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**OVERVIEW OF AGRICULTURE
AND
FERTILIZER CONSUMPTION IN THAILAND**

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Overview of Agriculture and Fertilizer Consumption in Thailand

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Abstract

Agriculture plays an important role in Thai economy and provides an important part of its annual exports, average crop yields are rather low, mainly due to insufficient use of fertilizers. Almost all fertilizers consumed in Thailand are imported in the form of either straight fertilizers or formulated compound fertilizers. Chemical fertilizers use for rice is the highest among all crops followed by field crops, fruit tree and vegetables respectively. Thailand does not have any chemical fertilizer producing plant, but has more than 150 mixing plants of various capacities to produce bulk blending fertilizers. Thai Central Chemical Public Company Ltd., the largest local company, produces more than 90 percent of the domestic granulated compound fertilizers.

The important factors contributing to the trend of fertilizer consumption include diversity of crop production, prevailing climatic conditions, availability of credit, fertilizer distribution facilities and economics of fertilizer use. Although the significance of fertilizer application on crop production is realized, there are at least four factors which impact significantly crop productivity namely; low fertilizer application rate, imbalanced use of fertilizer nutrients, low fertilizer use efficiency and secondary and micronutrients deficiencies.

Generally, Thai farmers cannot afford to use the recommended fertilizer rates, due primarily to high fertilizer cost and low crop prices. Rice farmers applying suitable kinds and appropriate rate of chemical fertilizer usually have large-size farm holdings located in irrigated areas. High rates of fertilizer application are found in the leafy vegetable and fruit crop production zones. In addition to soil application, some vegetable and fruit crop growers also use foliar fertilizers for supplementing soluble plant nutrients.

1. Overview of agriculture

Agriculture is one of Thailand's most important sector, with around 60 percent of the population involved directly or indirectly in various aspects of this sector. The country has a total land area of 51.4 million hectares (ha), of which 21.3 million hectares or 41.5 percent are cultivated. Areas of approximately 10.1, 5.4, 0.2, 3.5, 0.8 and 1.3 million hectares are devoted to rice, field crops, vegetables, fruit trees, livestock, and other agricultural purposes respectively. Major agricultural export products are crops, fishery products, livestock and agro-industry products. The major crops are rice, maize, cassava, sugarcane and rubber. Thailand is the largest exporter of rice and rubber in the world.

Thailand has consistently produced a surplus of food crops and has been a net food exporting country. During the past two decades, the production of crops has remarkably increased, contributing to the impressive agricultural growth. The increasing of agricultural production during that time has been primarily based on the extension of agricultural land; increment production due to improvement of soil fertility and increased yields per hectare played only a minor role. However, now the availability of new arable land for expansion of agriculture has been almost exhausted. Planting area, total yield and average yield of some crops in 2004/2005 are shown in Table 1.

Table 1. Crop production in Thailand in 2004/2005

Crop	Planting area (million hectares)	Total yield (million tonnes)	Average yield (tonne/ha)
Major rice*	9.20	18.65	2.36
Maize	1.13	4.22	3.87
Cassava	1.04	16.94	17.18
Soybean	0.16	0.24	1.51
Oil palm	0.31	5.18	16.74
Durian	0.12	0.83	7.19
Mangosteen	0.04	0.24	5.48
Longan	0.11	0.63	5.77

* planting area of second (off season) rice is 1.35 million hectares.

Source: Land Development Department, 2004/2005 Report.

Rice production systems vary by types of rice and region. Paddy rice is mainly produced in all regions while upland rice is confined in only some upland or mountainous area. Paddy rice is cultivated in lowland areas and controlled flooded fields during the entire growing period. The Northeast region represents 57.1 percent of total acreage and produces 42.4 percent of rice with average yield of 1.84 tonnes/ha. The Central Plain, with 17.19 percent of the area under rice, produces 26.1 percent of rice with average yield of 3.34 tonnes/ha. The comparison of rice production in four regions of the country is shown in Table 2.

Table 2. Rice production in four regions of Thailand in 2004/2005

Region	Planting area (million hectares)	Total yield (million tonnes)	Average yield (tonne/ha)
North	2.04	5.08	2.77
Northeast	5.28	7.91	1.84
Central	1.59	4.87	3.34
South	0.34	0.79	2.46

Source: Land Development Department, 2004/2005 Report.

Planting area of maize is 1.13 million hectares, produces 4.22 million tonnes with the average yield of 3.87 tonnes/ha. Other important crops are cassava, sugarcane, rubber and oil palm.

At present, continuous cultivation in medium or low fertility soils with little application of fertilizers has caused a rapid decline in soil productivity. The methods to increase agricultural production to satisfy both domestic consumption and export are to prevent soil degradation, especially by erosion, and to improve soil fertility by appropriate use of chemical and organic fertilizers.

Thailand has the potential to increase its food production through the usual means of:

- 1) increasing the yield per hectare by increasing soil productivity;
- 2) increasing the number of crops per year;
- 3) replacing the lower yielding with higher yielding crops and varieties; and
- 4) reducing post harvest loss.

The main target of agricultural development in 2009 is increasing irrigation area, improving production system and increasing planting area of some crops such as rubber and oil palm (Table 3).

Table 3. Target of increasing irrigation area and planting area of some crops or modifying production system in 2009

To increase	Million hectares
Irrigation area	0.16
GAP* planting area	3.20
Para rubber planting area	0.16
Oil palm planting area	0.16
Organic farming	0.05

* Good Agricultural Practices

Source: Ministry of Agriculture and Cooperatives, 2004/2005 Report.

2. Fertilizer import, consumption, and production

2.1 Fertilizer Import

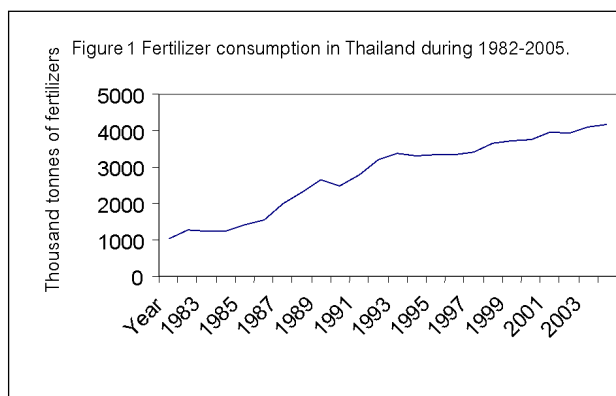
Almost all fertilizers used in Thailand are imported both in the form of formulated compound fertilizers (NP and NPK) and straight fertilizers. These imports were either for local mixing plants or for direct use. Urea, ammonium sulphate, di-ammonium phosphate and muriate of potash were the fertilizers most often used in the local production of various grade of NP and NPK. Other grades of compound fertilizers are also imported (Table 4).

Table 4. Type and quantity (thousand metric tonnes) of some chemical fertilizer imported in 2005

Fert. grade	Quantity	Fert. grade	Quantity	Fert. grade	Quantity
46-0-0	1,428.42	22-7-12	22.41	19-3-0	9.60
0-0-60	403.06	8-24-24	22.02	0-0-50	8.66
18-46-0	292.43	0-20-0	19.31	15-0-0	7.90
21-0-0	268.12	11-52-0	18.45	21-7-14	7.50
16-20-0	224.20	16-16-8	16.12	13-0-46	7.23
15-15-15	208.36	16-11-14	15.00	20-0-0	6.25
16-16-16	90.74	14-14-21	14.98	17-17-17	5.28
13-13-21	52.72	21-10-10	14.24	15-5-20	5.27
12-52-0	42.17	25-7-7	12.47	17-46-0	4.63
25-0-0	37.60	0-46-0	10.72	12-12-17	4.48

Source: Office of Agricultural Economics, 2004/2005 Report.

Total fertilizer import increased from 3,713,328 tonnes in 2000 to 3,952,356 tonnes of material in 2002; by 2005, fertilizer import had reached 4,004,321 tonnes of material (Figure 1). Among various compound fertilizers, 16-20-0 and 15-15-15 were the most popular grades. The Republic of Korea, Saudi Arabia, Norway, the United States, Malaysia and China are the major exporters of fertilizers to Thailand.



2.2 Fertilizer consumption

Fertilizer use for rice is the highest among all crops (Table 5). Rice is the most important in at least four respects:

- 1) about 50 percent of farm land is planted to rice;
- 2) it is the major subsistence and cash crop for majority of the farmers;
- 3) it is the staple food of the Thai people; and
- 4) it is Thailand's most important agricultural source of foreign exchange.

The use of fertilizer in rice production increased considerably during 2000-2005. Fertilizer use on paddy was 1,986 thousand tonnes material in 2000 and reached a peak of 2,774 thousand tonnes in 2005 and expect to reach 3,324 thousand tonnes in 2008. As shown in Table 5, about 69 percent of total fertilizer consumption was used for rice production in 2005. The typical fertilizer grade for paddy is 16-20-0 and 16-16-8 as basal application, followed by urea or ammonium sulphate for top-dressing.

Table 5. Chemical fertilizer use (thousand tonnes) for different crops during 2000-2008

Year	Rice	Field crops	Tree and fruit tree	Vegetable and ornamental plants	Total
2000	1,986	535	712	420	3,654
2001	2,076	525	699	412	3,713
2002	2,315	478	645	379	3,750
2003	2,459	470	636	374	3,833
2004	2,612	462	627	368	3,917
2005	2,774	453	618	363	4,004
2006*	2,946	445	610	357	4,092
2007*	3,129	438	601	352	4,183
2008*	3,324	430	593	347	4,275

* Forecast base on favorable condition.

Source: Office of Agricultural Economics, 2004/2005 Report.

The fertilizer demand in Thailand in the next 5 years will be increased progressively to support agricultural development policy (Table 3). The extension of Good Agricultural Practices (GAP) system in irrigated areas will enhance the proper use of fertilizers. Increasing rubber and oil palm planting area will also create substantial demand for chemical fertilizers.

The short term forecast of fertilizer consumption during 2006-2010 is shown in Table 6. The predicted demand, however, will be influenced by both environmental and economic situations in that cropping year. Under the worst case scenario, the fertilizer demand will be reduced by 16, 17 and 14 percent of N, P₂O₅ and K₂O quantity respectively as compared to the best case scenario (Table 7).

Table 6. Forecast of fertilizer consumption (thousand tonnes of nutrients) in 2006-2010

Year	N	P ₂ O ₅	K ₂ O
2005/06	1,050	370	310
2006/07	1,100	390	320
2007/08	1,120	400	325
2008/09	1,140	410	330
2009/10	1,160	415	330

Table 7. Forecast of fertilizer consumption (thousand tonnes of nutrient) in 2009/10 under the best and worst case scenario

Nutrient	Best case	Worst case
N	1,200	1,000
P ₂ O ₅	425	350
K ₂ O	350	300

Source: Sakulyong, 2005. Survey report submitted to IFA.

2.3 Fertilizer production

Thailand does not have any fertilizer producing plant. However, the local supply of about 200 thousand tonnes of ammonium sulphate is from caprolactam plant. There are several mixing plants which blend mixtures of various grades by using imported straight or compound fertilizer as raw materials. There are several companies involved in fertilizer production, ranging from small units blending 100-500 tonnes/day and upwards. In 2004, more than 150 companies obtained license from the Department of Agriculture for blending fertilizers. The largest of these companies is the Thai Central Chemical Public Company Limited (TCCC). The most common grades locally produced are 16-20-0, 16-12-8, 16-8-4, 18-12-6, 18-10-6, 18-4-5, 15-15-15, 12-24-12 and 13-13-21.

TCCC has a 360,000 tonnes per annum steam granulation plant which began operation in 1975. The production capacity of TCCC increased to 500,000 tonnes in April 1994 with an upgrading of machinery on both production lines. The third production line operated in June 1995, adding 350,000 tonnes to raise the total annual capacity to 800,000 tonnes. At present, the maximum production capacity of TCCC is 1.2 million tonnes per annum.

3. Important factors contributing to the trend of fertilizer use

Important factors contributing to the trend of fertilizer use are crop diversification, climate, fertilizer price and distribution and credit.

3.1 Crop diversification

The progressive expansion of cultivation in the 1980's to new lands which were less suitable for rice production, coupled with a deliberate diversification policy initiated by the government, led to an increase in the cultivation of upland crops, such as maize, cassava, sugarcane, soybean, mungbean, groundnut, vegetables, cotton, kenaf, rubber and oil palms. Therefore, the share of upland crops markedly increased and, in 1987, these crops consumed 59 percent of fertilizer material.

However, in 2004, upland crops consumed 462 thousand tonnes of fertilizers. This represented 11.8 percent of the fertilizer used in this country (Table 4).

3.2 Climate

Thailand has only 4.5 million hectares of irrigated area, which is about 24 percent of the total area under cultivation (Table 8).

Therefore, crop production in this country is mainly in rain fed areas. Agricultural production is affected by drought or flood in some years. For example, due to severe drought that hit Thailand in early 1992, fertilizer consumption in 1991/92 dropped by 19 percent. The dry conditions that prevailed in the end of 2004 and the first quarter of 2005 have negative effect on the 2004 secondary rice crop and reduce the trend of fertilizer use in the next major rice cultivation.

Table 8. Water resources development by region

Region	Accumulated irrigated area (ha)
North-Eastern	756,114
Northern	1,098,020
Central Plains	2,216,925
Southern	465,918
Total	4,536,977

Source: Department of Irrigation. Annual Report 2004.

3.3 Fertilizer price and distribution

Practically almost all of Thailand's fertilizer requirements are met by import. This has often resulted in marked price fluctuations, reflecting those of the world market. Fertilizer prices paid by Thai farmers vary widely depending on the supply source and terms under which fertilizers is purchased. The cheapest supplier was the Marketing Organization for Farmers (MOF), which offered some fertilizers at a price subsidized by the Government. MOF, however, provided only 10 percent of the total supply. The price of the Bank of Agriculture and Agricultural Co-operatives (BAAC) was slightly higher than the MOF price owing to higher transportation cost, included in the farmer's price. The remaining 80 percent of fertilizers sold in Thailand was determined by free market force. Inadequate supplies of suitable fertilizers and delayed delivery during peak seasons sometimes create serious problems for farmers. These constraints are caused by limited availability and limited port storage and transportation facilities. This effect is more apparent in remote areas, where there is none or little storage capacity.

3.4 Credit

Provision of adequate agricultural credit was one of the most important factors in encouraging farmers to increase fertilizer use in order to obtain higher yields. Agricultural credit was obtained from BAAC, MOF and about 30 domestic and foreign banks which operate in Thailand. BAAC and MOF are the main sources of credit for fertilizers with low interest rates. Large percentage of farmers borrowed cash from non-institutional sources where interest rates are generally high.

4. General impact of fertilizer use on crop productivity

The increase in agricultural productivity has been attributed to several factors, such as use of fertilizers, adequate irrigation, use of improved seeds and effective pest managements. Nevertheless, fertilizer use may be singled out as the most important input contributing to increased agricultural productivity in modern agriculture. There is a clear relationship between fertilizer application rates and above-average agricultural production.

4.1 Low application rate

Thailand has a relatively low rate of fertilizer use per hectare among ASEAN countries. The average nutrient consumption per unit arable land increased from 18.10 kg/ha in 1982/83 to 23.60 kg/ha in 1986/87. The actual increase during those four years was only 5.5 kg nutrient/ha. Fertilizer consumption, however, markedly increased in the 1990's. The average nutrient consumption in 2003/2004 was 52.3 kg nutrient/ha.

Generally, fertilizer usage in Thailand is only half of agronomic recommendation. Raising the usage levels up to the agronomic recommendation would mean doubling the fertilizer usage and increasing crop yield and production.

4.2 Current practice

In 2005, Department of Agriculture proposed NPK fertilizer recommendation for rice, field crops and horticultural crops based on soil organic matter (%OM), available phosphorus (mg P/kg) and exchangeable potassium (mg K/kg). The data in Table 9 shows the recommendation rates of N, P₂O₅ and K₂O for rice, corn and cassava. However, many farmers in rain-fed areas cannot afford the high cost of chemical fertilizers. In the irrigated areas of the Central Plain about 70 percent of the rice farmers were aware of fertilizer recommendations for rice. In general, rice farmers applying chemical fertilizers had larger-size farm holdings than those not applying it. A high rate of fertilizer application was also found in leafy vegetable and fruit crop production.

Table 9. Fertilizer recommendation for rice, corn and soybean based on soil chemical analysis

Rice		Corn		Cassava	
Soil analysis	Fert.(kg/ha)	Soil analysis	Fert. rate	Soil analysis	Fert. rate
OM (%)		OM (%)		OM (%)	
<1	112 kg N	<1	125 kg N	<1	100 kg N
1-2	75 kg N	1-2	95 kg N	1-2	50 kg N
>2	38 kg N	>2	62 kg N	>2	25 kg N
Avail.P (mg/kg)		Avail.P (mg/kg)		Avail.P (mg/kg)	
<5	38 kg P ₂ O ₅	<10	95 kg P ₂ O ₅	<7	50 kg P ₂ O ₅
5-10	19 kg P ₂ O ₅	10-15	50 kg P ₂ O ₅	7-30	25 kg P ₂ O ₅
>10	0 kg P ₂ O ₅	>15	30 kg P ₂ O ₅	>30	0 kg P ₂ O ₅
Avail.K (mg/kg)		Avail.K (mg/kg)		Avail.K (mg/kg)	
<60	38 kg K ₂ O	<60	90 kg K ₂ O	<30	100 kg K ₂ O
60-80	19 kg K ₂ O	60-100	50 kg K ₂ O	30-60	50 kg K ₂ O
>80	0 kg K ₂ O	>100	30 kg K ₂ O	>60	25 kg K ₂ O

Source: Department of Agriculture 2005. Fertilizer Recommendation for Economic Crops.

The application of fertilizers to the plant shoot in the form of aqueous solution to supplement some limited nutrients is practiced in vegetables, fruit crops and some field crops especially in the irrigated areas.

Advantages of foliar sprays are:

- 1) application rates are relatively low,
- 2) uniform distribution is easily obtained and,
- 3) response to the applied nutrient is almost immediate so that deficiencies can be corrected during the growing season.

The under-use of fertilizers in Thailand is attributed to the following factors:

- 1) low profitability of fertilizer use, given its relatively high price,
- 2) poor arrangements for distribution of fertilizers in remote areas and,
- 3) unfavorable climatic conditions in non-irrigated areas.

This under-use of fertilizers is indeed the major cause of soil nutrient depletion and land degradation.

4.3 Imbalance of nutrients in fertilizers

The imbalance of N:P₂O₅:K₂O ratio was one of the significant problems in the past, but this has only worsened. In 1980, for example, the average fertilizer ratio (N:P₂O₅:K₂O) used in this country was 1:0.75:0.30; by 1990, this had become more imbalanced (1:0.55:0.26) but the ratio was adjusted to 1:0.61:0.43 in 2000. The predominant use of nitrogen and phosphorus has depleted potassium reserves in the soils. In some fruit crop production area, accumulation of phosphorus in soil caused some micronutrients deficiency. In the long run, efforts should be emphasized on promoting more balanced use of fertilizers for particular crops and soils.

4.4 Low fertilizer use efficiency

The low fertilizer use efficiency in Thailand is attributed to the following factors :

- 1) the system of extensive agricultural practice,
- 2) the small percentage of cropped areas that are irrigated,
- 3) the use of non responsive crop varieties and,
- 4) the use of improper fertilizer formula, rate and application methods.

4.5 Secondary and micronutrients deficiency in soils

Acid soils, especially those containing little clay or humus, are usually deficient in K, Ca, Mg or S. High leaching of acid sandy soils may even have produced a deficiency of some nutrients such as Zn, Cu, or B. In both over limed and naturally alkaline soils, Fe, Zn, Cu and Mn may become immobilized by precipitation and thus become unavailable to plants. Therefore, problems soils such as acid, alkaline, or sandy soils may have limited availability of one or more secondary or micronutrient elements.

Secondary element and micronutrient deficiencies may occur over broad geographic areas, or they be localized, even on the scale of isolated patches of poorer growth in otherwise healthy crops. Single or multiple deficiencies of secondary and micronutrient elements occur in a wide variety of soils in Thailand. Ammonium sulphate and triple superphosphate provide substantial amount of S and Ca respectively.

The compound fertilizers usually available in local markets, however, may or may not contain substantial amount of one or more secondary and micronutrients depending on fertilizer sources. Thus, enrichment of granular fertilizers and fertilizer blends with some of those elements might be required in some agricultural areas in the future.

It is necessary to stimulate the use of balanced nutrient fertilizer with the appropriate application rate; and it is also necessary to improve fertilizer use efficiency at the farm level through an information dissemination campaign on proper fertilizer application.

To stimulate proper fertilizer usage on small-holdings, the following measures are very suitable:

- 1) greater use of high-yielding cultivars,
- 2) extension of irrigation facilities,
- 3) appropriate fertilizer pricing policy and subsidy schemes,
- 4) improving marketing and logistics,
- 5) improving farmers access to credit and,
- 6) improving the effectiveness and efficiency of marketing and distribution systems for products and a guaranteed price scheme.