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高德錚

2012 年 9 月 20~21 日應邀赴印尼參加 2012 APEC 專家會議以“臺灣如何制定糧食多樣化策略來發展國家糧食產業之經驗”為題專題報告，茲將報告內容摘錄如下：

## Development of National Food Industry As Food Diversification Strategy in Chinese Taipei<sup>1</sup>

Te-Chen Kao<sup>2</sup>

### Abstract

The 32% sustained lower food self-sufficiency rate of Chinese Taipei weighted by energy in around 2005- 2012 is the bottleneck issue need to make the further improvement. The national food self-sufficiency ratio is an important issue concerned with food insecurity for the country development. Rice is the major staple food in Chinese Taipei, and it is sufficient of rice production since 1975. However, the cereals of wheat, corn, barley and soybean are five time more in volume imported both to meet for the food consumption and animal feed. The major factors caused to the food insecurity in Chinese Taipei are the lower rice consumption due to eating dietary pattern change and the quick expansion of livestock and fishery industries. The agriculture sector of it is serious facing challenges of the small scale of farming, aging farmers, large acreage of set-aside farmlands, soaring price of fertilizers, natural disasters accelerated by global climate change, and rapid changes in world food price. To cope with these challenges, Chinese Taipei will secure the stable food supply through revitalization of its set-aside farmlands and international market, and provide with advanced technical assistance to local farmers, in particular on the imported substituted food crops cultivation and consumption. This presentation provides information and experience on noteworthy measures in food diversification strategy in Chinese Taipei.

**Key words:** Strategy, Food Diversification, Self-sufficiency

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1. Paper presented in the “The Workshop On The Potential of Local Resources and Establishing Network Among Agricultural Research Centers On Food Diversification” held in Bogor – West Java, Indonesia, September 20 – 21, 2012.

2. Deputy Director of Taichung District Agricultural Research & Extension Station, Council of Agriculture, Taiwan, The Republic of China.

## I. Overview

Chinese Taipei is a mountainous subtropical island country with limited natural resources. The country has one of the world's highest population densities with a population of 23 million and only a total land area of 36,000 km<sup>2</sup>. The flat plain with 81,300 ha of cultivated land which occupied 24% of the island. Agriculture and food industry stood as the foundation of national economy and provided a livelihood for a broad base of farmers.<sup>(4)</sup> The share of agriculture in the GDP had accounted for 32.2% in 1952. Along with the rapid growth of other economic sectors, the share of agriculture in the economy has been declining. In 2010, agriculture generated a mere 1.58% of gross domestic product (GDP), 1.52% of total exports, and 5.24% of total employment. However, agriculture still plays an important role in terms of food security, rural development and nature conservation.<sup>(2)</sup>

Food security has been always the most crucial issue all over the world. In 2005-2006, in average some 16 per cent of the population in the Asia and Pacific region suffered from hunger and their food intake fell below the minimum dietary energy requirement set by the FAO. In 2007 and 2008, the figures of hunger were even higher due to the soaring food prices.<sup>(1)</sup> In Chinese Taipei there is none hunger suffered food supply but imbalance in nutrient uptake, and **over-reliant on imported food as well.** (Table 1)

## II. Food Security Situation

### a. Food Supply and Demand

In Chinese Taipei, the domestic food crop production including rice, wheat and corn & other cereals, in totaled 1.53 million tonnes of Taiwan's total consumption of 8.24 million tonnes of these crops.( Table 2). The food supply was composed by cereals 83.8 kg (including rice 46.2 kg), vegetables 104.7kg, fruits 127.3 kg, meats 75.6 kg, milk 42.3 kg, eggs 17.2kg , fish & shelf fish 33.4 kg, and oil and fat 22.7 kg. It showed that the consumption of rice was significantly decreased, (Table 2).

Table 1. Taiwan Food Import (Unit: 1000 metric tons)

Category	1990	2000	2005	2007	2009	2010
Cereals	6194.6	6,285.4	6,562.6	5,850.9	6,259.7	6,715.2
- wheat	<u>848.1</u>	<u>1,157.9</u>	<u>1,282.2</u>	<u>1,177.2</u>	<u>1,237.8</u>	<u>1,138.2</u>
- Barley	<u>236.4</u>	<u>139.9</u>	<u>140.7</u>	<u>63.8</u>	<u>62.3</u>	<u>66.3</u>
- Sorghum	<u>33.5</u>	<u>38.1</u>	<u>75.6</u>	<u>67.9</u>	<u>68.9</u>	<u>69.8</u>
- Corn	<u>5,070.9</u>	<u>4,941.8</u>	<u>4,980.1</u>	<u>4,380.4</u>	<u>4,592.4</u>	<u>5,007.5</u>
- Rice	<u>5.7</u>	<u>7.7</u>	<u>84.0</u>	<u>161.6</u>	<u>8.6</u>	<u>154.6</u>
Soybean	1,991.3	2,301.8	2,446.0	2,379.5	2,359.3	2,542.8
Vegetables	91.2	222.6	384.8	432.8	410.2	400.1
Fruits	324.7	583.2	610.7	511.8	382.9	395.5
Meat	58.7	183.7	274.7	227.6	275.2	316.2
Eggs	0.8	0.5	0.6	0.4	0.3	0.3
Fish & shell fish	78.1	179.8	172.2	183.7	191.4	209.9
Milk and milk products	100.3	140.4	137.3	132.0	134.7	139.1
Oils and fats	193.3	322.6	395.9	347.4	349.7	350.4

Source: The Statistic Book, 1990-2010, Council of Agriculture<sup>(3)</sup>

Table 2. Annual Available Food Consumption in Chinese Taipei

Category	(Units: Kg Per Capita Per Year)					
	1991	2000	2005	2007	2009	2010
Cereals :	99.5	92.5	91.5	88.4	87.7	83.8
- Polished Rice	<u>62.5</u>	<u>52.7</u>	<u>48.6</u>	<u>47.5</u>	<u>47.1</u>	<u>46.2</u>
- Flour	<u>28.5</u>	<u>32.6</u>	<u>38.0</u>	<u>36.0</u>	<u>35.9</u>	<u>32.5</u>
- Corn & others	<u>8.5</u>	<u>7.2</u>	<u>4.9</u>	<u>4.9</u>	<u>4.7</u>	<u>5.1</u>
Starchy Roots	21.2	23.7	21.7	21.3	21.9	22.8
Vegetables	97.5	115.4	104.3	103.8	103.6	104.7
Fruits	129.8	136.3	123.3	128.4	118.9	127.3
Meat	67.2	79.0	77.1	74.4	73.7	75.6
Eggs	13.7	19.2	16.8	17.2	16.4	17.2
Fish & shelf fish	39.7	40.2	47.4	37.0	31.0	33.4
Milk and milk product	51.4	56.0	47.36	47.2	42.9	42.3
Sugar & Honey	26.3	28.7	26.67	24.2	25.4	24.1
Purses& Oil seed	29.4	26.4	27.34	27.5	25.1	25.4
Oils & Fats	23.7	25.1	26.26	24.4	22.2	22.7
	400.4	457.5	426.73	417	393.4	411.7

Source: The Statistic Book, 2011, Council of Agriculture, ROC<sup>(3)</sup>

Among the food supply, the food self-sufficiency ratio is only 31.8% weighted by energy (68.9 % weighted by prices) in 2010, which is almost the lowest one among East Asia countries. (Fig. 1) The ratios varied among various categories of food. The ratios of eggs, fish & shelf fish, vegetables, and fruits are pretty high while the ratios of staple food supply like cereals of flour, corn and soybean were quite low except rice. (Table 3)

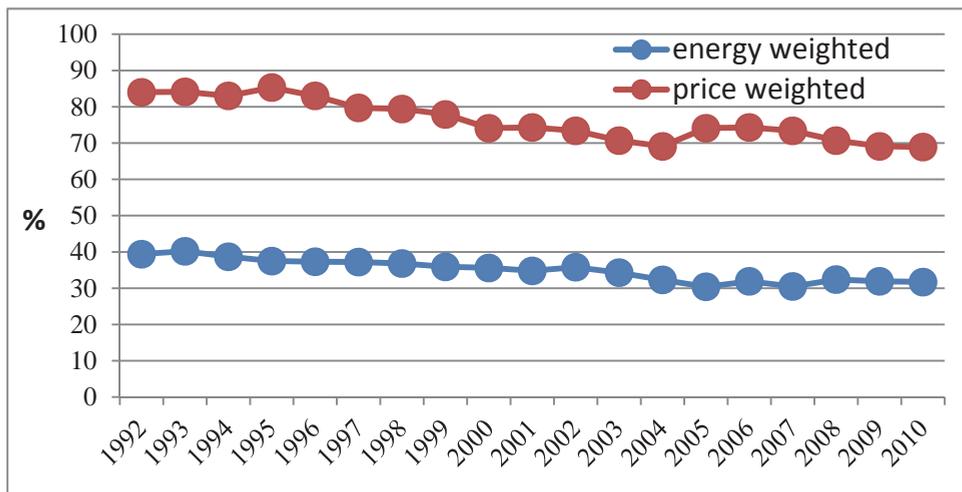


Fig. 1. Trends in food self-sufficiency rate in Taiwan

Table 3. Taiwan Food Self supply rate on each item (Weighted by domestic supply, Unit: %)

Category	2000	2005	2007	2009	2010
Cereals	58.6	41.9	36.5	38.2	36.6
- polished rice	<u>106.10</u>	<u>89.30</u>	<u>84.20</u>	<u>96.90</u>	<u>91.90</u>
- flour	<u>0.03</u>	<u>0.03</u>	<u>0.02</u>	<u>0.03</u>	<u>0.03</u>
- corn & others	<u>1.80</u>	<u>1.70</u>	<u>1.70</u>	<u>2.07</u>	<u>1.54</u>
Soybean	0.5	0.5	0.5	0.5	0.5
Starchy roots	30.7	36.2	22.1	27.7	25.3
Vegetables	86.4	87.4	83.3	86.1	87.6
Fruits	86.4	87.5	85.7	84.8	86.9
Meat	82.5	78.4	72.6	70.6	69.9
Eggs	100.1	100.1	100.1	100.1	100.1
Fish & shelf fish	123.7	139.6	148.9	125.2	127.2
Milk and milk products	30.3	28.7	27.8	31.2	30.9
Sugar & Honey	20.6	20.6	19.5	13.7	11.0
Purses& Oil seed	8.3	7.9	7.2	6.7	7.0

Source: Food Supply and Utilization Year Book, 2010, Council of Agriculture<sup>(2)</sup>

### b. PFC supplied Calorie composition

The dietary patterns of Taiwan are varied with the increase of fat intake and decrease in carbohydrates and the per capita food consumption in energy term was 2,685 kilocalories per day in 2010.(Table 4) which was 254 Kcal per capita lesser than 2000. Recently, the eating habit changes with the increase in eating-out and diversification of consumer preference and demands as contributed by the different age range. New food industries are developed to meet the consumer demands, especially on the young generation

Table 4. Taiwan per capita Daily Nutrient Availablely and PFC Ratio

Year	Item	PFC Ratio(%)		
	Daily Energy intake Kal Per capita	Protein (P)	Fat (F)	Cabohydrates (C)
2000	2,949	13.1	37.7	49.1
2005	2,899	12.7	39.3	48.0
2007	2,800	13.3	38.3	48.4
2009	2,701	13.0	37.3	49.7
2010	2,695	13.2	38.5	48.3

### III. Major constraints for food Security development <sup>(5, 9)</sup>

The agricultural development in Chinese Taipei is now facing tremulous impacts and challenges both at home and abroad. It is included with the pressure of trade liberalization, increasing concern about food safety, food security, global warming and environmental conservation. The turf issues are cited in followings:

#### A. Aging farmers:

The average age of the farmers is 63 years old in farming according to the statistical Book FY 2011.<sup>(3)</sup> Aged farmers who still own the land right but tend to be lesser efficiency, and over-reliant on subsidies from the government.

#### B. Smaller farming size:

The average farm size of Taiwan is 1.1 hectares since 1951 which is incomparable to the farm sizes of Japan, EU and US with 1.6, 20, and 190 hectares,

respectively. Only 25% of the farm households had a farm size with area more than 1.1 ha. The small scale farming system caused to weaken in the enhancement of crop productivity in Taiwan's agriculture.

C. The enlargement of set-aside farmlands:

Rice is the most important staple in Taiwan. Since entering the World Trade Organization (WTO) in 2001, Taiwan has to fulfill its commitments and abide by the WTO rules by opening up its agricultural market. In response to the importation of 144,720 metric tons of brown rice following the WTO accession, the government adopted the rice paddy and upland field utilization adjustment program. This program is basically an extension of the previous paddy field diversion and set-aside program. All farmers whose paddy fields joined in the rice price guarantee purchase program in the base year of 1994-1996 are eligible to register for the new program. Upon approval, the farmers will receive a direct payment of up to US\$ 1,360 per ha per cropping season. This is a rather attractive alternative especially for those farmers with low-yield or unproductive rice paddies. The set-aside acreage has consequently tripled from 65,000 ha in 1997 up to 220,000 ha in 2007. The total acreage set-aside plus acreage diverted has exceeded the acreage harvested since 2004.<sup>(5, 6, 7)</sup>

D. Lower rate in food self-sufficiency:

The food self-sufficiency ratio of the Chinese Taipei is maintained constantly low only around 32 % weighted by energy (70 % weighted by prices) in 2005-2010, which is almost the lowest one among East Asia countries. How to promote the food self-sufficiency ratio becomes a crucial issue.<sup>(6, 8)</sup>

E. Soaring prices of agricultural materials:

Prices of chemical fertilizer and other agricultural inputs are inflamed by high oil price, which may remain constantly high in the foreseeable future and will reduce the incentive of agricultural and food production.<sup>(4, 5)</sup>

F. Natural disasters accelerated by climate change:

Natural disasters have contributed to the shortage in food crop production in recent years. Unstable production resulted from changes in production patterns and frequent floods and draughts.

#### G. Rapid changes in world food price:

Under the rapid increases in demand in emerging economies such as China, India, Brazil and Russia for high quality foods, Taiwan tends to lose in buying competition. Soaring grain prices due to rapid increases in demand for bio-fuel is damaging dairy and livestock farmers. <sup>(7, 9)</sup>

#### IV. Strategy for food diversification development

To cope with the impacts and challenges, the present agricultural policy in Taiwan is based on three guidelines: “Healthfulness, Efficiency, and Sustainability. The main achievement of the three guidelines is to the developing healthful agriculture as to protect consumers’ rights and interests, to the developing efficient agriculture as to improve international competitiveness and to the developing sustainable agriculture as to maintain the ecological harmony. The food diversification development strategy is contributed into several aspects as follows:

##### **1. Diversification of rice varieties bred and cultivation**

###### (1). Breeding of Super high-yield of feed rice:

The new feed rice varieties with hectare yield of 8-10 tonnes are selected to take for corn as to meet the animal feed demand.

###### (2). Selection of Super high quality of bread rice

(a). The high quality local Japonica rice varieties are selected to take for certain parts of imported flour ( 20 - 50%).

(b).The high quality local Japonica rice varieties are bred to obtain functional components i.e. with special aromatic flavor, low alpha-amylase, high phytin, high vitamin E and superb embryo with high GABA etc.

###### (c). Stress resistant rice variety bred

The breeding goal is setup to the selection of extreme climate resistant breeds.

(3). Encouraging farmers to the rational use of fertilizers based on soil testing analysis and recommended dosage of fertilizer application.

(4). Accessing organic rice farming practices.

In 2008 Taiwan had about 820,000 ha. arable land, of which 25,000 ha or 3% of the total produced GAP, organic, and traceable products. By 2012 such products will reach up to 50,000 ha., or 6% of the total farm land and the organic rice farming will occupied half of it.

## **2. Selection of Stress resistant variety of winter wheat**

The breeding goal is setup to the selection of 105-day wheat variety as to fix onto the winter-fallow cropping pattern.

## **3. Administrative extension in food crop production increase**

Due to government policy, until 2004, a sum of 220,000 hectares farmland has been currently set-aside, The Program of “Revitalization of Set-aside Farmland” has started launched to make effective use of land that has become idle.

### **(1). Raising Self-Sufficiency for rice and feed corn**

In order to reach the set goal of 40 % food self-sufficiency rate, Chinese Taipei government launched a program in 2008 to encourage farmers to grow feed corn on fallow land. Planted area was 12,000 hectares, yielding 60,000 tonnes of feed corn to meet local demand. In 2012, more 1,000 hectares, of winter inter-cropping land will grow wheat yielding 3,000 metric tonnes of wheat to meet domestic demand.

### **(2). Efficient utilization of agricultural resources and improving environmental conditions in rural areas.**

A program entitled “Turning Small Landlords into Large Tenants” in 2008 enables tenant-farmers to expand farming scale and boost production efficiency. In 2011, more 73,000 hectares of set-aside land are revitalized to grow rice, feed corn, forage herb and soybean.

### **(3). Natural disaster damage reduction**

Typhoon Morakot with 3,000 mm rainfall in 3 days devastated Chinese Taipei in August 2009 with US\$ 30 million loss in Agricultural industry. Improving disaster preparedness in the agricultural sector and establishing a regional emergency food reserve system will make a significant contribution to safeguarding food security in emergency situations. Therefore, Chinese Taipei

proposes the establishment of a cost-effective, cooperative AFERM (APEC Food Emergency Response Mechanism) in accordance with the principles of voluntary contribution, collective action, risk-sharing and self-management.

#### **4. Promotion in food Processing industry**

(1) Program of “One Village One Product” was conducted by Local Farmers’ Association. With the regional brand to ensure the quality of the commodity was found in rice package. Local specialty alike rice package of “池上” and “西螺” are two of typical popular example. Besides, food processing of rice biscuits, rice burgers and rice bread etc. were creatively innovated by Home Economic Group to expand its multiple uses.

(2) Program of “Local product local Consumption” was to ensure the freshness and low carbon footprint of the food. Farmer’s market was established to attract more consumers with organic fresh food.

(3) Change consumer dietary pattern and lifestyle:

Program of “Daily one more bowl per capita a day helps to grow 5600 hectare more of paddy rice” is to encourage the people Chinese Taipei to consume more rice product. Besides, to have rice cook and mix with certain percent of sweet potato and other local yam is suggested to diversify the dietary pattern and lifestyle. These concerns need to attention in terms of prevention of fat-intake-overabundance. (Table 4 )

#### **V. Conclusion**

Chinese Taipei is a net food importing country and over-reliant on international market. Ensuring a certain level increase of food self –sufficiency, food crop productivity and boosting the production efficiency will always be the key to safeguarding food security of it. Moreover, in order to meet the needs of future generations, government investment more R&D efforts onto the creatively innovated technologies for developing modern agricultural practices and to the high quality product in crop production systems are of vital importance. As for the future respects, while Chinese Taipei needs to pay more attention on its food security issue, promoting

technological innovation in import-substituted crop that can adapt to extreme climate and fostering the adoption of environmentally -friendly farming practices are still in turn key to ensure food security.

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