

**The Change of Food Consumption Patterns  
— Implications to Rice Economy in Taiwan**

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**Abstract**

An increase in per capita income, not only a smaller percentage of that income is spent on food, but also the structure of food consumption is changed. The proportion of calories that an individual derives from the basic starchy staple is expected to decline along with rising income. The phenomena impacts considerably on rice and agricultural production in newly industrialized countries.

In this paper, the author firstly discusses the trend and the structure of food consumption in Taiwan during the last three decades. Then, briefly describes rice production, consumption and marketing situation in Taiwan, and the forecasts of consumption and production for major land-base crops is also presented. The production of rice has fallen steadily since 1977, but the decreasing rate of production still far behind that of consumption. Owing to high rice production cost, rice export to dispose rice surplus with great loss is not justified. While an overproduction of international rice economy is anticipated in the future, hence, how to restructure a new crop pattern is the most effective approach to solve the rice surplus problem in Taiwan.

**I. Introduction**

An economy with increasing per capita income requires

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that agriculture must undergo continuous changes and adjustments. Unfortunately for those in farming, these necessary adjustments all lead in one direction — agriculture becomes a declining industry. A necessary condition for agriculture to decline is that as the income of a person or family increases, that person or family spends a smaller percentage of the increased income on food. Or stated differently, the larger a family's income is, the smaller percentage of that income will be spent on food.

Moreover, the proportion of calories that an individual derives from the basic starchy staples (mostly grains and root crops) — the starchy staple ratio — falls with rising income as the consumer diversifies the food consumption bundle to include higher-priced source of calories.<sup>1)</sup> Grains are consumed indirectly in the forms of meat, milk, and eggs. Therefore, both the proportion of family's budget devoted to food and "starchy staple ratio" decline as household income increases that substantially influence the growth and the structure of agricultural production. The purposes of the paper are to analyze the changes of food consumption in Taiwan, and to discuss the implication of these change, to rice economy.

## II. Growth of Food Consumption

If relative prices are constant, the growth in demand for any commodity or service can be depicted as follows:

$$D = P + \eta g$$

where  $D$ ,  $P$  and  $g$  are growth rates of quantity demand, population and per capita income, respectively, and  $\eta$  is income elasticity of demand for a particular commodity or group of

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1) The relation between starchy staple ration and income is usually called as Bennett's law (Timmer, Falcon, Pearson, 1983).

commodities. If the income elasticity of demand is 0.5,  $g$  is 3 percent and  $P$  is 1 percent,  $D$  will be 2.5 percent. For given growth rate of income and population, the smaller is the income elasticity of demand, the greater is relative importance of population as a demand shifter.

Engel's law states that the proportion of a family's budget devoted to food declines as the family's income increases. One common interpretation of the law is that the income elasticity of demand for food is less than one. Although this seems to be universally true for all aggregate income elasticities for entire societies, individual low-income consumers may actually have income elasticities of demand for food of one or greater. However, the possibility that income elasticity of demand for some food items may be zero or negative cannot be ruled out.

As long as the income elasticity of demand for food is greater than zero, an increase in per capita income will result in some increases in the amount of food demanded, assuming constant prices. Then why is an income elasticity of demand less than unity of such critical importance for requiring change in agriculture? The reason is that income elasticity of demand for all goods and services produced in an economy is unity under conditions of full employment and departs from unity only slightly during period of moving away from or back towards full employment.<sup>2)</sup> If the income elasticity of demand for food is less than unity, the income elasticity of demand for all other goods and services is greater than unity. When per capita real income increases, the demand for food will increase less, proportionally, than the increase in income, and the demand for everything else will increase proportionally more than the increase in income. Put this in another way, the rate of increase in the demand for food will be less

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2) The idea of unity aggregate income elasticity is from D.G. Johnson (1973).

than the rate of increase in the demand for everything else.

Not only income elasticity of demand for food is low in industrial economies, but also the income elasticity declines as real per capita income increase. Not only does the demand for food grow more slowly than the demand for all other goods and services, but also the relative discrepancies between the growth rates enlarge as real incomes rise.

Based on the data of per capita consumption of major food items provided by "Food Balance Sheet" which published by the Council of Agriculture (COA), Republic of China, using average retail price of major food items during 1980-1982 as weight, and annual per capita food expenditure, income elasticities of demand for food are calculated and given in Table 1.

Table 1. Income Elasticities of Demand

Year	Per Capita Income	Food	Nonfood	Discrepancy	Food/Nonfood
	(US\$)	(1)	(2)	(3)=(2)-(1)	(4)=(3)(2)x100
1961	151	0.52	1.50	0.98	35
1966	221	0.49	1.47	0.98	33
1971	410	0.41	1.43	1.02	29
1976	1,039	0.36	1.46	1.10	25
1981	2,424	0.34	1.36	1.02	25
<b>Average</b>					
1962-1966		0.51	1.47	0.96	35
1967-1971		0.44	1.44	1.00	31
1972-1976		0.38	1.46	1.08	26
1977-1981		0.34	1.41	1.07	24

Source: Tso-Kwei Peng, *The Issue and Policy for Farm Product Price in Taiwan (in Chinese)*, *Quarterly Journal of Bank of Taiwan*, Vol. 36, No. 4, Bank of Taiwan, Dec. 1985.

The income elasticities of demand for food and for nofood were 0.52 and 1.50, respectively, in 1961, and those elasticities decreased to 0.34 and 1.36, respectively, in 1981. During the period of 1962-1966, the growth in demand for food due to an increase in per capita income was about 35 percent of the growth in demand for all other goods and services. During 1977-1981, the growth in demand for food was only 24 percent as great as for all other goods and services. It is quite clear that in aggregate further increases in per capita income will absorb only a small part of further agricultural output increases.

Another important element affecting the growth in demand for food and other products is the growth rate of population. Population growth does not have a differential effect on demand growth, if we assume that all other important variables remain unchanged. In other words, the population elasticity of demand is unity for all goods and services. As per capita income increases, however, there is a clear tendency for population growth rate to decline. The growth rate of population was 3.8 percent in 1953 and dropped to 1.5 percent in 1984, and it is expected to decline further to around 1 percent by the year of 2000 in Taiwan.

Economic growth appears to have an inherent limitation to the increase of the variable that shifts the demand for food products at the same rate as for all other goods and services. During the last two decades, due to the sharp decline of the income elasticity of demand for food, the increasing rate of food demand has been slowed down in Taiwan. The increasing rate of food demand was 5.8 percent during 1962-1966, and it declined to 3.6 percent during 1977-1981, as shown in Table 2.

An increase in real per capita incomes means that both aggregate supply and aggregate demand are increasing and that the demand for farm products is increasing as well, although more slowly than the demand for all other goods and services.

Table 2. Growth Rate of Food Demand and Agricultural Production

Period	Growth rate of population	Growth rate of per capita income	Income elasticity	Growth rate of demand	Growth rate of production
	(P)	(g)	( $\eta$ )	(D)	
1962–1966	3.10	5.36	0.51	5.83	5.83
1967–1971	2.92	7.76	0.44	6.33	5.72
1972–1976	1.94	5.68	0.38	4.10	3.28
1977–1981	1.90	4.90	0.34	3.57	1.09

Source: The Same as Table 1.

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But farm output has increased more slowly than the demand for farm products during the last two decades in Taiwan, as shown in Table 2. Those indications show that although the increasing rate of food demand has been influenced substantially by Engel's law, it is not a critical factor as to have caused the slowed growth rate in agricultural production. Agriculture in ROC has continued to face the challenges of economic structural adjustment since a turning point of economic development is reached.

Although the relative price of farm products has increased, agriculture's share of all economic indicators, including employment, has begun to decline even since in 1953. Despite of new workers entering the market, the net agricultural employment began to decline in 1965, and the pace of decline gradually increased. By 1968, agriculture began feel real stress. The decade of 1970's saw a net loss in agricultural employment by 424,000 workers, and the outmigration rate of farm labor is much higher than either more advanced or less developed countries.

Introduction of new input and new technology to agricultural sector would be most justified measures to solve those difficulties. For all countries with small farms under highly economic growth, however, there is an "unavoidable" lag in farm mechanization due to the time needed to develop adaptable small machines and to organize the custom service system, which is the only way to justify investment made in machineries by small farms. A squeeze between the loss of labor on one hand and a lag in mechanization on the other resulted in sharply increase of farm wage. This, in turn, caused an annual increase of production cost for major agricultural products by 11-13 percent during 1970's of which about 65 percent was due to labor cost increase. Farmers have been forced to adopt extensive cultural practices for low valued crops that off-sett productivity gains. As a result in the gradual loss of competitiveness of ROC agricultural products

in general, large volume of agricultural products are imported to make up the gap between production and demand.

### **III. Modernization of Food Consumption**

Most of the food consumed by people in high-income countries is consumed because people “want” to consume it and not because it is required for a diet that is nutritionally adequate for the maintenance of life, good health and physical vigours. Most of the original calories produced on farms in high income countries are used to feed livestock, because intake of calories is limited by human physiology, and the consumers desire for variety in the diet and for high-quality protein. Therefore, the impact of rising income on food demand is perhaps best understood by examining its effect in grain consumption.

According to the study of Brown (1977), in poor countries the annual availability of grain per person is nearly all consumed directly to meet the minimum energy needs. Little can be spared for conversion into animal protein. However, in industrial countries, only a small fraction of the annual availability of grain per person is consumed directly in the forms of bread, pastries, and breakfast cereals. The remainder is consumed indirectly of high protein contained products, such as meat, milk, and eggs.

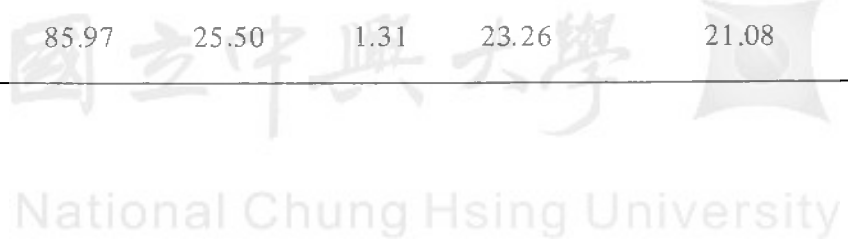
The consumption of starchy food has dropped considerably during last two decades in Taiwan, while indirect consumption of grain for production high quality food has increased drastically. According to the “Food Balance Sheet” published by COA, per capita annual availability of rice and sweet potato have moved downward from 141.19 kg and 62.96 kg, respectively, in 1953 to 85.97 kg and 1.13 kg, respectively, in 1985. Annual availability of meat per person jumped from 17.81 kg in 1953 to 54.30 kg in 1985. Dairy product per person availability rose from 1.59 kg to 29.58 kg during the same period, as shown in Table 3. The consumption



Table 3. The Per Capita Annual Availability of Food

Unit : kg

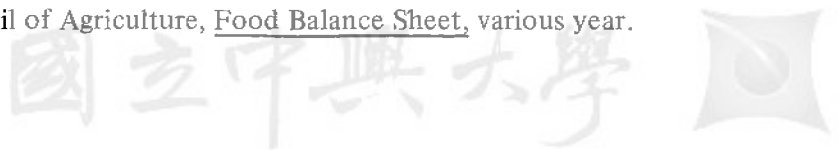
Year	Cereals		Flour	Sweet Potato	Sugar	Pulses, Nuts and Seeds	Vegetables
	Total	Rice					
1953	157.07	141.19	15.15	62.96	9.41	9.47	60.23
1956	150.16	132.59	16.55	64.18	9.41	10.87	58.38
1961	265.03	136.78	24.57	55.04	9.41	12.28	57.18
1966	156.33	137.42	16.58	44.45	11.70	13.50	52.67
1971	164.63	134.28	25.51	17.94	12.36	17.43	91.27
1976	156.25	128.12	20.78	7.73	16.34	19.19	118.39
1981	131.66	99.44	23.38	3.16	22.82	18.49	115.60
1985	111.47	85.97	25.50	1.31	23.26	21.08	127.07



(9)

Year	Fruits	Meat	Eggs	Fish	Milk	Oilseed Fats
1953	17.94	17.81	1.45	16.05	1.59	3.43
1956	14.52	17.04	1.63	18.81	6.03	3.72
1961	19.86	15.60	1.63	25.33	9.38	4.84
1966	26.18	22.91	2.63	28.84	4.97	5.01
1971	44.96	26.43	4.12	34.34	10.98	7.75
1976	62.14	31.64	5.86	25.27	18.35	9.95
1981	80.51	40.10	8.56	35.79	27.77	9.95
1985	82.01	54.30	11.16	38.41	29.58	15.01

Data Source: Council of Agriculture, Food Balance Sheet, various year.



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of vegetables and fruits has moved upward significantly in the same period as well.

As to grain consumption (including rice, wheat, corn, soybean, barley, and sorghum) per person, the direct consumption increased from 157.07 kg in 1953 to 167.81 kg in 1974, then dropped to 111.47 kg in 1985, while indirect consumption of grain per person jumped substantially from 13.97 kg to 296.65 kg, and the total grain consumption increased from 171.04 kg to 408.12 kg through out the period (Table 4 and Figure 1). The indirect consumption of grain is expected to increase continuously along with the rice in consumption of high quality food.

Although food quality is at the best a vague term, economists can be very precise about its definition in this context: food quality is measured by the average price paid by calories. Therefore, the food quality is the difference between food expenditure and food quantity (Timmer, Falcon, Pearson, 1983). The regular relationship is that the average quality of food calories, measured by prices, rises with incomes. From Table 5 and Figure 2, energy intake per person increased from 2,283 calories in 1953 to 2,845 calories in 1985, and it showed a uprising trend in quality of food consumption in Taiwan in the same period. Moreover, the sources of calories intake per person changed rapidly. The proportion of calories from starchy staple was decreased from 76.36 percent in 1952 to 41.28 percent in 1985. Therefore, the consumption of starchy staple food has decreased as the per capita income increase in Taiwan.

#### **IV. Impacts on the Production and Demand of Rice Economy**

Rice is a commodity with unique economic and political significance in Taiwan. Since World War II, it has generated an important protein of foreign exchange earnings for this island. Moreover, rice has been used in paying or calculating wages, rents, loans and in settling other transaction. Farmers

Table 4. Per Capita Grain Consumption in Taiwan

				Unit: kg			
Year	Direct Consumption	Indirect Consumption	Total Grain Consumption	Year	Direct Consumption	Indirect Consumption	Total Grain Consumption
1953	157.07	13.97	171.04	1970	164.11	91.89	256.00
1954	145.05	13.29	158.34	1971	164.63	80.33	244.96
1955	149.20	13.31	162.51	1972	165.78	142.39	308.17
1956	150.16	12.42	162.58	1973	161.58	141.43	303.01
1957	157.44	14.38	172.27	1974	167.81	120.16	287.97
1958	153.14	15.24	168.38	1975	162.11	160.17	322.28
1959	156.23	15.35	171.64	1976	156.25	187.34	343.59
1960	159.68	21.04	180.72	1977	156.63	196.19	352.82
1961	165.03	20.74	185.77	1978	146.46	219.34	365.80
1962	156.81	13.73	170.54	1979	144.16	248.01	392.17
1963	156.77	23.39	180.16	1980	138.75	230.71	369.46
1964	150.84	23.88	174.72	1981	131.66	258.54	390.20
1965	157.34	26.21	183.55	1982	130.26	248.45	378.71
1966	156.33	27.07	183.40	1983	122.94	297.45	420.39
1967	157.80	47.33	205.13	1984	119.11	270.02	389.13
1968	162.59	64.24	226.83	1985	111.47	296.65	408.12
1969	166.67	68.26	234.93				

Data Source: The same as Table 3.

(12)

Table 5. The Change of Food Quality in Taiwan

Year	Per Capita Income (NT\$) (1)	Food Expense (NT\$/person) (2)	Energy (Calories) (3)	Calories from Starchy Staple Food (4)	Ratio of Calories from Starchy Food (5)=(4)/(3)	Food Quality (6)=(2)-(3)
1953	17,861.00	8,071.11	2,283.00	1,743.31	76.36	5,788.11
1954	18,682.00	8,239.75	2,176.00	1,639.61	75.35	6,063.75
1955	19,607.00	8,300.65	2,247.00	1,666.67	74.17	6,053.75
1956	19,791.00	8,212.50	2,262.00	1,678.86	74.22	5,950.50
1957	20,587.00	8,290.50	2,369.00	1,755.25	74.09	5,921.50
1958	21,339.00	8,497.26	2,359.00	1,725.37	73.14	6,138.26
1959	22,077.00	8,649.28	2,340.00	1,744.32	74.54	6,309.28
1960	22,521.00	9,019.27	2,339.00	1,778.28	76.03	6,680.27
1961	23,309.00	8,949.72	2,430.00	1,803.04	74.20	8,519.72
1962	24,598.00	9,180.58	2,317.00	1,711.54	73.87	8,863.58
1963	26,704.00	9,179.80	2,325.00	1,687.84	72.60	6,854.80
1964	29,544.00	10,035.87	2,364.00	1,658.21	70.14	7,671.87
1965	30,959.00	10,446.83	2,411.00	1,707.26	70.81	8,035.83
1966	32,980.00	10,515.06	2,433.00	1,686.09	69.30	8,082.06
1967	35,613.00	10,813.50	2,504.00	1,703.33	88.02	8,309.50
1968	38,062.00	11,136.34	2,545.00	1,681.33	66.06	8,591.34
1969	41,130.00	11,036.08	2,639.00	1,763.14	66.81	8,397.08
1970	45,031.00	11,503.80	2,662.00	1,687.66	63.40	8,841.08
1971	49,722.00	12,017.98	2,674.00	1,692.56	63.30	9,343.98
1972	55,438.00	12,891.14	2,737.00	1,695.00	61.93	10,154.14
1973	61,236.00	13,580.67	2,754.00	1,650.47	59.93	10,826.67
1974	58,839.00	15,059.72	2,780.00	1,708.06	61.44	12,279.72
1975	59,739.00	16,151.12	2,722.00	1,643.40	60.37	13,429.12
1976	68,095.00	16,007.46	2,771.00	1,576.78	56.90	13,236.46
1977	72,899.00	16,590.25	2,805.00	1,578.54	56.28	13,785.25
1978	79,891.00	17,107.09	2,822.00	1,478.86	52.40	14,285.09
1979	85,016.00	16,851.12	2,845.00	1,450.26	50.98	14,006.12
1980	87,090.00	16,560.52	2,812.00	1,394.13	49.58	13,748.52
1981	89,161.00	17,061.87	2,727.00	1,320.62	48.43	14,332.87
1982	90,454.00	17,425.03	2,749.00	1,305.59	47.49	14,676.03
1983	96,521.00	18,039.60	2,719.00	1,465.55	53.90	15,320.60
1984	105,481.00	18,506.25	2,752.00	1,164.72	52.30	15,786.25
1985	108,442.00	19,098.28	2,845.00	1,162.00	41.28	16,253.28

Data Source: (1) DBAS, National Income, 1985.(2) COA, Food Balance Sheet, various year.

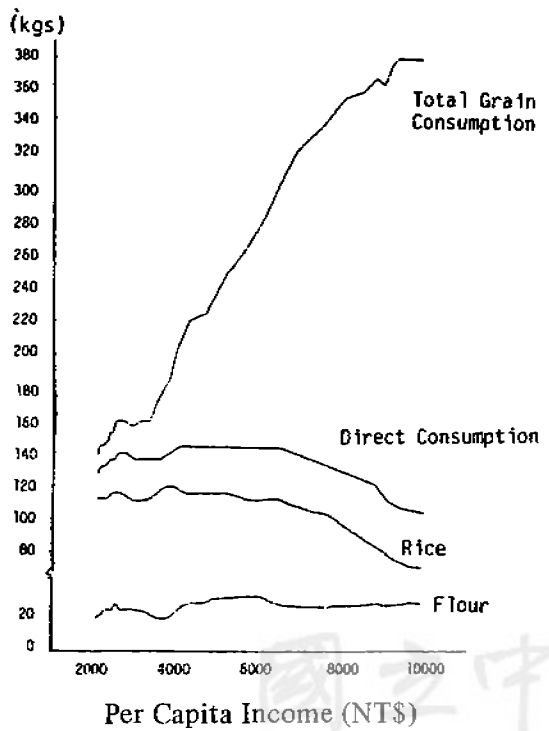


Figure 1: Per Capita Consumption of Grain Relative to Income

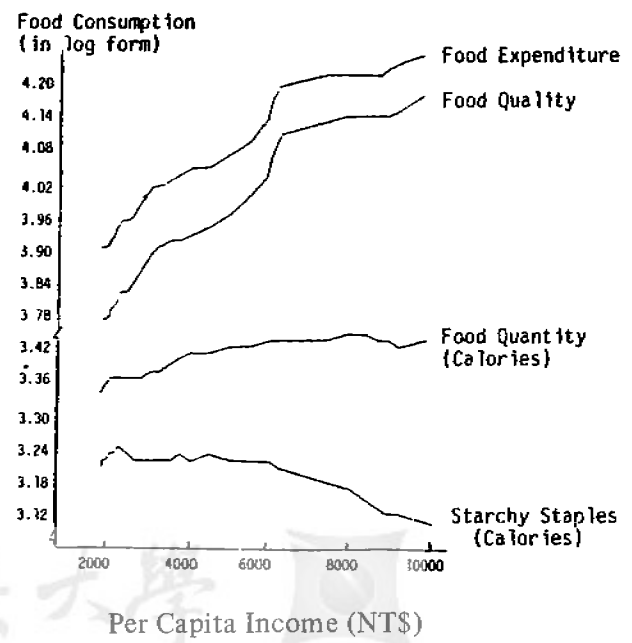
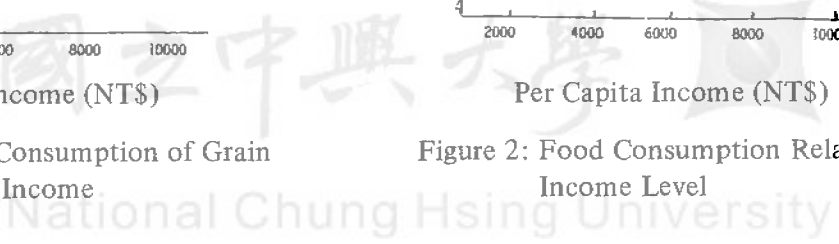


Figure 2: Food Consumption Relation to Income Level



(14)

prefer to grow rice if appropriate land is available. In 1976, rice acreage (record high of rice acreage) amounted 790,000 hectares, or about 48 percent of the 1,659,000 hectares planted crops in that years. However, in 1985, rice acreage reduced to 564,000 hectares, which was still about 45 percent of the 1,257,000 hectares planted crops in that year. The per capita energy intake in Taiwan was 2,845 calories per day in 1985, and rice supplied 30% of this total. Back 1953, rice supplied 61% of total energy intake.

### (I) Production

Rice growing in Taiwan is much less affected than other crops by natural hazards, such as typhoons. Insects and diseases affecting rice are more effectively controlled, and the market price also tends to be rather stable. Hence, farmers prefer to grow rice even though other highpriced but more risky crops are available.

Rice production in Taiwan increased steadily between 1946 to 1977 except in 1972. With the high guaranteed price since 1974, rice output set a record high of 2.7 million tons in terms of brown rice in 1977, as shown in Table 6. From 1946 to 1974, rice production grew with 3.8 percent annually, however, the rice acreage increased by 1.1 percent, which implies that the rice production increase were achieved almost by raising the yields. The annual growth rice production was still far above annual population growth rate of 3.2 percent a surplus of rice production has caused very serious problems in rice economy. In order to balance the supply and demand of rice in the market, to lessen the fiscal burden of rice collection, since 1976 the government has changed the unlimited volume purchase policy to a limited purchase 970 kg per hectare policy.

Due to the reduction of economic incentive of rice production, both rice output and acreage have dropped sharply since 1977. The rice output in 1985 was down to 2.2 million tons. The rice production and acreage declined by 2.2 percent and

3.3 percent, respectively, per annum from 1976 to 1985. However, the yield per hectare still increased steadily in this period of time. Factors underlying this increase in yields include: development and distribution of better varieties; the better utilization of chemical fertilizers and pesticides; extension of new farming practices; and increased supplies of efficient farm implements.

## (II) Consumption

Rice consumption per capita in Taiwan showed an uprising trend before 1967. However, rice per capita consumption dropped from 141 kg in 1967 to 85.9 kg in 1985 or a 2.8 percent decrease per annum mainly due to increase in per capita income. However, significant differences exist among different groups in population. The per capita consumption of rice is influenced by the extent of urbanization. Consumption per capita was 77 kilograms of polished rice for urban families, 93 kilograms for suburban families, and 103 kilograms for rural families. Although the average of population growth rate was of 2.1 percent per annum during this period, because of the considerable declines in per capita consumption and miscellaneous consumption, such as demand for animal feed, processing, etc., the total consumption also revealed a downward trend since 1977. The total demand for rice decreased from 2.4 million tons in 1977, to 2.2 million tons in 1985 (Table 6).

In 1985, the total available supply was 2.2 million tons on brown rice base, of which 82 percent or 1.8 million tons was used as food, 15 percent as animal feed, and 3 percent was for manufacturing. Although the per capita expenditure on rice consumption increased, however, the proportions of the rice expenditure to food expenditure and to household expenditure were declining. According to the survey, in 1970, the average expenditure on rice was NT\$ 890 (US\$ 29.7 at NT\$ 32=US\$ 1, prevailing in June 1987) per year, which accounted for 29 percent of all foods, and 14 percent of all



consumption expenditure. In 1985, the average rice expenditure was NT\$ 2,000 (US\$ 62.5) per year, however, which accounted for, respectively, 15.5 percent or 5.8 percent of all foods and all consumption expenditures. The phenomenon implies that aggregate income elasticity of rice is negative, and that per capita consumption of rice is expected to be decreased continuously as per capita income is increased.

### (III) Marketing

Rice production in Taiwan is of highly commercial basis. Rice is marketed through two channels, free market and government; the government collection accounts for about 30 percent of the total production. In the free-market channel, rice mills at local markets play a predominant role. In addition to processing paddy into brown rice and polished rice, most rice mills in Taiwan also perform wholesaling and retailing functions. In 1985, there was a total of 21,000 rice merchants, including shippers, wholesalers, retailers, and processors.

Before the policy of barter of fertilizer for rice was abolished in 1973, the government collected rice from paddy land taxes in kind, compulsory purchases of paddy from the paddy landowners, rent on government-owned farmland, proceeds in kind from the sale of public land, barter of fertilizer for rice, sales proceeds collected from ex-tenants who received land under the land reform program, and repayment of rice production loans. The total rice collection by the government in terms of brown rice was about 400,000 metric tons a year in 1950. It increased to about 600,000 metric tons from 1950 to 1960, to about 678,000 metric tons in 1966. Total rice collection by government then declined to about 500,000 metric tons per year, then further dropped to 211,000 metric tons in 1974 because of a shortage of rice production. Rice collection from barter of fertilizer for rice was registered about 30-70 percent of total rice collection of government.

In 1974, the guaranteed price for rice was set up under the finance of "Food Stabilization Fund". The government would purchase rice from market at guaranteed price to ensure rice farmer's income. Owing to the fact that the economic incentive for rice production was enhanced sharply, rice production increased steadily. To maintain the government's stock at safety level, the government purchased rice from the market in the early 1970s. By 1977, the total rice collection by government reached about 813,000 metric tons which caused serious shortage of government warehouse spaces to store the rice. Although the government has implemented the planned rice purchase measure to moderate the fiscal burden since 1977, the total rice collection was still up to 957,000 metric tons or 45 percent of total production in 1984 as shown in Table 6. The major reason for farmers selling their rice to government was existing wide gap between guaranteed and market prices. In 1985, farm price of paddy rice was only 75 percent of the guaranteed price.

Normally, rice consumption is more stable than rice production. The market price of rice is influenced by the level of rice production and the quantity of government purchases from the rice market. Both production and government stock have showed a reversal relation with rice price. That is, the larger quantity the production and government stock is, the lower the market price is. In other words, the main objective of government rice purchase from market is to maintain the "reasonable" market price for rice growers under the guiding of the "Food Stabilization Fund". The government stock has increased steadily since 1978. In 1985, the rice stock in government warehouse was up to 1.5 million tons, however, farm price of rice was down to NT\$ 14.00 per kilograms. (Table 6) The fiscal burden of government has been heavy and the policy is widely criticized.

Once rice export was a major foreign exchange earner in Taiwan. However, rice export during the last decade mainly

Table 6. The Balance of Rice Economy

Unit: Brown Rice 1000 M.T.

Year	Production	Consumption	Surplus or Shortage	Export	Government Collection	Government Stock at the End of year (Paddy, M.T.)	Farm Price (Rice Paddy)	Government Price (Rice Paddy)	Percentage of Farm Price to Guaranteed Price
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)	Ponlai NT\$/kg (7)	Ponlai NT\$/kg (8)	(9)=(7)/(8)
1946	894.2	848.3	+45.9	2.1	144.4	—	—	—	—
1951	1,484.8	1,355.0	+129.8	74.7	379.8	—	—	—	—
1956	1,789.8	1,598.8	+191.0	113.9	604.7	340,107	—	—	—
1961	1,912.0	1,813.4	+98.6	48.1	561.8	296,021	3.93	2.77	141.9
1966	2,348.0	2,148.8	+199.2	238.7	678.1	326,776	4.15	3.15	131.7
1971	2,462.6	2,367.8	+94.8	5.7	510.5	466,718	4.65	4.15	121.0
1976	2,494.2	2,407.8	+86.4	1.3	536.7	976,552	10.62	11.50	92.3
1977	2,713.0	2,407.6	+305.4	5.0	813.4	1,065,605	8.90	11.50	77.4
1978	2,648.9	2,363.6	+312.6	326.9	736.7	1,092,464	9.08	11.50	79.0
1979	2,444.5	2,300.7	+143.8	264.3	561.0	874,349	10.98	13.25	82.9
1980	2,449.8	2,262.1	+187.8	505.9	659.8	876,182	13.40	15.55	86.2
1981	2,353.6	2,060.8	+292.8	129.0	653.1	1,288,024	14.10	18.05	78.1
1982	2,375.1	1,917.3	+457.8	75.2	811.9	1,403,186	15.58	18.80	82.9
1983	2,482.6	1,912.5	+570.1	652.3	762.8	1,554,132	14.12	18.80	75.1
1984	2,485.2	1,891.2	+594.0	397.3	957.1	1,438,200	15.23	18.80	81.0
1985	2,244.2	1,887.1	+357.1	113.5	640.9	1,525,950	14.00	18.80	74.5

Data Source: 1. Taiwan Food Bureau, Taiwan Food Statistics.2. Department of Agriculture & Forestry, Taiwan Agricultural Prices Monthly, Government of Taiwan.

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was to dispose the surplus of production with great loss of government revenue. In 1983, the quantity of rice export was 652,200 metric tons in brown rice base, which set a record high and was 26 percent of total production in that year.

The rice market appears to be the most competitive agricultural product market in Taiwan. Numerous buyers and sellers operate in the market, and the product is homogeneous in quality although local brands are established to create product differentiation. Therefore, price differentiation among different location is negligible. As shown in Table 7, recent differences in monthly prices among four major cities have been less than 10 percent. The marketing cost for rice is presented in Table 8. Under such cost structure, rice farmers received nearly 75 percent of the retail price. Middleman margin was only 10 percent, while other costs, including transportation and processing expenses, represented about 15 percent.

### **V. The Prospects of Food Production and Consumption<sup>3)</sup>**

The structure of food consumption is expected to change continuously along with per capita income increase in Taiwan. Based on the quantity of consumption of various products for the last three decades, the quantity of food consumption for the years of 1991 and 2001 can be estimated by Box-Jenkins approach. The future consumption trend of different products is showed as Table 8. The total consumption of starchy food, such as rice and sweet potato, still shows a strong downward trend. The quantity of rice consumption will decrease from 1.88 million metric tons in 1985 to 1.79 million tons in 1991, and will further decline to 1.77 million

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3) Because the purpose of this section is to discuss the adjustment of paddy acreage, therefore, only "land-base crop" is referred.

Table 7. Price Differentiation of Rice Among Four Cities in Taiwan

Unit: NT\$/kg

	Taipei	Taichung	Tainan	Kaohsiung	Keelung	Maximum price difference	Percent against lowest price
1986							
April	25.80	24.30	25.00	23.90	25.00	1.90	7.95
May	25.80	24.30	25.00	23.90	25.00	1.90	7.95
June	25.30	24.10	23.30	23.10	24.90	2.20	9.52
July	24.90	22.70	24.10	22.50	—	2.40	10.67
August	24.20	22.90	24.00	22.50	23.30	1.70	7.56
September	24.20	22.90	24.00	22.50	23.30	1.70	7.56
October	25.50	24.70	24.90	24.30	26.00	1.70	7.00
November	25.80	25.50	25.50	24.60	26.70	2.10	8.54
December	25.80	25.00	25.00	24.60	26.70	2.10	8.54
1987							
January	25.80	25.00	25.90	24.60	26.70	2.10	8.54
February	25.80	25.00	26.00	24.60	26.70	2.10	8.54
March	25.80	24.80	26.00	24.60	26.70	2.10	8.54
April	25.80	24.30	24.70	24.00	26.70	2.70	11.25
May	25.80	24.20	25.00	23.30	25.00	2.50	10.73
Average	25.45	24.26	24.89	23.79	25.59	2.09	8.78

Source: Provincial Department of Agriculture & Forestry, Taiwan Agricultural Prices & Costs Monthly, various month.

Table 8. Cost of Marketing 100 Kilograms of Polished Rice  
(1984)

Items	Amount (NT\$)	Percent of retail price
Farm Value (140 kg of paddy)	2,160.80	74.86
Assembling	53.96	1.87
Storage	22.95	0.78
Processing	72.45	2.51
Grading & Packaging	63.95	2.21
Transportation	41.99	1.45
Selling Charge	90.22	3.13
Profit (excluded by-product)	103.24	3.58
Sub-total	448.40	15.53
Wholesale price	2,609.20	90.39
Retail charge	155.05	5.37
Profit	122.35	4.24
Sub-total	277.40	9.61
Retail price of polished Rice (100 kg)	2,866.60	100.00

Source: Wu, Z. Y., A Study on Rice Marketing Cost in Taiwan (in Chinese), Quarterly Journal of Agricultural Marketing, Agricultural Marketing Association of the Republic of China, September 1, 1985.

tons by 2001. However, the consumption of fruits and vegetables will be doubled in 2001 from 1985.

The future trend of production of major crops can also be estimated by Box-Jenkins approach based on the production data of the last three decades. Their productions in the years of 1991 and 2001 are presented in Table 9, too. The productions of rice and sweet potato show a decreasing trend, but

Table 9. The Forecast of Demand for and Production of Major Crops in Taiwan

Year products	1985			1991			2001		
	demand	production	self- sufficiency rate	demand	production	self- sufficiency rate	demand	production	self- sufficiency rate
Rice	2,102.3	2,173.5	103.4	1,796.9	2,161.8	120.3	1,766.4	1,922.0	108.8
Sweet potato	323.4	369.5	114.3	248.5	259.9	104.6	204.3	258.8	126.6
Wheat	689.3	2.1	0.3	778.2	11.3	1.4	996.6	25.1	2.5
Soyhum	632.5	86.6	13.7	636.1	170.9	26.9	952.3	660.8	69.4
Corn	3,293.0	226.6	6.9	3,383.0	273.8	8.1	4,057.8	566.7	14.0
Soybean	1,368.9	12.2	0.9	2,005.1	23.9	2.2	3,204.7	52.2	1.6
Sugarcane	4,448.9	6,823.0	153.4	5,886.9	8,642.7	146.8	7,612.0	7,790.0	102.3
Peanuts	87.0	89.1	102.4	92.2	89.9	97.5	101.6	90.2	88.8
Vegetables	2,702.8	3,243.4	120.0	3,277.7	3,897.5	118.9	4,493.4	4,558.0	101.4
Fruits	1,594.3	1,911.9	119.9	2,014.1	2,242.4	111.3	3,053.9	3,119.0	102.1

Data Source: Tso-Kwei, Peng, *An Econometric Analysis on the Adjustment of Agricultural Land Utilization in Taiwan*, (in Chinese), National Chung Hsing University, NSC-75-0301-H005-05 Report, December, 1986.

the decreasing rate of production is still far behind that of consumption, thus, a surplus of rice and sweet potato is expected. However, the production of feed grains is much less than domestic demand for rapid development of livestock industry. Hence, the production of corn, wheat and soybean will be still a small fraction of demand for those products and the importation of those products is essential.

Obviously, the structural disequilibrium between demand and production for major crops in Taiwan needs to be solved. The number of proposals that have been made or might be made for solving the disequilibrium problem is virtually infinite. But there are only a few general approach to cope with the rice surplus and farm income problem.

The approach which government has implemented are listed as following:

- A. Let the problem work itself out in open market.
- B. Change market demand
  - 1. Subsidize the consumption of low income group
  - 2. Find new uses for rice
  - 3. Change consumer preferences by promotion and advertising.
  - 4. Restrict the supply of substituted products.
- C. Change market supply
  - 1. Restrict paddy field
  - 2. Reduce the efficiency with which inputs are transformed into rice for market
  - 3. Lower guaranteed price for rice production

Among the proposals, restrict market supply might be the most effective approach. In order to alleviate the surplus problem in rice economy and to restructure the agricultural production, the government in Taiwan has implemented the paddy field conversion program since 1984. The brown rice production will be forced down to 2 million tons, which is about the quantity of rice demanded in 1989. In other words, by 1989, 140,000 hectare of paddy acreage should



be diversified to other crops, such as corn, sorghum, fruits and vegetables.

To ensure the incentive for rice farmers to diversify paddy field to other crops, the government has adopted payment-in-kind (PIK) approach to encourage farmer to participate the program. The government will pay 1000 kgs of paddy for those who grow corn, sorghum and soybean. The latter crops are purchased at high guaranteed price. The government will pay 1,500 kgs paddy for those who grow fruits, vegetables and grass for livestock. Both the rice production and planted acreage in 1984, 1985 and 1986 decreased significantly. However, the rice market price still remained at low level, partly owing to the flooding of market by government stock through payment-in-kind program. Approximately, 135,000 metric tons of paddy rice got into market from government stock in 1985 and 1986.

## **VI. Concluding Remark**

It has been noted, increase in per capita income not only a smaller percentage of that income will be spent on food, but also the structure of food consumption will be changed. Hence, the proportion of family expense devoted to starchy staple food is expected declining. Rice culture has been the most favorable and traditional crop for farmer in Taiwan, though rice farmers diversify the paddy field to grow the high value crops so as to deal with the reduction of rice consumption, a serious surplus of rice production still bothers the government. Owing to the high production cost in rice farming, rice export has become a fiscal burden of government to dispose the rice stock. However, rice export becomes a trade friction issue between US-ROC international trade.

While an overproduction of international rice economy is anticipated in the future, in order to solve the domestic rice surplus problem, the government has taken a strong action to enforce the paddy field conversion program in Taiwan, to

balance between supply and demand of rice economy as well as to increase the self-sufficiency rate of food economy are expected. To develop new rice processing products in order to stimulate the rice consumption is another important measure. However, we can concluded that the quantity of rice or starchy food consumption will be further reduced in Taiwan although the population is growing, how to restructure a new crop pattern in Taiwan is the most important issue of farm policy in near future.

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# 台灣糧食消費型態之改變

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## 摘 要

隨著國民所得之提高，不僅使得糧食消費支出佔總支出之比例下降，糧食消費結構亦隨之改變，尤其澱粉類食物佔每人日常攝取熱量之比例亦逐年降低。對新興工業國家而言，此種趨勢確實影響到稻作與農業之生產。

本文首先探討近三十年來台灣糧食消費之趨勢與結構，同時藉由稻米之生產、消費及運銷制度以預測未來主要作物之消費與生產情況。雖自 1977 年起，我國稻米生產已逐年遞減，但其遞減速度仍不及消費量之減少速度，且由於其生產成本過高，使得以出口來解決稻米過剩問題頗不經濟。未來稻米生產過剩將成爲一國際性的共同問題，故建立一新的作物生產結構實爲解決稻米過剩之途徑。

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