

## 10. PRESENT SITUATION OF FERTILIZER USE IN TAIWAN

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### Importance of the Topic

For Taiwan, whose arable land is too limited to provide the rapidly growing population, it has always been a key point in the whole food production program to increase yield per unit area by every means. Much effort was made through four 4-Year Economic Development Plan in the improvement of fertilization for various crops and great achievements were obtained. It may be easily seen from the figure 1, just how chemical fertilizers have made a wonderful contribution to rice production in Taiwan. The production of brown rice increased, in accordance with expansion of fertilizer consumption, from 1,570,000 tons in 1952 to 2,413,800 tons in 1967, and the yield per hectare per crop increased from 1,998 kg to 3,067 kg.

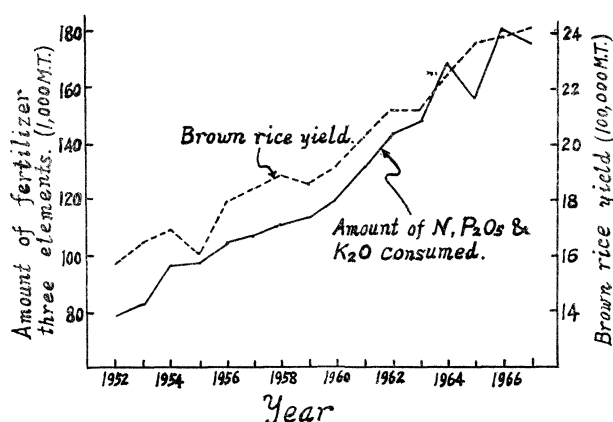


Fig. 1. Trend of total consumption of N,  $P_2O_5$  and  $K_2O$ , and rice production in Taiwan for years 1952 to 1967.

### Trend of Consumption, Local Production and Import of Chemical Fertilizers

The annual fertilizer distribution in Taiwan is precisely planned every year by Fertilizer Sales Division of Food Bureau, Taiwan Provincial Government, based on the cultivative condition and fertilizer demand in each district. The fertilizers needed for distribution are supplied preferentially by domestic production and the deficit is to be imported. Farmers receive their fertilizers through the Farmer's Association in accordance with project proposed by the concerned agency.

Table 1. gives data on the fertilizer allocations for the years from 1952 through 1972. 1952 is the year preceding the first 4-Year Plan for Economic Development of Taiwan and

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**Table 1. Trend of Consumption, Local Production and Import of Chemical Fertilizers in Taiwan**

unit: M. T.

Year	Consumption <sup>1)</sup>			Local production		Deficit			Actual import		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N	P <sub>2</sub> O <sub>5</sub>	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
1952	70,742	22,010	11,606	14,760	13,313	55,982	8,697	11,606	65,605	14,797	14,883
1953	70,765	25,210	15,228	15,816	14,981	54,949	10,229	15,228	49,925	11,655	25,108
1954	82,748	27,339	15,924	15,348	16,120	67,400	11,219	15,924	64,768	6,391	6,498
1955	83,364	29,103	17,401	15,688	15,933	67,676	13,170	17,401	67,309	13,471	10,364
1956	91,903	30,609	19,848	16,553	19,934	75,350	10,675	19,848	74,316	10,262	19,080
1957	97,109	31,989	23,736	19,437	20,912	77,672	11,077	23,736	76,869	11,993	24,407
1958	102,287	34,071	26,830	27,954	22,489	74,333	11,582	26,830	74,434	12,897	29,622
1959	103,132	33,976	28,913	33,999	25,596	69,133	8,380	28,913	77,976	12,319	29,614
1960	110,601	31,949	30,965	45,647	25,495	64,954	6,454	30,965	55,800	14,060	35,540
1961	105,451	31,832	30,280	52,973	26,287	52,478	5,545	30,280	71,938	4,001	34,720
1962	118,909	30,233	31,179	77,243	25,957	41,666	4,276	31,179	58,581	1,576	28,409
1963	121,570	33,087	37,324	82,712	31,131	38,858	1,956	37,324	65,322	1,933	32,097
1964	155,078	39,201	43,406	135,782	33,973	19,296	5,228	43,406	1,588	1,985	39,411
1965	152,996	35,468	44,473	164,438	37,432	11,442	1,964	34,473	63,000	—	44,842
1966	163,116	35,124	50,425	163,775	40,366	+659	5,242	50,425	63,000	—	50,860
1967	176,413	37,355	53,720	172,734	40,047	3,679	2,692	53,720			
1968	144,500 <sup>2)</sup>	36,800	56,300	191,400	36,800	+46,900	—	56,300			
1969	156,888 <sup>2)</sup>	33,700	58,200	264,500	33,700	+107,612	—	58,200			
1970	161,630 <sup>2)</sup>	33,800	60,800	275,300	33,800	+113,670	—	60,800			
1971	166,967 <sup>2)</sup>	33,900	63,700	283,100	33,900	+116,133	—	63,700			
1972	172,389 <sup>2)</sup>	34,000	66,600	286,900	34,000	+114,511	—	66,600			

Remarks: 1) Including both fertilizers distributed through the regular government channel and a small amount of the locally produced fertilizers to free market by the manufactures.

2) Estimation.

Source of data: (1) The consumption figures for years 1969 to 1972 are based on estimation of the 5th Agricultural 4-Year Plan. They are subject to revision.

(2) The local production figures for years 1969 to 1972 are based on estimations of the 5th Industrial 4-Year Plan. They are also subject to revision.

(3) The actual import figures are based on official statistics.

the ensuing period covers that of five consecutive 4-Year Plans. From the Table 1, the following observations are made:

A. Ever since the first 4-Year Plan, the consumption of chemical fertilizers has continuously increased with remarkable rapidity. The trend of increase was most marked during the period from the end of the third 4-Year Plan through the fourth 4-Year Plan. The preliminary estimations suggest that the consumption of potash fertilizer will continue to increase during the coming fifth 4-Year Plan period, while that of both nitrogenous and phosphorous fertilizers will increase little. The increase in absolute amount is largest in nitrogen fertilizer and smallest in phosphorous fertilizer. However, when expressed in indices, the increase is fastest in potash fertilizer, followed by nitrogen and phosphorous fertilizers.

B. The local production of nitrogenous and phosphorous fertilizers has increased at rapid rate in the consequence of increasing consumption requirement.

Although the local production index increased at a faster rate than the consumption index, the deficit of N, P fertilizers did not show any apparent trend of reduction until 1959 when the absolute increase in production exceeded consumption demand. The increase in the production of nitrogenous fertilizer was more marked in the recent years due to the construction of new urea plant.

Year	Consumption index			Local production index	
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N	P <sub>2</sub> O <sub>5</sub>
1952	100	100	100	100	100
1956	130	139	171	112	150
1960	156	145	267	309	192
1964	219	178	374	920	255
1968	245	167	485	1297	276
1972 (plan)	287	154	574	1944	255

C. Along with consistent increase in consumption demand, local production of chemical fertilizers, except potash fertilizer which Taiwan does not produce, has expanded in the recent years. In 1952, only 20.9 percent of the nitrogen fertilizer and 60.5 percent of the phosphorous fertilizer were supplied domestically. However, in 1965, locally produced N, P fertilizers came to meet the consumption requirement. It is expected that there will be about 114,500 tons of surplus nitrogen fertilizer in 1972.

D. The actual import of the fertilizers does not coincide exactly with the "deficit" due obviously to variations in carry-over stock and discrepancies in time of consumption requirement, production and import arrival.

### Trend of Fertilizer Use for Rice

Table 2 gives data on the use of NPK fertilizers for rice and the other crops.

During the consecutive 4-Year Plan period in the past, the fertilizer extension works were promoted through the determination of optimum fertilizer rates for various crops. In the consequence, the amounts of fertilizer consumed by rice and other crops have all increased largely. In absolute amount, the rice fertilizer increased with substantial quantities. The amount of the rice fertilizer in 1952 was 78,510 tons. It continued to increase at a rapid rate and reached to 174,000 tons in 1967, that is, more than twice the rice fertilizer consumption in 1952. As the matter of fact, the increase in rice acreage was quite limited, being increased only from 533,643 hectares in 1952 to 537,575 hectares in 1967. It was

**Table 2. Fertilizer for Rice and Other Crops<sup>2)</sup>**(1) Total of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O

Year	Total			Rice			Other crops		
	Amount (m/t)	%	Index	Amount (m/t)	%	Index	Amount (m/t)	%	Index
1952	104,358	100.0	100.0	78,510	75.23	100.0	25,848	24.77	100.0
1953	111,203	100.0	106.6	82,323	74.03	104.9	28,880	25.97	111.7
1954	126,011	100.0	120.8	96,767	76.79	123.3	29,244	23.21	113.7
1955	129,868	100.0	124.4	98,217	75.63	125.2	31,651	24.37	122.5
1956	142,360	100.0	136.4	104,445	73.37	133.0	37,915	26.63	146.7
1957	152,834	100.0	146.6	107,398	70.27	136.8	45,436	29.73	175.8
1958	163,188	100.0	156.4	111,683	68.44	143.3	51,505	31.56	199.3
1959	166,021	100.0	159.1	112,750	67.91	143.6	53,271	32.09	206.1
1960	173,514	100.0	166.3	119,413	68.82	152.1	54,102	31.18	209.3
1961	167,563	100.0	160.6	131,109	78.24	167.0	36,454	21.76	141.0
1962	180,321	100.0	172.8	143,287	79.46	183.5	37,034	20.54	143.3
1963	191,981	100.0	184.0	147,531	76.85	187.9	44,450	23.15	172.0
1964	237,685	100.0	227.8	168,110	70.73	214.1	69,575	29.27	269.2
1965	223,200	100.0	213.9	155,557	69.69	198.1	67,643	30.31	261.7
1966	248,665	100.0	238.3	180,698	72.67	230.2	67,967	27.33	263.0
1967	267,488	100.0	256.3	174,770	65.34	222.6	92,718	34.66	358.7
1968	237,600 <sup>1)</sup>	100.0	227.7	180,400 <sup>3)</sup>	75.93	229.8	57,200	24.07	221.3
1969	248,800 <sup>1)</sup>	100.0	238.4	183,900 <sup>3)</sup>	73.91	234.2	64,900	26.09	251.1
1970	256,200 <sup>1)</sup>	100.0	245.5	188,200 <sup>3)</sup>	73.46	239.7	68,000	26.54	263.1
1971	264,600 <sup>1)</sup>	100.0	253.6	192,500 <sup>3)</sup>	72.75	245.2	72,100	27.25	278.9
1972	273,100 <sup>1)</sup>	100.0	261.7	196,800 <sup>3)</sup>	72.06	250.7	76,300	27.94	295.2

Remarks: 1) Estimation.

2) Figures for 1952 through 1967 given in table 2 (1), (2), (3) and (4) included both fertilizers distributed through the regular government channel and a small amount of the locally produced fertilizers sold to free market by the manufacturers.

3) Rice fertilizer figures for 1968 through 1972 are calculated from the estimated yield of brown rice when multiplied it by average amount of three elements required per each M. T. yield.

**Table 2. Fertilizer for Rice and Other Crops<sup>1)</sup>**

(2) Nitrogen

Year	Total			Rice			Other crops		
	Amount (m/t)	%	Index	Amount (m/t)	%	Index	Amount (m/t)	%	Index
1952	70,742	100.0	100.0	51,833	73.27	100.0	18,909	26.73	100.0
1953	70,765	100.0	100.0	52,163	73.71	100.6	18,602	26.29	98.4
1954	82,748	100.0	117.0	64,762	78.26	124.9	17,986	21.74	95.1
1955	83,364	100.0	117.8	62,857	75.40	121.3	20,507	24.60	108.5
1956	91,903	100.0	129.9	66,878	72.77	129.0	25,025	27.23	132.3
1957	97,109	100.0	137.3	68,299	70.33	131.8	28,810	29.67	152.4
1958	102,287	100.0	144.6	70,032	68.57	135.1	32,255	31.43	170.6
1959	103,132	100.0	145.8	69,105	67.01	133.3	34,027	32.99	180.0
1960	110,601	100.0	156.3	73,839	66.76	142.5	36,762	33.24	194.4
1961	105,451	100.0	149.1	80,023	75.89	154.4	25,428	24.11	134.5
1962	118,909	100.0	168.1	92,235	77.57	178.0	26,674	22.43	141.1
1963	121,570	100.0	171.9	91,023	74.87	175.6	30,547	25.13	161.6
1964	155,078	100.0	219.2	104,759	67.55	202.1	50,319	32.45	266.1
1965	152,996	100.0	216.3	105,204	68.76	203.0	47,792	31.24	252.8
1966	163,116	100.0	230.6	117,643	72.17	227.0	45,473	27.88	240.5
1967	176,413	100.0	249.4	121,325	68.77	234.1	55,088	31.23	291.3

Remarks: 1) See Remark 2) of Table 2 (1).

Table 2. Fertilizer for Rice and Other Crops<sup>1)</sup>

(3) Phosphorous

Year	Total			Rice			Other crop		
	Amount (m/t)	%	Index	Amount (m/t)	%	Index	Amount (m/t)	%	Index
1952	22,010	100.0	100.0	18,948	86.09	100.0	3,062	13.91	100.0
1953	25,210	100.0	114.5	21,511	85.33	113.5	3,699	14.67	120.8
1954	27,339	100.0	124.2	22,708	83.06	119.8	4,631	16.94	151.2
1955	29,103	100.0	132.2	25,020	85.97	132.1	4,083	14.03	133.3
1956	30,609	100.0	139.1	26,375	86.17	139.2	4,234	13.83	138.3
1957	31,989	100.0	145.3	26,279	82.15	138.7	5,710	17.85	186.5
1958	34,071	100.0	154.8	27,152	79.69	143.3	6,919	20.31	226.0
1959	33,976	100.0	154.4	26,662	78.47	136.8	7,314	21.53	238.9
1960	31,949	100.0	145.2	25,925	81.14	136.8	6,024	18.86	196.7
1961	31,832	100.0	144.6	28,190	88.56	148.8	3,642	11.44	118.9
1962	30,233	100.0	137.4	26,904	88.99	142.0	3,329	11.01	108.7
1963	33,087	100.0	150.3	28,948	87.49	152.8	4,139	12.51	135.2
1964	39,201	100.0	178.1	33,827	86.29	178.5	5,374	13.71	175.5
1965	35,468	100.0	161.1	30,045	84.71	158.6	5,423	15.29	177.1
1966	35,124	100.0	159.6	28,463	81.04	150.2	6,661	18.96	217.5
1967	37,355	100.0	169.7	24,596	65.84	129.8	12,759	34.16	416.7

Remarks : 1) See Remark 2) of Table 2 (1).

**Table 2. Fertilizer for Rice and Other Crops<sup>1)</sup>**

(4) Potash

Year	Total			Rice			Other crops		
	Amount (m/t)	%	Index	Amount (m/t)	%	Index	Amount (m/t)	%	Index
1952	11,606	100.0	100.0	7,729	66.59	100.0	3,877	33.41	100.0
1953	15,228	100.0	131.2	8,649	56.80	111.9	6,579	43.20	169.7
1954	15,924	100.0	137.2	9,297	58.38	120.3	6,627	41.62	170.9
1955	17,401	100.0	149.9	10,340	59.42	133.8	7,061	40.58	182.1
1956	19,848	100.0	171.0	11,192	56.39	144.8	8,656	43.61	223.3
1957	23,736	100.0	204.5	12,820	54.01	165.9	10,916	45.99	281.6
1958	26,830	100.0	231.2	14,499	54.04	187.6	12,331	45.96	318.1
1959	28,913	100.0	249.1	16,983	58.74	219.7	11,930	41.26	307.7
1960	30,965	100.0	266.8	19,649	63.46	254.2	11,316	36.54	291.9
1961	30,280	100.0	260.9	22,896	75.61	296.2	7,384	24.39	190.5
1962	31,179	100.0	268.7	24,148	77.45	312.4	7,031	22.55	181.4
1963	37,324	100.0	321.6	27,560	73.84	356.6	9,764	26.16	251.8
1964	43,406	100.0	374.0	29,524	68.02	382.0	13,882	31.98	358.1
1965	44,473	100.0	383.2	20,308	45.66	262.8	14,428	54.34	372.1
1966	50,425	100.0	434.5	34,592	68.60	447.6	15,833	31.40	408.5
1967	53,720	100.0	462.9	28,849	53.70	373.3	24,871	46.30	641.5

Remarks: 1) See Remark 2) of Table 2 (1). (1)

**Table 3.**  
(1) Optimum Rate of Fertilizer Application for Rice<sup>1)</sup>

District	Crop season	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Taipei	1st crop	100 - 110	30 - 40	60 - 90
	2nd crop	60 - 90	30 - 40	60 - 90
Taichung	1st crop	80 - 120	40 - 60	40 - 60
	2nd crop	80 - 100	40 - 60	40 - 60
Kaoshung	1st crop	120	60 - 80	80
	2nd crop	100	40 - 60	60
Average	1st crop	108	52	68
	2nd crop	88	45	62

Remarks: 1) Officially recommended in 1965.

(2) Actual Distribution of NPK Fertilizers per Hectare for Rice<sup>1)</sup>

Year	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
1952	66.0	24.1	9.8
1953	67.0	27.6	11.1
1954	83.4	29.2	12.0
1955	83.7	33.3	13.8
1956	85.3	33.7	14.3
1957	87.2	33.6	16.4
1958	90.0	34.9	18.6
1959	89.0	34.4	21.9
1960	96.3	33.8	25.6
1961	102.3	36.9	29.3
1962	116.1	33.9	30.4
1963	121.5	38.6	36.9
1964	137.0	44.2	38.6
1965	136.1	38.9	39.2
1966	149.2	36.1	43.9

Remarks: 1) Calculated by dividing the actual total ditribution by the planted acreage.



**Table 4. Trend of Use of Different Fertilizers in Taiwan<sup>1)</sup>**

(1) Commercial Fertilizers

Unit : M. T.

Year	Ammonium sulphate	Calcium cyanamide	Ca. ammo. nitrate	Urea	Ca. super-phosphate	Potassium chloride	Others <sup>2)</sup>	Total
1952	182,814	63,673	63,103	69	72,843	22,148	69,935	474,625
1953	182,196	63,625	3,411	18	128,635	27,681	89,178	495,744
1954	314,944	70,192	67	6	124,817	30,071	36,946	579,045
1955	304,594	81,204	6	536	117,009	31,017	44,617	578,983
1956	357,321	86,326	96	1,987	156,263	33,715	17,414	653,122
1957	372,690	73,746	3,355	—	153,967	37,229	33,766	674,753
1958	360,199	65,932	28,891	9,321	158,248	42,467	38,566	703,624
1959	355,495	61,988	40,765	4,136	144,758	46,021	54,030	707,193
1960	352,096	55,717	43,314	24,991	135,086	47,301	53,887	712,392
1961	319,049	30,697	38,867	41,624	131,745	47,578	50,663	658,223
1962	282,967	78,104	66,414	57,821	142,475	46,843	35,396	710,020
1963	306,775	79,335	63,260	69,022	170,368	55,182	29,152	773,084
1964	410,225	46,705	59,446	92,935	201,037	65,129	33,128	908,605
1965	385,431	27,595	42,840	113,397	184,031	48,875	36,423	838,592
1966	413,407	10,299	35,283	135,133	187,992	74,952	31,449	888,515
1967	479,146	10,887	61,902	122,363	190,222	72,684	47,338	984,542

Remarks: 1) Including both fertilizers distributed by regular government channel and a small amount of fertilizers sold to free market by manufactures.

2) The item of "Others" included Ammonium chloride, Ammonium phosphate, Nitrophosphate, Fused phosphate, Potassium sulphate, Composed fertilizers, etc.

Table 4. Trend of Use of Different Fertilizers in Taiwan

(2) Farm-produced Fertilizers

Unit: M. T.

Year	Green manure	Compost	Animal dung	Night soil	Others <sup>1)</sup>	Total
1952	1, 878, 247	7, 069, 533	2, 344, 024	1, 537, 975	820, 122	13, 649, 901
1953	1, 862, 490	6, 857, 579	2, 510, 060	1, 464, 983	838, 831	13, 533, 943
1954	1, 627, 341	6, 613, 929	2, 596, 784	1, 596, 010	796, 822	13, 230, 886
1955	1, 489, 616	6, 902, 215	2, 531, 348	1, 697, 350	714, 815	13, 535, 344
1956	1, 544, 921	7, 327, 320	2, 529, 885	1, 652, 392	985, 288	14, 039, 806
1957	1, 275, 607	8, 109, 158	2, 483, 784	1, 772, 840	1, 058, 253	14, 699, 642
1958	1, 223, 802	7, 759, 408	2, 919, 908	1, 999, 864	1, 101, 520	15, 004, 502
1959	1, 227, 755	7, 721, 130	2, 732, 085	2, 200, 650	1, 065, 823	14, 947, 443
1960	1, 164, 755	7, 183, 356	2, 627, 923	2, 085, 244	1, 073, 796	14, 135, 074
1961	1, 107, 322	9, 207, 591	2, 668, 894	2, 226, 964	1, 217, 270	16, 427, 959
1962	1, 112, 825	9, 583, 005	3, 031, 371	2, 550, 658	1, 122, 393	17, 400, 252
1963	998, 604	9, 095, 082	3, 076, 956	2, 511, 240	1, 184, 126	16, 766, 008
1964	927, 792	6, 538, 269	3, 150, 263	2, 724, 942	1, 122, 393	14, 339, 324
1965	813, 749	6, 957, 458	3, 248, 578	2, 778, 416	1, 918, 418	15, 716, 619
1966	773, 616	6, 138, 951	3, 386, 929	3, 057, 325	916, 826	14, 273, 647
1967	782, 222	6, 073, 689	3, 138, 251	2, 917, 528	925, 456	13, 837, 145

Remarks: 1) The item of "Others" included Burned soil, Rice-hull, Ash, Straw, etc.

essentially due to the supply increment of fertilizer for a given area. Of the fertilizer elements, the increase of nitrogen is the largest, potash the second and phosphorous the least. However, the rate of increase is fastest in potash fertilizer, followed by nitrogenous and phosphorous fertilizers.

In contrast to marked increase of fertilizer use for crops other than rice since 1964, there is an apparent trend of numeral decrease in the consumption percent of rice fertilizer against total fertilizer consumption. By 1972, it is estimated that rice will make up about 63 percent of the total fertilizer consumption while the other crops will make up about 37 percent. This trend should be considered to be healthy, indicating increasing recognition of proper use of NPK fertilizers by farmers on crops other than rice.

### **Comparison on Recommended Rate and Actual Distribution of Fertilizer Application on Rice**

Table 3 shows the recommended rate of NPK fertilizer application and actual fertilizer distribution records on rice.

The recommended optimum rates of fertilization for rice are based on islandwide NPK testing trials. Actually, the optimum rates of rice fertilizer have been apparently increased due to the achievement in breeding new varieties and the improvement of agricultural techniques in various fields. Before 1955, the recommended rate of  $N-P_2O_5-K_2O$  application for each hectare was 80-40-40 on the average of two crop seasons as general. But, at present, the rate of 98-49-65 on an average is considered to be adequate.

It is apparent from Table 3 that the actual distribution of NPK fertilizers per unit area on rice have steadily increased ever since the first 4-Year Plan. The rate of increase is fastest in potash fertilizer distribution, followed by nitrogen and phosphorous. The rapidity of increase in potash fertilizer distribution will bring on a more balanced application of NPK fertilizers on rice.

Obviously, the current rate of nitrogen application for each hectare is already within optimum range while both phosphorous and potash are still short of the respective optimum level.

### **Trend of Use of Different Fertilizers**

Table 4 shows data on the consumption of both commercial and farm-produced fertilizers for the years from 1952 to 1967.

Of various nitrogenous fertilizers, ammonium sulphate is the form applied in largest quantities by Taiwan farmers. The amount of consumption has expanded and made up about half of total consumption of commercial fertilizers ever since 1954. In recent years, the consumption of urea has increased at a marked rapidity and has become the third one in the amount of fertilizer consumption, owing to the great development of urea industry in Taiwan.

Phosphorous fertilizer is mostly consumed in the form of calcium superphosphate and potassic fertilizer is potassium chloride.

Compared with the substantial increase in the consumption of chemical fertilizers, the use of farm-produced fertilizers such as green manure, compost, animal dung etc., is apt to stagger and shows little increase in consumption. As shown in the figure 2, there is no intimate relationship between the production of brown rice and the consumption of farm-produced fertilizers. Therefore, it might be adequate to consider that farm-produced fertilizers are mainly supplied for the purpose of maintaining soil fertility.

### **Conclusion**

In the above paragraphs, the trend of fertilizer use on rice in Taiwan is investigated

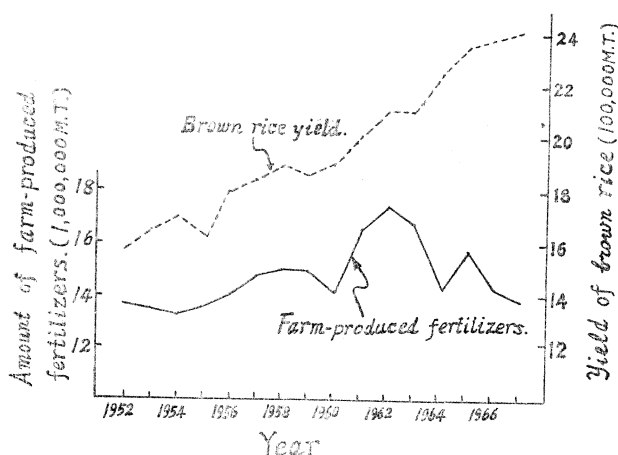


Fig. 2. Trend of farm-produced fertilizer consumption and rice production for the years 1952 to 1967.

through the quotation of statistical figures. The chemical fertilizers, with their constant increases in consumption requirement, have brought on substantial increase in rice production. The trend is more significant through the promotion of four 4-Year Plans for Economic Development, thus providing enough food to rapidly growing population and raising overall prosperity of the country.

Even though the actual distribution rate of NPK fertilizers on rice has been approaching to their respective optimum amounts, the grain yield per hectare is still continuing to increase year after year.

It may be expected from the future prospect that rice production will most possibly be increased continuously by further application of chemical fertilizers in Taiwan in cooperation with improvement of agricultural techniques, especially that of breeding varieties with high fertilizer response and insect and disease resistance, method of cultivation and fertilization techniques.

### Discussion

**H. Shiga, Japan:** How did you decide panicle application in practice?

**Answer:** By examination of panicle initiation stage before heading in addition to farm's practice experience.

**K. Kawaguchi, Japan:** How many percentage of rice plant residue is returned to a field now in your country? Has it been increasing or decreasing in recent years? How about in near future?

**Answer:** I think about 10% of rice residue is returned. It has been decreasing year by year. Attention should be paid to maintain the fertility of paddy field.

**E. D. Reyes, Philippines Y. Ota, Japan, S. Matsushima, Japan:** What is the present practice in the use of fertilizers on rice, especially the timing of nitrogen application?

**Answer:** All of phosphorus and potash are applied before rice planting, but in the case of nitrogen two top-dressings and basal application are recommended. Panicle fertilizer is also gradually becoming in practice.

**A. Tanaka, Japan:** How about urea compared with other nitrogenous fertilizers in its

effect ?

**Answer :** Effect of urea to rice in Taiwan seems to me a little bit lower than other ammoniacal nitrogenous fertilizers.

**S. Ishizawa**, Japan : What kind of green manure crop is utilized ? Is it applied to paddy rice or upland crop ?

**Answer :** Astragalus is the best one in paddy rice of northern part of Taiwan, *Crotalaric juncea* is the another best green manure in the southern and Lupine is most popular one in tea cultivation. But recently the acreage of green manure decreases year by year.

**M. Shafi**, Pakistan : What is the sale rate of nitrogen fertilizer per metric ton of N ? Is the price subsidised by Government ?

**Answer :** Sorry, I cannot answer, because there are no information on my hand.