.O.C. has been actively engaged in introducing to farmers Rice-Duck Symbiotic Farming and subsequently Wild Rice-Fish Symbiotic Farming techniques in I-Lan County, R.O.C. (Figure 3-2), expecting to create a new organic agricultural development model containing production, lifestyle, and ecology.

Figure 3-2 I-Lan County where symbiotic farming is experimented in R.O.C.

2. Innovative Management on Farm

Input Choices

Duck Species chosen for the symbiotic farming should be active, omnivorous, white feathered, and unable to fly, so that the ducks would eat the weeds and pests while paddling in the rice paddy (Figure 3-3). In I-Lan case, both Medium-Reformed Mule Ducks and Largely-Reformed Mule Ducks are used.

Rice Species are Taichung Sen No. 10 (Long grain rice), Taichung Sen No. 2, MT8 and MT9. The rice cultivations are complied with the Organic Farming Standards.

Green Manure plays important role in this model where *Sesbania* is used.

Figure 3-3 Ducks are foraging in the paddy field.

---

❹ Written by Dr. Chi-Tsun Chen (陳吉村分場長), Director, Hualien District Agricultural Research and Extension Station Lanyang Branch, Council of Agriculture, R.O.C. & Mr. Wen-Hwa Lin (林文華助理研究員), Assistant Researcher, Hualien District Agricultural Research and Extension Station Lanyang Branch, Council of Agriculture,R.O.C.

Figure 3-4 Electric grid fences and movable steel pergolas.

Farm Setting

In order to prevent attacks from street dogs and cats or duck loss, the rice paddies were surrounded by power grid fences. Movable steel pergolas were set by rice fields covered by plastic sheets as resting and feed supplement places, where ducklings may enter or leave the paddies freely (Figure 3-4).

Rice seedlings are transplanted on farm with 30 x 30 cm row-and-plant spaces.

Rice-Duck Farming Model

Grow *Sesbania* in the fallowed 2nd-harvest paddy for 50 days

↓

Bury *Sesbania*, flood the paddy and restock ducklings

↓

Transplant 1st - harvest rice seedlings 20 days later and restock 15-day ducklings (300/ha).

↓

Set up electric grid fence around the farm ridges to prevent attacking from dogs and cats.

↓

After 25 days from stocking ducklings, the ducks are separated for fattening

↓

Ducks are ready for sell after 80-90 days

3. Outcomes

Rice Productivity

MT8 cultivar showed the best result with both Medium-Reformed Mule Ducks (5,192 kg) and Largely-Reformed Mule Ducks (5,236 kg), followed by Taichung Sen No. 2. with Medium-Reformed Mule Ducks (5,071 kg), and Largely-Reformed Mule Ducks (5,027 kg).

Revenues

Although the grain output were slightly less than organic rice farming or traditional rice farming, the advantages of rice-duck symbiotic farming are at a high selling price and low production cost; the increased revenue per hectare was USD 480 and USD 1,130, respectively (Table 3-1).

Soil Fertility

The investigation on soil content revealed that both the soil organic matter and effective phosphorus content have increased. As the average daily excretion of one duck is approximately 0.18 kg (91% moisture content), there were 2,700 kg of duck manure per hectare after 50 days of stocking.

Table 3-1 Rice output, production cost and revenue per hectare in 1st crop, 2001

Cultivation Model	Rice production (kg/ha)	*Output value (USD)	Production cost (USD)	Income (USD)	Comparison (USD)
Rice-Duck Paddies	5,236	4,370	1,800	+2,570	+1,130
Organic Farming	5,302	4,420	2,330	+2,090	+480
General Rice Paddies	5,583	3,420	1,980	+1,440	0

Notes: (1) The output value is based on Take Taijing No. 8. (2) Rice-Duck Rice USD 0.83 × 5,236 Kg = USD 4,370 (3) Organic Rice USD 0.83 × 5,302 kg = USD 4,420 (4) General Rice USD 0.7 (purchase price) × 1,920 kg + USD 0.57 (market price) × 3,663 kg = USD 3,420.

(Source:Hualien District Agricultural Research and Extension Station Lanyang Branch (2001).)

Benefit from Rice-Duck Symbiotic Farming

Rice paddies in R.O.C. have suffered from the apple snails (*Pomacea canaliculata*). Duck stocking is an effective way to control their number; together with *Sesbania*, used as green manure or feed, the duck manure may supplement the fertility of organically cultivated rice. This approach utilizes the re-use of poultry wastes and biodiversity of rice paddies, providing a sustainable business model.

3.1.2 Wild Rice-Fish Symbiotic Farming

1. Background

"Wild Rice-Fish Symbiotic Farming" is an approach that grows wild rice and fish in the same field, utilizing the long-term impoundment characteristic of water-rice fields and the concept of aquaculture, in order to achieve the goals of pest reduction and double income.

2. Innovative Management on Farm

Input Choices

Generally speaking, the purposes of "crop-fish symbiosis" are: 1) to achieve double income (from crops and fish) by raising fish in the rice or wild rice paddies, and 2) to use the fish to control diseases and pests in the field and eliminate the use of pesticides. The former is more common in Mainland China, where they raise carp, loach, silver carp, grass carp, and other economic species, or sometimes tilapia or Asian turtle, in the symbiotic fields; the latter is more common in R.O.C., particularly effective for the control of apple snails (*Pomacea canaliculata*). For the purpose of snail control, farmers often choose snail carp (also known as Chinese roach or black carp), Thai snakehead fish (*Channa striata*), Northern snakehead, or other snail-eating species. However, the Thai snakehead fish shall be cautiously used as it is comparably aggressive and performs greater impact to the aquatic ecosystem.

Every 0.1 ha of land may contain 1,300 g tilapia fish, and the best stocking period is March to May; fish stocked prematurely may die from the cold. With grass carp, black carp, or other large fish in the water, the waterway should be deepened and fish number reduced to provide sufficient area for fish activities.

Amended Facilities

To perform symbiotic farming in the Wild Rice fields, two additional fish-shelter facilities are required: "waterway (fish trench)" and "puddles (fish pond)". A puddle is a deepened pit, as a daily resting area and shelter for fish, as well as the main measure for the fish to survive after the field is drained. Traditional rice-fish symbiotic farming usually take 10% of the land for puddles, set in the center or at the edge of a field, preferably with a depth of 80 to 100 cm. Waterways are shallow ditches crossing the field and connecting the puddles with water inlets and outlets of the field.

The waterways serve as passages for the fish, making it easier for them to travel and forage, as well as a channel for the fish to escape into the puddles during the drainage of the field. The waterways are usually 30 to 50 cm wide, 25 to 30cm deep; those set around the field may be wider and deeper. The configuration of puddles and water way are shown in Figure 3-5.

As the rice farming in R.O.C. has been highly mechanized, the traditional "window-frame" or "checkerboard" distributions may be damaged by the machines. Therefore, HDAIS-LYB amended the waterway configuration to a single waterway on one side of the field or one on each side. The best size for the waterway is more than 50 cm deep and 2 to 4 m wide. For a single waterway, it is better to connect the inlet along the footpath to the back; for the double waterways, it is suggested to set another waterway on the opposite side of the field with the same instruction. This approach would combine the functions of waterway and puddles, while preventing damages from the large farm machineries by careful operations (Figure 3-6).

3. Outcomes

Snail Control

The results showed that seven 1.8-kg black carp in a paddy would be sufficient for snail control; larger fish provide better control (Table 3-2).

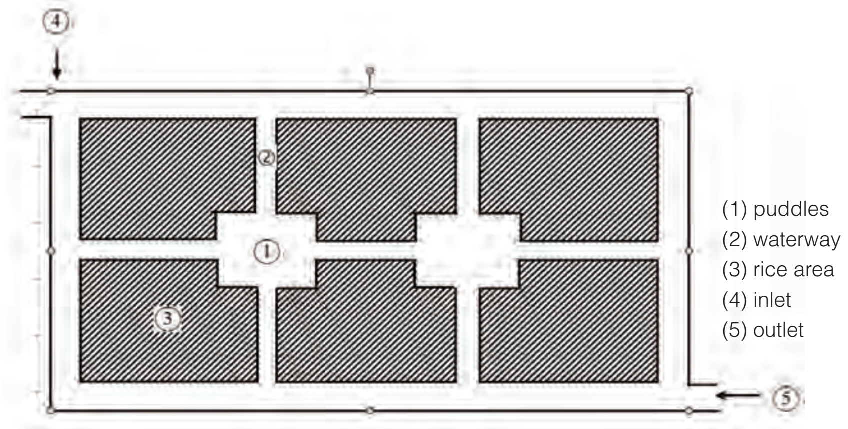


Figure 3-5 Traditional symbiotic fish trenches in the rice paddies

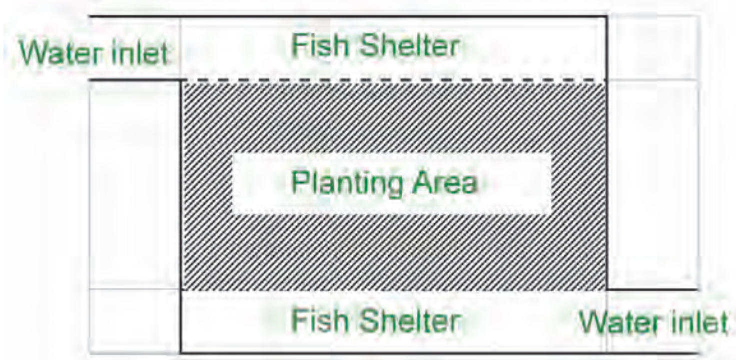


Figure 3-6 The modified fish shelter.

Table 3-2 The impact of restocking of Tilapia (Tilapia spp.) and waterway settlement on the survival rate

Fish density (fish/ha)	Modified fish shelter	Survival rate of water bamboo (%)	Yield of water bamboo (kg/ha)	Wt. of water bamboo shoot (g)	Survival rate of Tilapia (%)	Wt. gained rate of Tilapia (%)
0	Yes	100	2790	62.1[a*]	----	----
2500		100	3260	64.4[a]	74.7	16.6
5000		100	3560	66.3[a]	74.0	14.6
10000		100	3620	66.6[a]	60.5	19.1
0	No	100	2660	67.7[a]	----	----
2500		100	2970	69.5[a]	4.0	-10.5
5000		100	3040	67.5[a]	8.7	-3.3
10000		100	3210	67.7[a]	13.2	-7.2

Note:output value and the weight of single shoot with shell of Red-Shelled Water Bamboo as well as the survival rate and weight gain of Fish in I-Lan area.

(Source : Hualien District Agricultural Research and Extension Station Lanyang Branch (2012).)

*Means within the same survey item columns followed by the same letters are not significantly different by Duncan's multiple range test at P=0.05.*Own calculation.

Benefit from "Wild Rice-Fish Symbiotic Farming"

Wild rice-fish symbiotic farming model not only provides double income from wild rice and fishery, it also proves the natural and safe qualities of wild rice fields and enhances consumer confidence in organic products.

3.1.3 Holistic Management in Tenha Organic Farm[5]

1. Background

Tenha Life Science Co. Ltd was established in October 2005 in R.O.C., starting up with the development of agricultural microbial products. The 9.85 ha agriculture plot was rent afterwards and the agricultural production starts. The site was expanded later to 16 ha of land including 12 ha of actual farming area. It mainly plants and produces leafy vegetables, melons, and fruits, and outputs over 400 tons of more than 40 species and items annually.

Aerial View of Tenha Organic Farm (Photographed in April 2006)

❺ Written by Dr. Chun-Chin Chou (周俊吉博士), Founder, Tenha Organic Farm.

2. Innovative Management on Farm

Ecological Control

(1) Soil improvement: Utilizing homemade composts, liquid fertilizers, and green manures made from agricultural wastes, the soil organic matter content has increased from 0.5% (in 2006) to 1.5% (in 2007) and 2% (in 2008). Crop output has significantly increased by 114% from 172 tons in 2006 to 369 tons the next year, and further increased by 20% in the third year (443 tons). (Figure 3-7)

(2) Adopting crop rotation, intercropping, and fallowing: The farming areas are divided into fields of approximately 1 ha ; however, instead of cultivating one crop in a large area, there are at least 5 to 10 kinds of crops in 1 ha, which provides a balanced ecological environment.

(3) Underground water treatment: we use multiple aeration, aquatic plant roots adsorption, and precipitation methods to purify the groundwater. These simple and effective methods provide certified irrigation water containing few oxygen and iron.

(4) Weed control: weed control is the simplest yet most labor-intensive task. The weeding cost in the summer often shares 1/3 of laboring costs; common weeding methods on farm including mechanical weeding, row weeding, manual weeding, plastic sheeting, or rice hull covering. However, chicken for pest control in the greenhouse has been applied 7 years ago, and the magic weeding efficiency occurred.

(5) Pest control: the most favorable way is to find the disease- (pest-) resistant species for a better successful rate of farming, or adopting other methods, such as grafting to obtain the disease- (pest-) resistance ability from certain plants; or the biological control (ladybugs against aphids). (Table 3-3)

Making our own compost

Making our own liquid fertilizer

Green Manure

	2006	2007	2008
Organic matter content in soil	0.45-0.47%	1.5-1.7%	1.86-3.03% (2.02%)
Harvest amount	172,518 kg	369,262 kg	443,988 kg

Figure 3-7 The increase in output from 2006 to 2008 after Tenha organic farm added homemade composts, liquid fertilizers and green manures in the soil. (Source:Tenha organic farm.)

Table 3-3 A list of methods used as ecological characteristics to prevent diseases and pests in Tenha Farm.

Aphid Control	Food Chain Control	Physical control
- Remove affected plants - Maize-field techniques - Sandfly and ladybugs	- Stinkbugs vs. army worms - Parasitic wasps control boring insects in maize crops - Chickens eat grass and -insects - Geese eat grass - Fish in the water eat algae and snails	- Lighting - Covering - Shading plans:controls grass growth
Fatal Attraction	Provision of an Unsuitable Environment for Pests	Modern biotechnology
- Attraction of sex - pheromones	- *Rhizoctonia spp.* disease escape method - Spinach and mildew	- Microbial pesticides - *Bacillus thuringiensis* added to bran controls boring insects in maize

(Source:Tenha Organic Farm (2013))

Quality and Quantity Control

(1) Production Plan: a) Collect, confirm, and compile the orders beforehand, after compiling the items and quantities of customers' demands, the Farm Production Department would make the production plan accordingly, evaluate which species to plant, how much area, the planting methods and growth time, determine if the plan is feasible according to farm database, and start planting the target crops. b) Create farm database, the statistics of production were collected and organized over the past three years. Before the order is placed, the Production Department would find suitable vegetables from the "crop database" according to the demand and the target vegetable species could be chosen by both the producers and the clients after discussion. After the species are decided, the database is used for calculating the output value and harvest time which differs in different seasons. See the example of Chinese Cabbage below. (Figure 3-8)

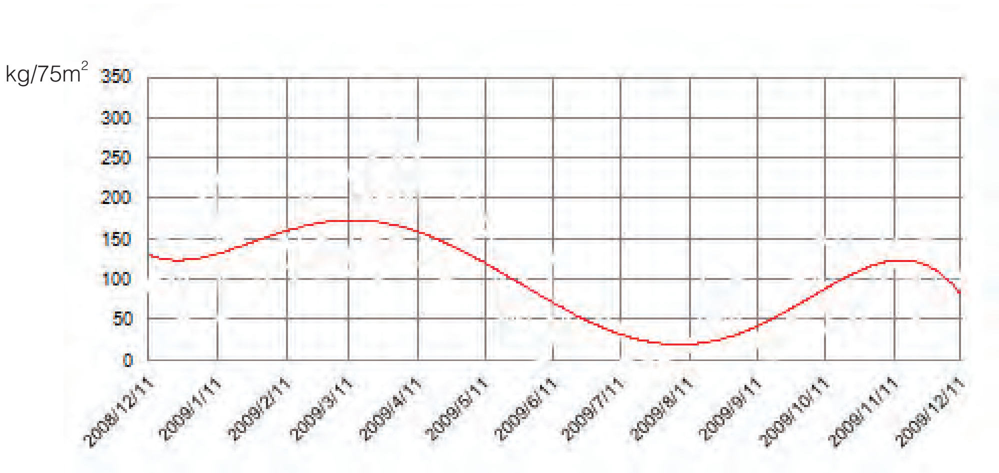


Figure 3-8 Annual output distribution of Chinese cabbages.

(Source: Annual unit production of Tenha Organic Farm (2008).)

(2) Product traceability: Tenha Farm requests all directors to fill in daily work records, recording the planting, harvesting, fertilizing, irrigation, and pest/disease control details, and input to the computers for data compiling. To fully implement the requests of product traceability, the sales and production processes are connected by the serial numbers on organic verification logos on the packages. Every pack of vegetable produced by Tenha may be traced back for cultivation details.

Material recycling system

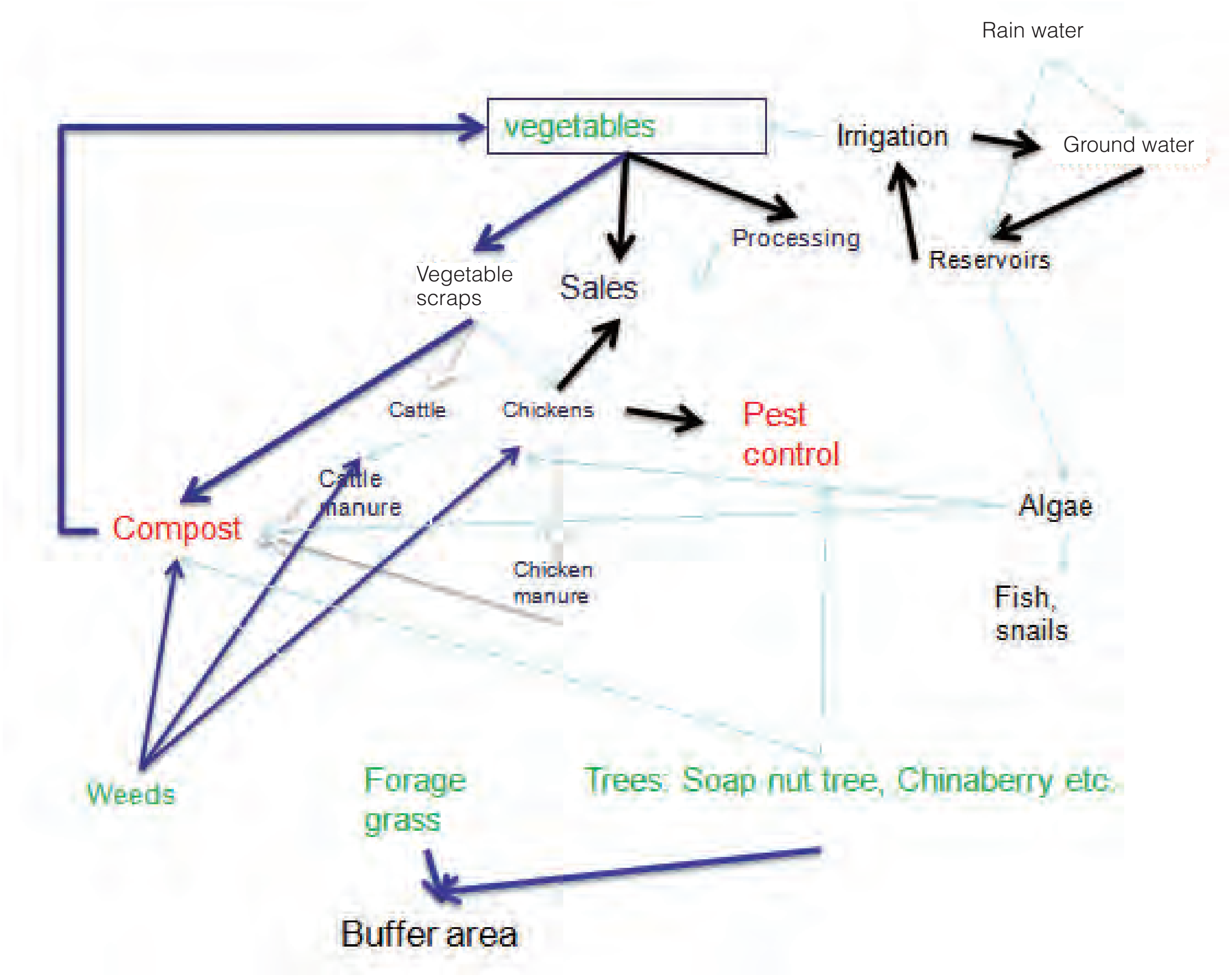


Figure 3-9 The recycling and reuse of materials in Tenha Organic Farm.

3. Outcomes

- Tenha received the Organic Eggs Certification from the National Animal Industry Foundation in March 2009, becoming the first in R.O.C. to pass the certification for organic animal products.

- Later on, in July 2009, Tenha received the "Organic Chicken" Certification.

- Again in November 2009, Certification from the Tse-Xin Organic Agriculture Foundation Processed Product Processing, Packing and Distribution Industry

- In January 2010 Tenha Received a commission from the Hon Hai/FoxconnTechnology Group to establish and run the YonglingShanlin Organic Farm (http://www.sanlingfarm.com.tw) to provide employment opportunities for those who severely affected by Typhoon Morakot in 2009.

3.1.4 Innovative Biological Insecticide by Fwusow Industry Co., Ltd.

1. Company Profile

Fwusow was established in 1920, the main products include edible fat and oil, cereals, processed aquatic products, pet food, feeds, organic fertilizers, microbial preparations, barley flake products, single flavor raw materials, etc.

Fwusow products have obtained the Chinese National Standards (CNS) mark, Good Manufacturing Practice (GMP) quality certification and ISO-9001 international quality certification. Currently, the company operates an R&D Department which is divided into Food Research Division, Feed Research Division, and Agricultural Material Research Division, responsible for the development, research, improvement, quality control, and after-sales services of related products.

2. Innovative Management

Pioneer of Domestic Biological Insecticide

Fwusow had been authorized by the Agricultural Chemicals and Toxic Substances Research Institute of the COA (hereinafter referred to as TACTRI/COA) in 2005 to start the development and stable research on the mass production of *Bacillus thuringiensis* subsp. *kurstaki*strain E-911. Back then, the *Bacillus thuringiensis* products available in the markets were imported from other countries or were authorized products produced in R.O.C. The *Bacillus thuringiensis* strains used in such products were not local strains, which provide weaker insecticidal. Besides, due to the worse environment adaptability and higher prices, they were poorly accepted by the farmers. In order to promote the usage rate among farmers, Fwusow has screened the domestic *Bacillus thuringiensis* strains and increased the insecticidal activity according to the climate and environmental conditions in R.O.C.

Technology Transfer

Fwusow made a successful cooperation with TACTRI/COA. Assistant Manager Yu-Tsai Chen of the Agricultural Material Research Division explained there were two opportunities they worked with TACTRI/COA on technology transfer. The first technology transfer was conducted in 2006 and has resulted in the manufacturing permits for technical concentrates and wettable powder products of *Bacillus thuringiensis* in R.O.C. The second one, on the other hand, was to respond to the launching and marketing of *Bacillus thuringiensis*. Fwusow completed an expansion project of a 5KL fermenter in April 2012 especially for this product. Through the second technology transfer of *Bacillus thuringiensis* subsp. *kurstaki* strain E-911, the company has developed mass production techniques and liquid formulations to increase the application of this authorized technology (Figure 3-10).

Figure 3-10 Fwusow's new products in powder (right) and emulsion (left) form.

3. Company Achievements

Besides the development of *Bacillus thuringiensis* subsp. *kurstaki* strain E-911, Fwusow also plans to conduct another industrial-academia cooperation with TACTRI/COA on the development of *Bacillus thuringiensis* subsp. *aizawai* strain AB-12. The future goal is to enhance product efficacy, safety, and stability by combining the two strains. The microbial fermentation mass production, formulation development, in vivo analysis, and field trial analysis techniques applied in this project will further benefit the development of microbial preparations or health food, and achieve the goal of industrial technology upgrading.

3.1.5 Microbial Fertilizers of *Bacillus mycoides* by Sinon Corporation

1. Company Profile

Sinon was founded in November 1963, mainly engages in pesticides, fertilizers, chemicals, plastic products (containers), group meals, housewares, international trading, etc., and is the largest pesticide and second largest compound fertilizer manufacturer in R.O.C. In the past, Sinon focused on the agrochemical products, including insecticides, fungicides, and herbicides. In recent years, to pursue natural approaches for food safety and environment protection, Sinon established the Taiwan Crop Protection Department, which is in charge of the production and marketing of crop pesticides, fertilizers, seeds, seedlings, farm machineries, and agricultural materials.

2. Innovative Managements

Farmers Training

Sinon Corporation has trained hundreds of plant doctors and technical personnel who are equipped with knowledge of plant protection and nutrients, and has actively provided services to farmers around the country through 300 supply centers. Moreover, Sinon has held many activities including "field trials," "demonstration field tours," "crop cultivation seminars," "night talks," and "crop group technology promotions" in addition to "soil examination," "pest diagnosis & control" and other instrument verifications.

Technology Transfer

In order to implement the R.O.C. policy of "reasonable fertilization," assisting farmers to reduce the use of chemical fertilizers, to encourage the use of microbial pesticides and fertilizers, and to promote sustainable operation and food safety, COA guided Sinon Corporation to commence a research plan in 2010, fermenting *Bacillus mycoides* into microbial fertilizers with the assistance of Professor Zhen-Wen Huang, Dean of Chung Hsing University. In this technology transfer, The microbial fertilizer has fertilizing functions and plant protection effects; it may not only promote crop growth (the growth of tomato seedlings and roots) but also prevent and treat crop diseases (tomato wilt disease, powdery mildew and Cabbage *Rhizoctoniasolani* AG-4). Sinon Research team is mainly working on the research of fermentation formulations, preparation formulations, and application advantages; their tasks include development of liquid or solid microbial preparation series, additional formulation adjustment during interim or final microbial fermentation periods, and the development of superior agricultural microbial fertilizers and plant protection preparations.

R&D Team Members Regularly Check The Fermentation Tank.

3. Company Achievements

The most outstanding outcome by Sinon research team so far is to develop disease suppressive media and screen diseases suppressive microbes led by Professor Zheng-Wen Huang, a well-known phytologist, also the Dean of Agricultural Information Institute, Chung-Hsing University. The team overcame the difficulty to stabilize the viable microorganisms and protect them from ambient temperature and qualitative damages in the mass production and transportation processes.

▶ 3.2 *Organic Certification and Accreditation*

3.2.1 Organic Certification and Accreditation Systemin R.O.C.[6]

National Regulations and Act in R.O.C.

Due to the rapid economic development, people have gained awareness of food safety and healthcare; with bettered organic agricultural regulations set, consumers find the organic agricultural products more trustworthy nowadays. Thus, the demand for organic products is increasing; farmers and corporations are investing more in the production and marketing of organic agriculture. Following the trend, R.O.C government found the necessity to enhance the quality and safety of agricultural products and the processed products, most importantly, to protect citizen's health and consumers' rights.

In 1999, R.O.C. government started to develop production standards, certification system guidance standards, and certification guidelines for organic products. In the matter of fact, ever since 1989, there has been a national quality control system for agricultural products implemented in R.O.C. called Certified Agricultural Standards (CAS). It was until 2006, CAS emblem started to serve as one of the compulsory certified labels for organic products in R.O.C., and one year later (2007), "Agriculture Production and Certification Act" (The Act) was put into enforcement to distinguish organic products from others. Furthermore, regulations for organic product traceability and certification requirements were developed later. The Act was set in high standards in terms of organic integrity, for example:

> Organic agricultural products and processed agricultural products are prohibited from using chemical pesticides, chemical fertilizers, veterinary drugs, or other chemicals. Violation of agricultural production and certification article 13 may result in fines of USD 5,000 to 10,000.
>
> Article 21 regulates organic emblems management. When agricultural certification emblems are put on the products which have not yet undergone certification, or the continual use of products that have been suspended, are prohibited. Violators will be fined between USD 6,700 and USD 34,000.
>
> Article 25 is for the production and certification of agricultural products. If production and certification of agricultural products or processed agricultural products violates regulations or contains untrue markings, the relevant authorities shall announce the name and address of the manufacturer, along with the name of the agricultural or process agricultural products, and the circumstances of the violation.

Certification and Accreditation Bodies in R.O.C.

In order to have the agricultural products, no matter in fresh, processed, packaged forms, in line with the official organic certification, and be able to export, COA developed strict management measures as references for organic farming and production regarding practices, livestock, and crops. Organic Certification Bodies (CBs) could operate inspection procedures based on eligibility requirements, and taking into account various objectives and subjective factors of influencing the development of organic agriculture, organic products and organic agricultural processed products are determined to verify management approach. Meanwhile, COA plays the role handling accreditation for organic CBs and establishing a termination mechanism for the agencies. By far, COA has accredited 13 organic CBs (Table 3-4), of which 12 for organic agri-food products and 1 for organic animal products. Besides, COA conducts annual organic auditor training exams to improve the certification quality.

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❻ Written by Dr. Chia-Chang Wu (巫嘉昌分場長), Director, Tea Research and Extension Station Wenshan Branch, Council of Agriculture,R.O.C.

Table 3-4 Certification bodies accredited by Council of Agriculture, R.O.C.

Organization	Scope of Certification	Organization	Scope of Certification
Tse-Xin Organic Agriculture Foundation	Organic Agriculture and Food Products Processed Organic Agriculture and Food Products	FSI Taiwan-Asia Pacific	Organic Agriculture and Food Products Processed Organic Agriculture and Food Products
Mokichi Okada International Association	Organic Agriculture and Food Products Processed Organic Agriculture and Food Products	National Cheng Kung University	Organic Agriculture and Food Products Processed Organic Agriculture and Food Products
Chinese Organic Agricertification Association	Organic Agriculture and Food Products Processed Organic Agriculture and Food Products	National Chung Hsing University	Organic Agriculture and Food Products
Taiwan Organic Production Association	Organic Agriculture and Food Products	National Quality Assurance	Organic Agriculture and Food Products Processed Organic Agriculture and Food Products
Taiwan Formosa Organic Association	Organic Agriculture and Food Products	Universal Certification Service (UCS)	Organic Agriculture and Food Products
National Animal Industry Foundation	Livestock and Poultry Products	Harmony Organic Agriculture Foundation	Organic Agriculture and Food Products
Association of Taiwan Tea	Organic Tea Products		

(Source:Taiwan Organic Information Portal (2013))

3.2.2 Organic Value Chain Facilitation through Standards and Certification[7]

Globalization helps extend the food system boundaries to their maximum, which means that the whole value chain is the issue to be discussed instead of merely the crops on farms. Ecologically managed products emerging on the market provide alternatives to consumers other than long existing industrialized production. According to IFOAM, there are over 80 countries with governmental organic regulations (plus over twenty that are drafting regulations) worldwide, plus dozens of privately owned certification standards. Additionally, there are more than 550 organic CBs active in the world. With so many different programs, there is a difference among them. Some are stricter than others, but overall, the bulk of the content of these standards is quite similar.The minor differences though have made complications for those who want to trade their products across countries. For many years, requiring absolute *compliance* of one standard to another was the norm. The newer approach is based on the concept of *equivalence*, which acknowledges that different organic standards are written by people living in different regions under different cultural and agronomic conditions.

This diversity logically gives rise to a certain tolerance for "regional variation" among different standards, which can be allowed as long as the standard as a whole agrees with the **Principles of Organic Agriculture,** and contains certain critical elements deemed necessary for a standard to be adequately robust.

The Family of Standards Chart of IFOAM

[7] This section is adapted from the notes of the speech given in Taipei, R.O.C., in November 2013, "The Organic Paradigm for Sustainability in Agriculture" by Mr. Markus Arbenz, Executive Director, IFOAM.

Basing negotiations around these minor differences created barriers to trade. Granting of equivalence by one country to another facilitates trade as recent examples between USA, Canada, EU, and Switzerland provide evidence. However, if all countries with organic regulations (84 countries) would have to recognize each other based on bilateral agreements, nearly 3,500 such agreements would be necessary for completely solving the problem. This is unrealistic. United Nations Conference on Trade and Development FAO and IFOAM, developed a solution: Have a common reference point for all standards to compare themselves to. The Common Objectives and Requirements of Organic Standards (COROS)[8] is an organic standard, which reflects the core content of all organic standards. Standards owners (governmental or private) can each compare their standard to the COROS, and the results of this comparison then be shared with all. This happens ideally in the frame of the Family of Standards, a visualization to draw a line between what is organic and what is not.

---

❽ Common Objectives and Requirements of Organic Standards (COROS) were developed as a joint venture of the IFOAM Organic Guarantee System (OGS) and the GOMA (Global Organic Market Access) project undertaken by FAO, IFOAM and UNCTAD. (Source: IFOAM 2013)

▶3.3 *Dissemination Platform*

3.3.1 Taiwan Organic Information Portal[9]

The crucial motivation for agricultural producers drifting to ecological farming system is the encouragements coming from the market; while market is mainly constituted by two ends, accordingly supply and demand. To raise the sustainability awareness of the society could positively influence the demand, consequently the supply follows. However, the information between two ends should be able to flow transparently so that the responses to both ends could be activated effectively in time. There is "Taiwan Organic Information Portal"(hereafter referred to as The Portal) available online in R.O.C. since 1998, founded by the Organic Center, I-Lan University (Huang-Tzeng and Kuo, 1998) with the funding from COA.

It shows in Figure 3-11 the scheme of the Taiwan organic information systems designed by the Organic Center, I-Lan University. The Portal can be divided into three parts: the systems to disseminate organic agricultural information; systems derived from organic certification database; and e-commerce systems.

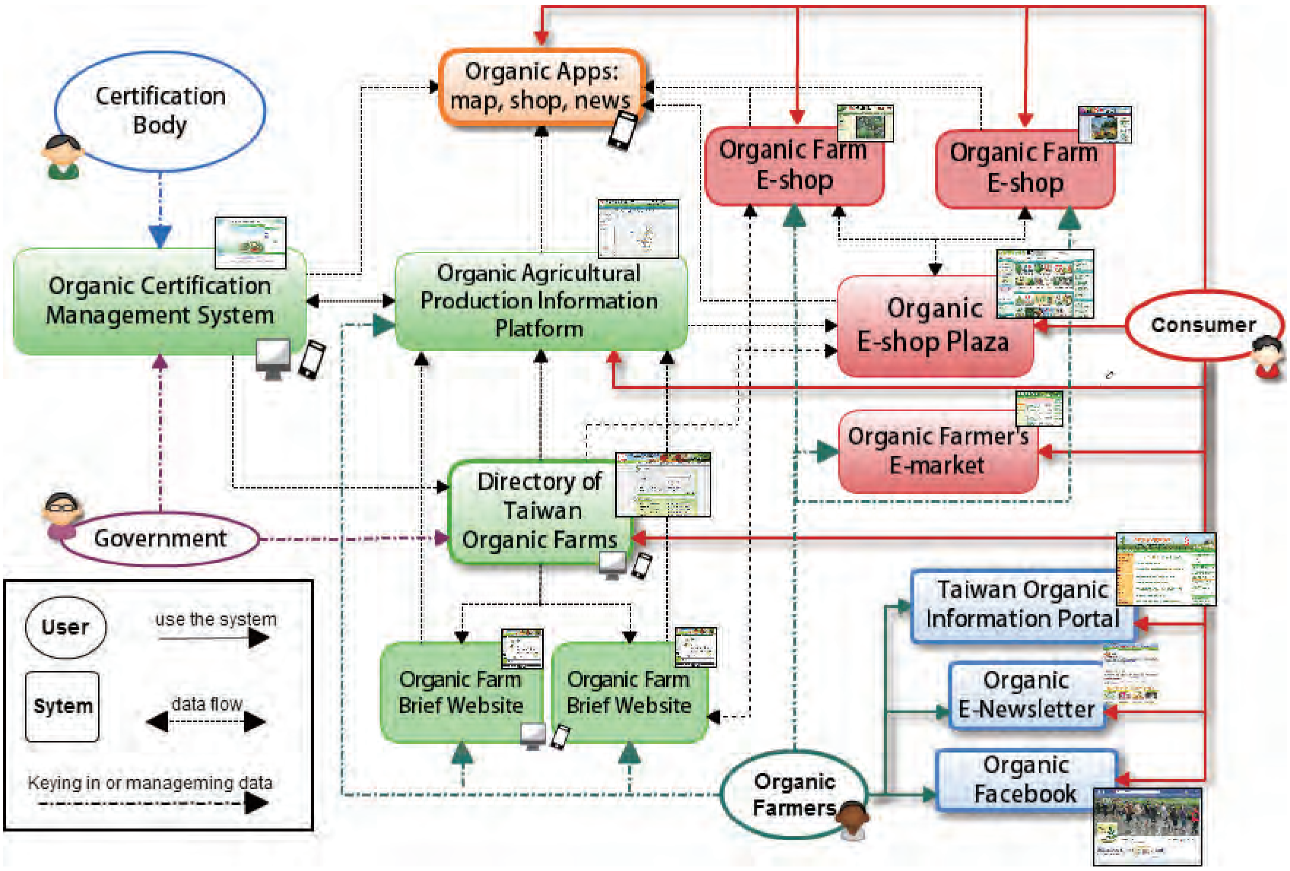

Figure 3-11 The structure of Taiwan organic agricultural information systems.

9 Written by Dr.Chang-Ju Huang-Tzeng (黃璋如教授), Director, Organic Center, National I-Lan University, R.O.C.

The dissemination of Organic Information

The initial idea of The Portal was to introduce the ideas and rules of the organic agriculture to the public in order to speed up the organic agricultural development (Figure 3-12). Gradually, the focus has been turned to food safety and organic consumption, where the records of the pesticide residue monitoring commonly become top search in the site.

Figure 3-12 Information dissemination board on Taiwan Organic Information Portal.

Systems derived from organic certification database

Corresponding to plenty of inquiries from the users of The Portal, such as whether the farm is properly certified or where to find an organic farm in his/hers neighborhood, the Certification Database Management System (http://oapv.coa.gov.tw/) was built in 2001 and put in use in 2002. All CBs in R.O.C. are required to key in the specified data about the certification of organic producers. The Directory of Organic Farmers system (http://www.i-organic.org.tw) was established in order to provide the search function (Figure 3-13). Aside from the certification data, other information about farms is integrated into this system.

Figure 3-13 Directory of Taiwan Organic Information Portal.

The Portal provides "brief website" of each producer where they could add on information about their farms, such as farmer introduction, farm scenery, traffic directions, logo, production plan, bank account, delivery fee, product pictures, and so on.The producers can also utilize the Uniform Resource Locator (URL) of their own website as an advertising tool (Figure 3-14).

Figure 3-14 An example of brief website of an organic farm.

This year (2013), a new application is derived from the brief website. The quick response code (QR Code) of the URL for each briefing webpage can be created then printed and/or labeled on the package of organic products. This QR Code is a very convenient medium for consumers to track the organic products through the use of smart phones. The government is subsiding each farm (USD 100) to encourage farmers to label the QR Code on their products.

E-commerce systems

The System of Organic E-shops (http://eshop.organic.org.tw) was established in 2005. It is a custom client/server system like an e-shop plaza (Figure 3-15). It allows organic farmers to create their own e-shop for themselves (Figure 3-16). There are approximately 130 e-shops in this system and is expected to grow with the USD 67/year government subsidy. Farmers nowadays only pay USD 134/year .

Because some farmers are not able to manage or pay for the e-shop system, the other system named organic E-market (http://market.organic.org.tw) is designed for them to post their sales information (Figure 3-17). Some popular posts in the E-market even got more than 3,000/month clicks. Recently, the organic mobile e-commerce system will be constructed by combining the use of APP technology, geographic information system (GIS), and location based service (LBS).

Figure 3-15 The organic e-shops plaza.

Figure 3-16 An example of organic e-shop

Figure 3-17 The system of E-market

Important Information Flow

After years of efforts, this portal continuously develops to be a multi-function system that includes the Directory of R.O.C. Organic Farms, Organic E-Shops, and Organic farmers' E-Market. In 2013, 29,000 people visited this portal per month, which is 7.7 times more than that in 2003. This portal always ranked first in all popular search engines of R.O.C. with the keyword "organic agriculture." The organic information portal becomes the most important online information source and contributes to R.O.C. organic agricultural development.

According to the database of The Portal, there are 249 organic businesses in the processing phase for crops (Table 3-5) and most of them are the processors. Reviewing the products processed in R.O.C.[10], it was found that organic teas, crop powder, soy products (such as soy milk, soy sauce and tofu), as well as fruit and vegetable vinegar are most popular. The organic livestock industry is not yet well-developed in R.O.C. yet. There are only 3 organic livestock farms producing chicken, chicken eggs, and duck eggs, and 2 processors producing milk powder. To date, according to the law, only the crop and livestock products can be certified as organic.

The imported organic food has to be labeled with the approval document. To date, there are 22 countries are recognized to be equivalent in organic crops[11] and 5 countries in livestock[12] to R.O.C. There are 206 organic importers in R.O.C. and the majority import crop products (Table 3-6).

Table 3-5 The number of businessesin organic processing, repackaging and distributing.

Nature of business	Number
Processing	130
Repackaging	33
Distributing	1
Processing & Repackaging	23
Repackaging & Distributing	40
Processing, Repackaging & Distributing	22
Total	249

(Source:Agriculture and Food Agency, R.O.C. (2013))

Table 3-6 The business of organic food importer

Product Categories	Importer
Crop Products	188
Livestock Products	10
Fishery Products	8
Total	**206**

(Source: Agriculture and Food Agency, R.O.C. (2013))

[10] http://www.afa.gov.tw/organicAgriculture.asp?CatID=235
[11] United Kingdom, France, Austria, Denmark, Finland, Holland, Germany, Italy, New Zealand, Australia, Sweden, Luxemburg, Greece, Spain, Ireland, Belgium, Portugal, USA, Canada, Switzerland, Hungary, and Chile
[12] Australia, New Zealand, USA, Canada and Chile

4. Key Policies on Organic Agriculture in R.O.C.[13]

In response to globalization and the liberalization of international trade, to ensure the sustainable development of agriculture and to better utilize the technological advantages and geographical conditions of agriculture in R.O.C., COA proposed the "Exquisite Agriculture Health-Excellence Program" (hereinafter referred to as The Program) based on the guideline of "healthy, efficient and sustainable management." The Program was approved by Executive Yuan, R.O.C. on 7th May, 2009, included in promoting six novel industries plan in R.O.C. The Program provides vision for advanced agriculture, provided people with new values of living, and created many intangible external economic benefits, so that the agriculture is not merely about production but also a green industry that serves people.

Aims of the Program

The Program was a medium term program for four years that started in 2009 aiming to double the organic farming area in R.O.C. when reaching 2012. Although typhoon Morakot caused a huge damage during the Program period, fortunately, the production and marketing were recovered in time. On the other hand, the program had obtained abundant achievements in the promotion of the safety of agricultural products, technology R&D and industrialization of key industries, leisure agricultural tourism, and so on.

There are many intangible external economic benefits in the agricultural industry; the program not only increases the additional value but also protects our health and social stability. The three major themes of the Program were: (1) Healthy Agriculture: Enhance the safety validation and create a toxic-free healthy island; (2) Excellent Agriculture: Lead the Technology R&D and Create an Island of Superior Agricultural Science and (3) Smart-Living Agriculture: Reshape the rural culture and create a smart-living island. Figure 4-1 shows the respective aim for 3 themes.

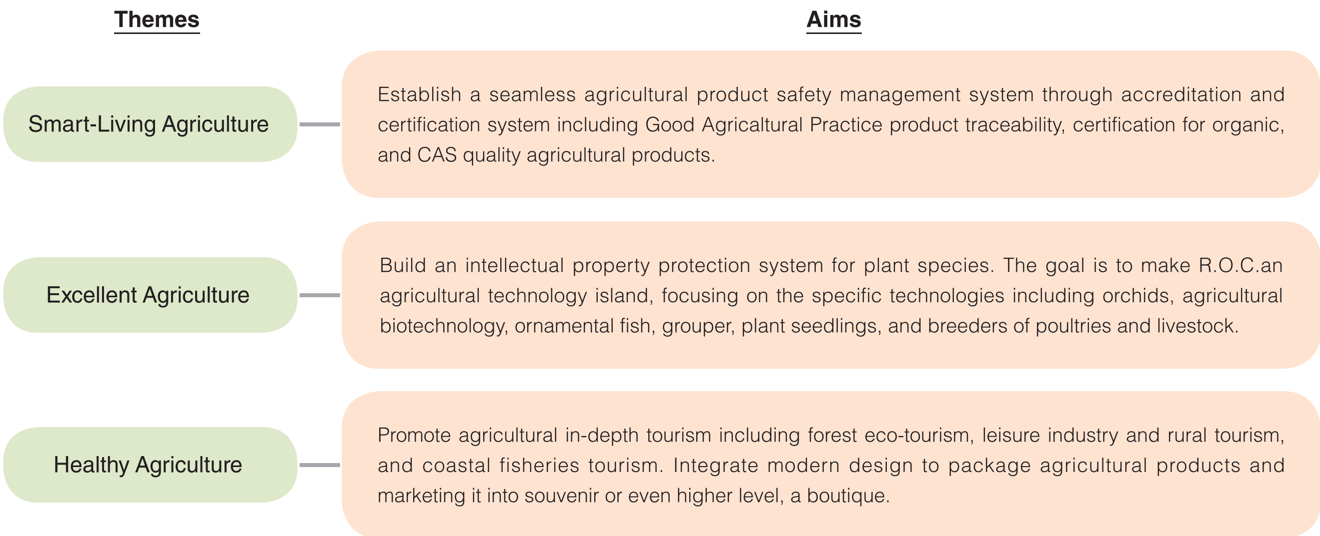

Figure 4-1 Three themes constituted in the Program and their aims.

[13] Written by Mr. Ming-Zhou Lin (林銘洲技正), Senior Specialist and Chief, Food and Agriculture Agency, Council of Agriculture, R.O.C.

Strategies and Achievements of the Program

The Program met the expected goals by the end of its execution period. Several strategies in different aspects have been applied which also distinguished organic agricultural sector in R.O.C. from other countries. The essential idea about the Program is to enlarge the organic production area, on the other hand, to expand organic market by bridging consumers and producers with trust. Therefore, the strategies adopted within the Program include:

(1) Enhanced the management of organic certification agencies

a. COA handles accreditation and audit for organic certification agencies and establishes a termination mechanism for the agencies.

b. Conduct annual organic auditor training exams to improve the certification quality.

(2) Strengthen the certification management of organic agricultural products.

a. Set related regulations and administrative work essentials according to the "Agricultural Production and Certification Act," adopt strict management and thorough investigation, and trace each controlled case until the completion of penalty.

b. Annually conducte label checks for 3,000 pieces, random quality test for 1,800 pieces, inspection for 252 pesticides, and 160 food additives to domestic and imported organic products (Table 4-1); the standard is "not detected" as provided in EU and Japan.

Table 4-1 Organic agricultural product testing results from 2009 to 2012 in R.O.C.

Item	2009			2010			2011			2012		
	Pieces	Failed	Passing Rate (%)	Pieces	Failed	Passing Rate (%)	Pieces	Failed	Passing Rate (%)	Pieces	Failed	Passing Rate (%)
Quality	1657	22	98.6	1853	12	99.4	1900	12	99.4	2068	19	99.1
Label	4621	199	95.7	3192	109	96.6	3254	69	97.8	3275	99	97

(Source:Agriculture and Food Agency, R.O.C.(2013))

(3) Promote centralized organic farming to achieve clustering effect

a. Coordinate with arable land acquirement: coordinate national-owned Taiwan Sugar Corporation and Veterans Affairs Commission to lease farms to the local government, to conduct overall planning for the organic zone in order to gather the massive area of diverse production and to avoid pollution by neighboring fields. From 2009 to 2012, there are 14 organic agriculture zones, occupying 642 ha.

b. Help farmers expand the operation scale: establish group organic cultivation, and encourage group certification. By September 2013, COA has guided and built 10 group cultivation areas, occupying 357 ha.

c. Develop multi-faced organic villages: Based on rural regeneration policy, community development, and public construction, 12 selected intensive organic farm areas were built into organic villages (clusters) combined with production, lifestyle, and ecology, by the end of 2012.

d. Develop and promote organic cultivation techniques: COA have established 8 "organic agriculture research teams" and "organic technique service groups" to conduct research and promotion from market development, cultivation technology R&D, and industry counseling.

e. Develop multiple marketing channels for organic products: construct the organic group-meal supply system for school meals; set up organic specialized area in supermarkets and organize farmers' market and electronic stores.

f. Strengthen the promotion of consumer education.

5. Cooperation between R.O.C. and Other Countries

R.O.C. dispatched its first overseas agricultural mission to Vietnam in 1959 and unveiled the history of technical cooperation mission. It then expanded from Asia to African Continent especially many newly independent countries. In 1960s, R.O.C. government established the International Development Fund (IECDF) in 1989 for overseeing economic assistance to developing partners. As the variety of cooperative development projects expanded yet further and the number of overseas technical missions increased, the government dissolved the IECDF in 1996 and established an independent organization, the International Cooperation and Development Fund (TaiwanICDF) dedicated to boosting socio-economic development, enhancing human resources, and promoting economic relations in a range of developing partner countries. Every new project from TaiwanICDF is to proceed according to a rigorous project cycle and reach mutual consensus by relevant stakeholders.

In over 50 years, R.O.C. agricultural assistance has developed into a wide range of technical cooperation. TaiwanICDF now operates 27 permanent technical missions in 27 partner countries across Africa, Central and Latin America, the Caribbean, Asia-Pacific, and the Middle East. The successful cases of TaiwanICDF's technical missions have been acknowledged worldwide, TaiwanICDF technical group in Nicaragua had been invited by FAO in 2010 to share their outstanding experience with FAO staff and Nicaraguan government. However, the most rewarding feedback comes from the smile of people living in area where the mission is implemented. Take the project on "Citrus Greening disease prevention" in El Salvador for instance, the project matters thousands of job opportunities and nearly USD 1 billion gross output value since citrus plantation is a dominate industry in OrganismoInternacional Regional de Sanidad Agropecuaria area which includes 9 countries in central and southern America. Similar stories are taken place in partner countries in Asia southeastern countries, hereby are two examples demonstrating nicely the missions in Indonesia and also Thailand.

▶5.1 Cooperation between TaiwanICDF and Royal Project Foundation(RPF),Thailand [14]

1. Background

The RPF was founded in 1969 by His Majesty the King of Thailand with the objectives: 1) to help the hill tribes for humanitarianism, 2) to help the nation by reducing the destruction of natural resources in terms of forest and watershed, 3) to stop opium cultivation, 4) to conserve soil and make proper use of land, that is to avoid the encroachment of cultivated fields upon forest areas, and 5) to produce cash crops for the benefit of the Thai economy. RPF and TaiwanICDF started technical cooperation in 1996 and ended in 2004. The bilateral cooperation was restored in November 2010 and an Agreement was signed in Taipei, R.O.C. Based on the Agreement, TaiwanICDF is to assist the horticultural development project locally, including mushroom, passion fruit, citrus, and astringent persimmon. The essential progress to make in this project is to improve the productivity and quality with advanced technology.One of the breakthrough achievements is to solve serious virus infection on passion fruit plants and fruits.

2. Serious problems with passion fruit plants and fruits

RPF has extended No. 2 purple passion fruit varieties to nearly 600 farmers more than twenty years, however, the problems with either deformed or

[14] Written by Mr. Cheng-Kuo Yang, Technical Cooperation Department, International Cooperation and Development Fund (TaiwanICDF)

shrinking fruits and twisted leaves led to massively lower commercial value of the fruits. It was until January 2012, project manager of TaiwanICDF visited the fields (Figure 5-1) and diagnosed that the deformed passion fruits were caused by boron-deficiency symptom, meaning that the plantations lacked a micro-element, “boron”. After that, he also discovered that the plants were seriously infected with PWV (passion fruit woodiness virus) that caused the plant leaves twisted and made the fruits shrink and become distorted.

Figure 5-1 The staff of TaiwanICOF and RPF having discussion in the field.

3. Solutions and Support from R.O.C.

First of all, the project manager asked the Royal Project technicians to apply a small amount of Borax to the field to improve the symptom. Later, phytologists specialized in passion fruit virus were invited to participate in the Project to survey and solve the virus infection problem. Several biotechnological methods were adopted to detect the virus also propagate virus-free grafted plantlets for farmers. Ultimatly Professor Chang Ching-An from Chao-Yang University recommended that the production of virus-free plantlets and the multi-virus detection technique were the measures to solve the passion fruit virus problem in Royal Project. Based on the research by Dr. Chang, 300 Tainung No.1 passion fruit grafted plantlets from R.O.C. to use as mother plants and to build isolated green houses to keep the mother plants for producing healthy plantlets (Figure 5-2). TaiwanICDF assisted with green house construction techniques and materials. Furthermore, researchers from RPF were invited to Dr. Chang’s lab to learn multi-virus detection technique.

Figure 5-2 The passion fruit produced from virus-free grafted plantlet.

4. Specific outcomes

The propagation of virus-free passion fruit plantlets was started in March 2013. From March to November 2013, a total of 1700 Tainung No.1 virus-free grafted plantlets were produced and sent to 15 Royal Project work stations for field trial. Until December 2013, Tainung No.1 virus-free plantlets are still growing well in the isolated houses. Two months later, the big round fruits with strong flavor were harvested and the fruits were sold at 40-50 Baht (around USD 1.5)/kg at the Royal Project shop. The customers gave the fruits high comments.

▶5.2 *Cooperation between TaiwanICDF and Republic of Indonesia*[15]

1. Background-Agribusiness Project

Two projects are presently be implemented by the R.O.C. Technical Mission in the Republic of Indonesia: an Agribusiness Project; and a One Village, One Product (OVOP) Agribusiness Project. The ultimate goals for both projects are to facilitate economic growth and increase opportunities for local citizens to generate wealth. Bogor Agriculture University (IPB) is the counterpart of TaiwanICDF in Agribusiness Project, there will be several achievements to be made in the project, including establishment of 1 organic vegetable production and marketing organization and 1 fruit and vegetable production and marketing organization; setting up of standard operating procedures (SOP_s) and technical standards for the cultivation and management of guava and vegetables, as well as waste composting systems. Besides production, the focus of project is also placed in sales, marketing, and also staff training. In final stage of the project, well-established Bogor Agribusiness Development Center will be transferred to IPB.

Taiwan ICOF Provides Agribussiness Consultation to IPB Counterparts

2. Project Progresses-Agribusiness Project

1. Extended 29.341 ha of fruits and vegetables; harvested 143.81 tons of fruits and vegetables; propagated 2,461,625 fruit tree and vegetable seedlings.
2. Drafted one guava seedling propagation technology and one organic vegetable pest management SOP_S manual in cooperation with IPB counterparts.
3. Developed four project migration-related SOPs.
4. Trained IPB counterparts to plan for four training courses, 12-product promotion activities and 4 exhibitions, experiences, and conduct research into horticultural exchanges between Indonesia and R.O.C.

3. Background-OVOP

This project is mainly to support development in Bangli and Badung regencies, Bali province, where oranges and asparagus have been selected as featured local products with which to develop distinctive local industries. Overall, the objectives of this project are to develop Bangli regency into a professional orange production area and Badung regency into a professional asparagus production area by improving cultivation techniques, increasing the quality of produce, and stabilizing yields. In cooperation with the Ministry of Cooperatives and Small and Medium Enterprises, the successful model in Bangli and Badung regencies for developing distinctive local industries will be transferring to the Indonesian government.

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⑮ Written by Ms, Yu-Hsien Yeh, Project Manager, Indonesian Technical mission, International Cooperation and Development Fund (TaiwanICDF)

4. Project Progresses-OVOP

By introducing modern agricultural techniques and increasing productivity and the quality of production, the project has produced the production worth USD 200,000. There were several orange and asparagus exhibitions, training courses, field demonstration, and consultation services taken place which are beneficial to more than 2,400 visitors, 440 participants, and 200 farmers. Establish tourist and leisure farms in both orange and asparagus production areas and integrate the OVOP project with local tourist operations to transform Bangli and Badung regencies into tourist destinations.

6. Prospect

There can be foreseen six major trends in agriculture with many challenges and opportunities. The first is commercialization. Through increasing fragmentation of agricultural activities and market efficiency, establishment of supply chain involving lots of small-and-medium business is the new trend. This trend development is more significant in Asia countries where most farmers are small-scale farming style. The second is globalization where both domestic and global supply chains through multinational enterprises and regional trade arrangements are emerging. The third is science and technology where productivity and efficiency of agricultural activities and supply chain management could be enhanced. The forth is environmental friendliness where agricultural pollution and land degradation can be avoided. The fifth is bioenergy which is unique to our agricultural sector. Only agriculture has the sustainable capacity to provide biomass recycling. The last one is food safety where increasing consensus requires reduction of pesticides and chemical fertilizers, increasing traceability of supply chains, and harmonization of global food safety standard. These six major trends are not independent. Actually they are interdependent.

Ecological agriculture involves all six major trends mentioned above. This manual provides an overview and case studies on ecological agriculture innovation and management model in R.O.C. The experience and policies towards ecological agriculture in R.O.C. may provide one of the best practices for other countries to learn where they share the same small-scale farming mode.

It is because organic agriculture is an industry concerned with production, lifestyle, and ecology, as well as an eco-friendly way of farming; it is critically beneficial to the water and soil conservation, food safety, and public health. Therefore, COA is aiming to make R.O.C. an organic agriculture island in a long run. Although organic farming area has been drastically increased since "Exquisite Agriculture Health-Excellence Program" the implementation by R.O.C. government in 2009, there are many challenges yet to be overcome: 1) The fragmented farming area caused by specific geographic and historical factors in R.O.C. makes individual fields adjacent closely to each other and the pollution through air and water coming from the neighboring fields has been the important constrain for organic farmers in R.O.C. Therefore it is essential to have a long-term development plan for domestic organic agricultural zones concerning the production, environment and water resource. 2) Due to urbanization, the rural population has been aged and relocated, it is important to motivate young generations to engage in agriculture production by replacing the traditional farming style with innovative and efficient management. 3) R.O.C.is located in a subtropical monsoon climate area, where it is hot and humid, with severe impacts by pests and diseases. The organic agriculture insect/pest control technology is one of the most important requirements for the organic farming transition. The urgent need is to develop and promote organic farming SOP for a variety of crops, which will reduce much stress for farming transition. 4) The agricultural products need complete marketing channels. It is important to incorporate the 2nd and 3rd levels of marketing into the organic industry to create new jobs for farmers and enhance the output value, and 5) The lack of understanding about organic agricultural products reveals the need to promote education of organic food agriculture, organic lifestyle and business opportunities for smart-living.

After almost two decades' endeavor, R.O.C. has had a significant progress in promoting organic agriculture. The promoting strategies have evolved over time from the aspects of on-farm production to consumers' education. In order to stimulate the booming of organic industry, it is encouraged to have cross-field cooperation and integration, for example, to link the environmental conservation initiatives with organic production to raise the awareness of consumers; to incorporate tourism into organic farming to create the leisure farming industry and to encourage private investment to support rural or aboriginal villages to develop organic agriculture. Meanwhile, in order to facilitate whole supply chain and keep its integrity, foreign materials and management system as well as organic seeds/seedlings are introduced to the market. On the other hand, natural resources such as water, soil and ecosystem should be conserved in the first place.

The goals of R.O.C government regarding to organic agriculture development are to reach 15,000 ha organically managed area, to share 2% of the overall farming area, to build up 20 organic villages, to have 400 certified organic processing and packaging factories, and eventually to achieve USD 430 million billion of output value. Although there is "Agricultural Production and Certification Act" covering CAS and traceability currently, the norms cannot respond to various needs. For reaching the prospects, a specific law needs to be developed exclusively for organic industry, including organic production, processing, materials, product quality, management and promotion of third-country trades, regulations, research and education, etc.

Moreover, of uniqueness to our agriculture sector is the innovation in bioenergy use. The vision is to cope with the global issue such as climate change and resource efficiency through diverse means of good agricultural management. The initiatives of replacing traditional energy source with renewable energy have been advocated when the upcoming shortage of the oil alerted, whereas solar power, wind power as well as biomass are developed. Biomass contains agriculture crops, agriculture residue, livestock residue, living waste and food process. The biomass utilization is seen as one of the key solutions for resource efficiency and environmental conservation, especially for those countries with massive agricultural production, such as India, Thailand, Vietnam, and the Phillipnes.

R.O.C. has had well developed techniques in renewable bio-fuel production from livestock excretion or organic waste from grain harvesting. Take the briquette production from rice residue as an example shown in Figure 6-1, there could form a sustainable biomass recycling from harvesting, processing, bio-fuel product to return the ashes back to the field, which not only reduces the fossil fuel consumption significantly, but also helps prevent of land degradation.

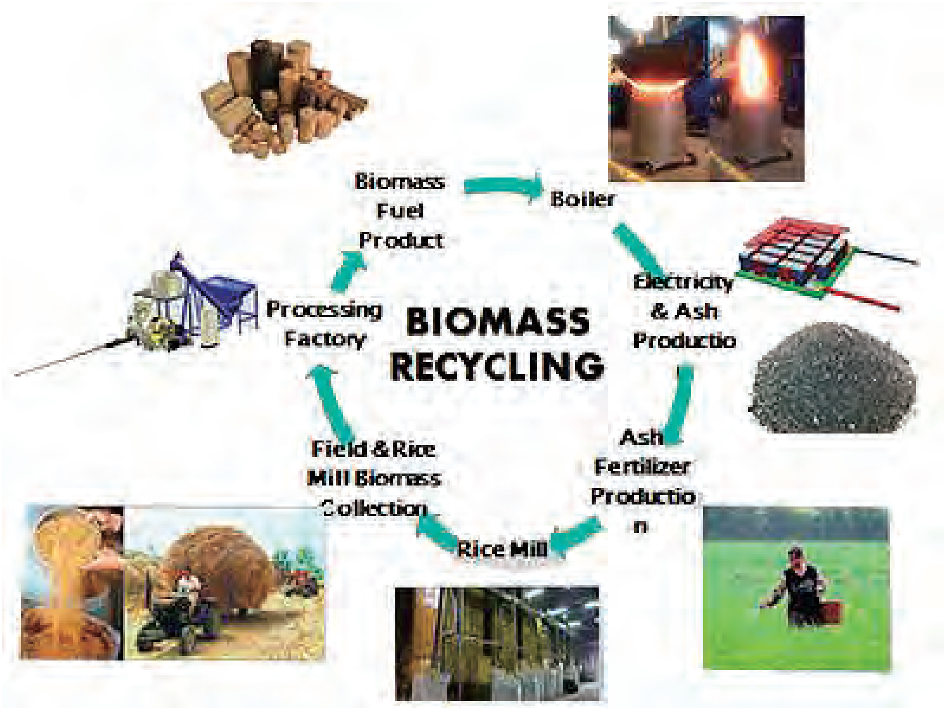

Figure 6-1 Steps of biomass recycling withrice residue as an example

(Source: New Bonafide Machinery Co. Ltd., R.O.C. (2013))

Our agriculture sector and Food Supply Chain play incredibly important role for food safety and food security. Along with the six major trends in agriculture, R.O.C. government is delighted to share her successful experiences in sustainable agriculture with other countries.

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How APO Member Countries Will Benefit

The APO COE GP will enhance, demonstrate and share with other countries its excellence in GP. It shall develop models in various sectors including manufacturing, service and agriculture to serve as showcase to inspire stakeholders in member countries. It shall initiate research to be undertaken in collaboration with APO on green issues. It shall provide technical assistance in specific sectors and provide experts to member countries when needed. A database on GP experts and other indicators will be established by the COE GP to serve the needs of members. The database will be made available online to community of experts and practitioners. Best practice manuals and handbooks shall be published to serve the needs of all stakeholders.

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