Organic Farming Criteria, Farm Survey and Mapping in Thailand

Supported by

Small Projects Facility
EU-Thailand Economic Co-operation

Yuttachai Anuluxtipun et al., 2006

Land Development Department
Ministry of Agriculture and Cooperatives

Thammasat University

Short Intensive Overseas Program (SIOP) on Organic and Unique Quality Food Production and Marketing
Building an Euro-Asian Network for Quality, Organic and Unique Food Marketing Bangkok, Thailand 1 March 2006

Further Information

Research and Development for Global Warming; Office of Research and Development of Land Management Land Development Department, Ministry of Agriculture, Bangkok 10900, Thailand, Tel: 662-579-1803

Fax. 662-579-1803 e-mail address : yuttchai2004@yahoo.com,yuttchaithai@hotmail.com

Organic Farming Criteria, Farm Survey and mapping in Thailand

Yuttachai Anuluxtipun,[1] Phongthorn Phianphitak, [2] Busarin Swanglap[2] and Bundit Anurugsa[3]

Abstract

Organic farming has had a tentative start as an alternative production system but now is more widely accepted. A change to organic production may have a number of benefits, and policy debates or interventions to support growth in organic farming inevitably have to consider why farmers do, or do not, take up organic techniques. While the institutional settings and the economic and social contexts of farmers have an influence on decision making. Agricultural crop residues are abundant at least 43 million tons per year both in kind and quantity. Currently, most of them are wasted on the fields and ploughed into the soil as conditioners or organic fertilizers. Theoretically, the organic amendment reduces 50% to import chemical fertilizer 1.92 million tons per year and pesticides 25,155 tons per year. That meaning more than 430 million EURO per year (21,500 million THB per year) is saving. However, the convention to conversion is gradually changing and the government policy should subsidize the budget 175.44 million EURO per year (8,772 million THB per year) for replacing the dramatically deplete of plant nutrients.

Sites selection of suitable for organic farming and mapping by means of GIS and modeling has been provided an opportunity to integrate physical, chemical and organic residue parameters with irrigation areas and other relevant data. To identify the suitable and reclassify highly potential organic area are 0.5 million hectare (3.12 million rai). These area can divide in irrigated 0.16 million hectare(0.99 million rai) and rainfed 0.34 million hectare (2.13 million rai). However, these organic suitable areas are a preliminary figure. Not only use GIS interpretation data but also should be consider farmer adoption. In so doing the values of organic and conventional farmers will be concise presented as well.

This paper delineates and focus on the first is a strategic government policy making. The second is a number of organic farming and stake holder. The last one is to identify organic land suitability mapping in Thailand. The government strategy designed to help farmers get better prices and reduce the cost. Furthermore, Thai government try to find out and extend the good opportunities for Thai farmers to increase their income, so that they are able to take maximize advantage of new technologies in organic agriculture.

1 Head of natural disasters assessment mapping and Evaluation of Assets, Taxes and Agricultural Capital Division; Land Development Department, Ministry of Agriculture, Bangkok 10900, Thailand, Tel: 662-579-7405

2 Young scientist of natural disasters assessment mapping and Evaluation of Assets, Taxes and Agricultural Capital Division Land Development Department, Ministry of Agriculture, Bangkok 10900, Thailand, Tel: 662-579-7405

3 Assistance, Prof., Dr. in Thammasat University, Rungsit, Phratum thanee province, Thailand, Tel: 662-564-4480

Introduction

Agriculture forms the major sector in the national economy of the majority of the countries in the Southeast Asian region and Thailand is also the same in this situation. As these countries try to expand the sector, through diversification of agriculture and extensive multiple cropping programs, the demand for agricultural chemicals, fertilizers in particular, continues to grow. Some of the countries, endowed with the raw material resources, e.g. natural gas, developed and expanded their production facilities, whereas some still continue to depend on imports from neighboring countries in the region and beyond. To meet the growing demand of fertilizers domestically and regionally, the fertilizer industry in the region continues to expand, exploiting the rich natural resources available in the region. Southeast Asia countries have been encouraging foreign direct investments in various sectors of their economies to promote industrial and commercial developments based on the natural resources available in the countries and regionally. In many cases, foreign direct investments are crucial for the implementation of capital intensive industrial projects, such as ammonia-urea fertilizer production complexes. The present study attempts to identify the prospects for expansion of the fertilizer industry in the countries of Southeast Asia considering the natural resources available and the market potential for the products, and thence the opportunities for participation in the sector by foreign investors. Fertilizer markets in the countries are reviewed extensively to be of reference for trading companies with interest in Southeast Asia as a source of supply or sales targets.

Thailand imports 25 billion baht worth of chemical fertilizers a year. Its pesticide imports amount to 7 billion baht annually. This means that Thailand spends around 32 million baht each year on imported chemical fertilizers and pesticide.

The promotion of organic fertilizers has become the Government's new strategy to help develop Thailand into the "Kitchen of the World." So organic agriculture would give rise to the cultivation of chemical-free food crops.

The Chemical Fertilizer Industry forecast in Thailand

The chemical fertilizer industry has been very important to Thailand's economic development and will continue to be in the years to come. Chemical fertilizer has played a vital role in raising agricultural productivity. It is significantly of the steadily declining area suitable for agriculture in all regions of the country as well as the increasingly strong competition in the global market for agricultural goods. In order to improve the standard of quality of farm produce and to ensure that supply will be able to meet the ever rising demand, chemical fertilizer remains an indispensable factor of production in agriculture. A study of chemical fertilizer showed that there is still plenty of room for further growth of this industry during the next few years. The overall use of chemical fertilizer in Thailand's agricultural sector, according to the experts, should total around 6 million tons per year. However, the actual use of chemical fertilizer today is just over 3 million tons per year. But in spite of good future prospect, Thailand's chemical fertilizer industry still faces many limitations. One is the dependence on imported raw materials. Volatile rate of exchange has been a serious problem for Thailand's chemical fertilizer producers who find themselves constantly up against higher production cost and financial liquidity problem. Producers of chemical fertilizer, both in liquid form and pellets, basically import raw materials from abroad to mix with what is called "mixer" to achieve various nutrient formulas that are in demand on the domestic market. Chemical fertilizer produced by these companies comprises mainly the following 12 formulas: 0-0-60, 10-20-10,12-24-12,15-7-18,16-8-14, 20-20-20, 21-0-0,15-15-15,16-20-0, 16-16-8, 16-8-8 and 13-13-21 etc.,

Chemical Fertilizer Usage

The decline in land area suitable for agriculture and the deterioration of soil quality in cultivated land have resulted in a steady increase in the use of chemical fertilizer. Thailand's agricultural sector's chemical fertilizer use during the 10 year period between 1986 and 1995 increased at an average of 10.27 per cent per year. From a total of 1.4 million tons in 1986, chemical fertilizer use climbed to 2.6 million tons in 1990 and eventually to 3.3 million tons in 1995. For the period between 1996 and 2000, figures were not yet available but it was estimated that chemical fertilizer use increased from 3.4 million tons in 1996 to 3.48 million tons in 2000 and eventually will rise to 3.65 million tons in 2003. For this 8-year period, the average rate of increase is 1.3 per cent per year. Chemical Fertilizer Market, Thailand's chemical fertilizer market is strongly competitive. Promoting a chemical fertilizer's brand name is very important because, if a brand name becomes well-known to customers, maintaining the slice of the market the product has captured can be a lot easier. All of chemical fertilizer in Thailand was either imported or mixed with imported raw materials. The Industry's Problems, Trading fertilizers in Thailand can be quite risky. Among the fertilizer industry's many problems are: 1) nearly all chemical fertilizer and raw materials for mixing must be imported. Necessary raw materials for manufacturing chemical fertilizer cannot be found in Thailand. 2) Prices of raw materials for chemical fertilizer on the world market fluctuate wildly, especially the three basic ingredients of N-P-K fertilizer -- UREA, DAP or Di Ammonium Phosphate and MOP or Muriate of Potash. 3) Uncertainly involving the exchange rate has a negative impact on production costs. 4) The volume of chemical fertilizer sold each year depends on the weather and on prices of agricultural goods. 5) Prices of chemical fertilizer are controlled by the government. In spite of its dependence on such external factors as machinery, raw materials and energy, Thailand's chemical fertilizer industry will remain just as indispensable to the future of economic development as it has been during the past decades. Thailand is, after all, an agricultural country. Besides, its agricultural sector's use of fertilizers is still well below the level recommended by experts. Total chemical fertilizer use is, in fact, just over 3 million tons a year. The experts say the total amount should be about 6 million tons annually. Thailand's farmers to understand how to increase farm output per unit of input as recommended by the experts. Marketing strategy designed to help farmers get better prices for what they produce is also equally important. It is the best way to increase their income, so that they are able to take full advantage of new technologies in agriculture. This paper presents a brief overview on the present status of agricultural residues, their utilization for a raw material to produce the manure and liquid manure etc., The prospect for intensifying and expanding their uses is economical for small holder which is so pool farmer and low opportunity.

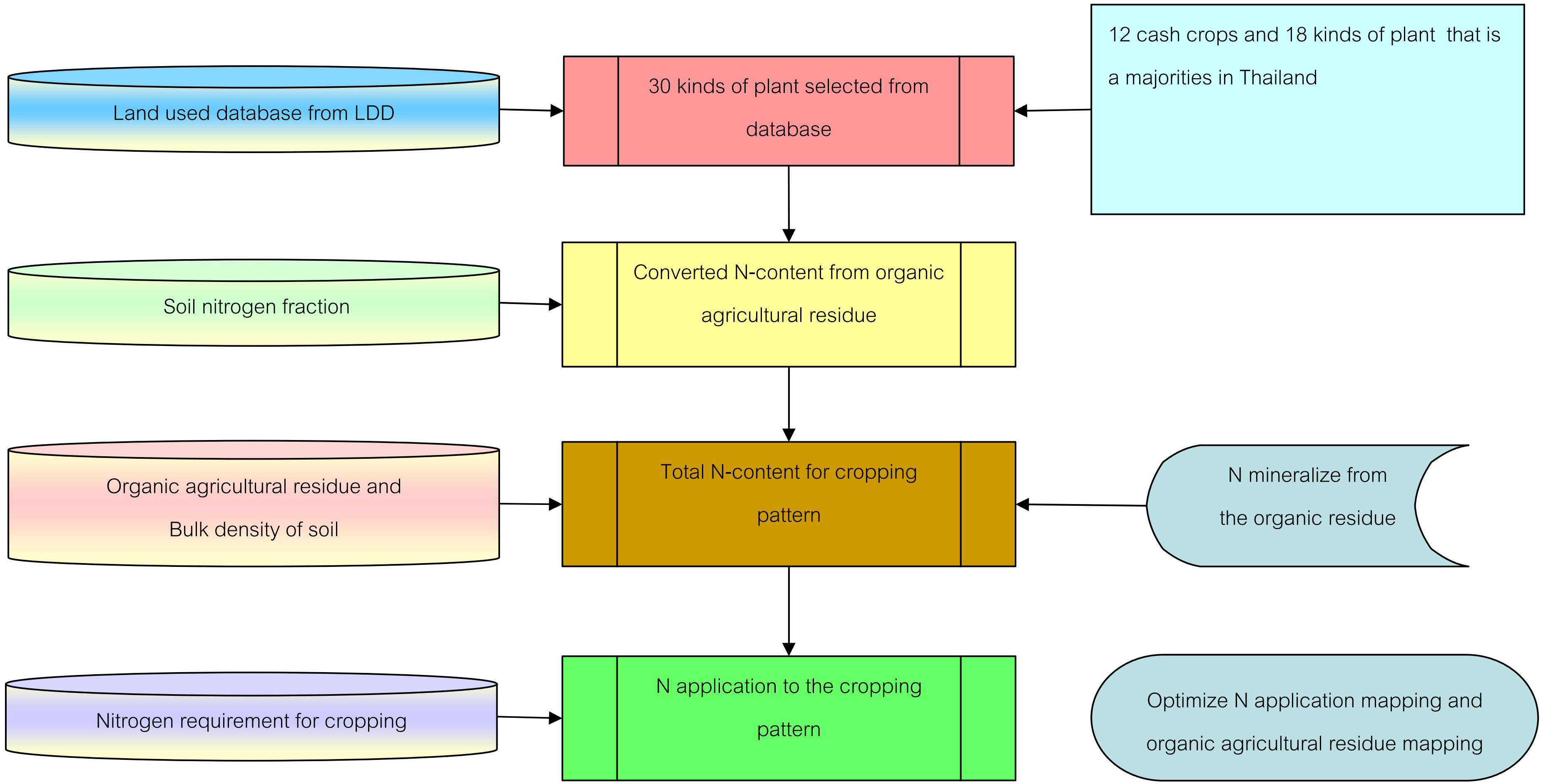


Figure 1 Estimated of Biomass, Carbon stock and Nitrogen mineralization to derive from the present land used and organic agricultural residue in soil of Thailand

LDD.1 (Compost)

Table1 A large number of agricultural and husbandry residues in Thailand

Order	Economic crops/ Manure	Area [1/] (rai)	Average yield per area per year [2/] (kg/rai/year)	Total average yield per year (kg/year)	Residue/Crop product Ratio [4/]	Total organic agricultural residues (kg/year)	Total organic agricultural residues (ton/year)
		(1)	(2)	(3) = (1)*(2)	(4)	(5) = (3)*(4)	(6) = (5)/1000
	Economic crops						
1	Rice	85,299,197.28	587.50	50,113,278,402	1.4	70,158,589,763	70,158,590
2	Maize	9,668,804.37	874.50	8,455,369,422	1.0	8,455,369,422	8,455,369
3	Cassava	8,167,857.80	3,000.00	24,503,573,400	0.4	9,801,429,360	9,801,429
4	Sugarcane	12,892,501.33	7,120.00	91,794,609,470	1.5	137,691,914,204	137,691,914
5	Cabbages	42,102.80	4,500.00	189,462,600	1.5	284,193,900	284,194
6	Pineapples	665,166.41	3,733.00	2,483,066,209	1.0	2,483,066,209	2,483,066
7	Tamarind	537,552.25	242.00	130,087,645	3.0	390,262,934	390,263
8	Rubber	19,117,116.43	286.00	5,467,495,299	3.0	16,402,485,897	16,402,486
9	Oil palm	1,438,725.98	2,725.00	3,920,528,296	1.0	3,920,528,296	3,920,528
10	Coconut	1,285,265.93	1,016.00	1,305,830,185	1.0	1,305,830,185	1,305,830
11	Lichi	88,219.88	6,744.00	594,954,871	1.0	594,954,871	594,955
12	Longan	376,947.71	1,000.00	376,947,710	2.0	753,895,420	753,895
13	Mangoes	295,616.18	700.00	206,931,326	2.0	413,862,652	413,863
14	Durians	26,453.77	1,313.00	34,733,800	2.0	69,467,600	69,468
15	Lemon	1,216.43	1,000.00	1,216,430	2.0	2,432,860	2,433
16	Soybean	89,634.98	224.00	20,078,236	2.1	42,164,295	42,164

LDD.1 (Compost)

Table 1(continue) A large number of agricultural and husbandry residues in Thailand

Order	Economic crops/ Manure	Area [1/] (rai)	Average yield per area per year [2/] (kg/rai/year)	Total average yield per year (kg/year)	Residue/Crop product Ratio [4/]	Total organic agricultural residues (kg/year)	Total organic agricultural residues (ton/year)
		(1)	(2)	(3) = (1)*(2)	(4)	(5) = (3)*(4)	(6) = (5)/1000
	Economic crops						
17	Bananas	86,936.72	1,982.00	172,308,579	2.0	344,617,158	344,617
18	Grapes	9,891.74	2,471.41	24,446,545	2.0	48,893,090	48,893
19	Watermelons	5,332.93	3,098.93	16,526,377	1.3	21,484,290	21,484
20	Mangosteen	41.80	1,227.00	51,289	1.1	56,417	56
21	Orange	354,301.17	2,780.00	984,957,253	2.0	1,969,914,505	1,969,915
22	Papaya	2,367.70	2,966.00	7,022,598	1.0	7,022,598	7,023
23	Jack Fruit	1,269.23	3,000.00	3,807,690	1.2	4,569,228	4,569
24	Rambutan	1,985.96	1,681.00	3,338,399	1.5	5,007,598	5,008
25	Peanut	2,662.43	235.00	625,671	1.0	625,671	626
26	Langsat	838.91	1,268.32	1,064,006	2.0	2,128,013	2,128
27	Potatoes	2,588.33	1,931.00	4,998,065	0.4	1,999,226	1,999
28	Coffee	218,264.52	159.00	34,704,059	2.0	69,408,117	69,408
29	Cashew Nut	52,005.82	268.46	13,961,482	2.0	27,922,965	27,923
30	Sesame seed	1,861.40	120.00	223,368	2.0	446,736	447
Total		140,732,728				255,274,543,479	255,274,543
Manure [3/]							21,936,897

LDD.1 (Compost)

Table 2 LDD.1 Soil microorganism requirement and cost for making the compost in Thailand

Level	Quantity of economic crops residues (ton/year)		Quantity of manure residues (ton/year)		LDD.1 (unit)	Compost production rate (ton/year)	Compost cover area (rai)	LDD.1 cost (Baht/year)
	Total	Compost production	Total	Compost production				
	(7) = sum (6)	(8) = (7)*0.1	(9) = (6)	(10) = (9)*0.1	(11) = (8)/1	(12) = (8)*0.6/1	(13) = (12)*1/2	(14) = (11)*20
Thailand	255,274,543	25,527,454	21,936,897	2,193,690	25,527,454	15,316,473	7,658,236	510,549,087

Remarks: LDD.1 = soil microorganism which isolated from LDD

Area 6.25 rai = 1 ha

50 Thai baht = 1 EURO

LDD.1 1 unit = 100 g

Sources: [1/] Landuse map on AgZone 2.0 Program, Land Development Department (2003)

[2/] Office of Agricultural Economics (2002)

[3/] Office of Agricultural Economics (2002)

[4/] Daniela Jolli and Stefan Giljum. Unused biomass extraction in agriculture, forestry and fishery. Nr.3, March 2005. SERI Studies.

Assumptions for calculation:

1) Using economic crops and manure residues 10 percentage of total agricultural residue for compost

2) 0.6 ton compost = 1 ton crops residues: 0.2 ton manure residues: 1 unit LDD.1

3) Recommended compost 2 ton per rai

4) LDD.1 cost = 20 baht per unit

Calculations:

1) Total average yield per year (kg/year) = area (rai) X average yield per area per year (kg/rai/year)

2) Agricultural residues (kg/year) = residue/crop product ratio X total average yield per year (kg/year)

3) Quantity of economic crops residues for compost (ton/year) = total economic crops residues (ton/year) x 0.1

4) Quantity of LDD.1 used for compost (unit/year) = economic crops residues (ton/year)/1 (ton/unit)

5) Compost production rate (ton/year) = economic crops residues (ton/year) x 0.6 (ton) / 1(ton)

6) Compost cover area (rai) = Compost production rate (ton/year) x 1(rai) / 2 (ton/year)

7) LDD.1 cost for compost (baht/year) = Quantity of LDD.1 (unit/year) x 20 (baht/unit)

LDD.2 (Liquid manure)

Table 3 A large number of crop residues in Thailand

Order	Succulents	Area[1/] (rai)	Average yield per area per year[2/] (kg/rai/year)	Total average yield per year (kg/year)	Residue/Crop product Ratio[3/]	Succulents residues (kg/year)	Succulents residues (ton/year)
		(1)	(2)	(3) = (1)*(2)	(4)	(5) = (3)*(4)	(6) = (5)/1000
1	Sugarcane	12,892,501.33	7,120.00	91,794,609,469.60	1.5	137,691,914,204	137,691,914
2	Cabbages	42,102.80	4,500.00	189,462,600.00	1.5	284,193,900	284,194
3	Pineapples	665,166.41	3,733.00	2,483,066,208.53	1.0	2,483,066,209	2,483,066
4	Tamarind	537,552.25	242.00	130,087,644.50	3.0	390,262,934	390,263
5	Coconut	1,285,265.93	1,016.00	1,305,830,184.88	1.0	1,305,830,185	1,305,830
6	Lichi	88,219.88	6,744.00	594,954,870.72	1.0	594,954,871	594,955
7	Longan	376,947.71	1,000.00	376,947,710.00	2.0	753,895,420	753,895
8	Mangoes	295,616.18	700.00	206,931,326.00	2.0	413,862,652	413,863
9	Durians	26,453.77	1,313.00	34,733,800.01	2.0	69,467,600	69,468
10	Lemon	1,216.43	1,000.00	1,216,430.00	2.0	2,432,860	2,433
11	Soybean	89,634.98	224.00	20,078,235.52	2.1	42,164,295	42,164
12	Banana	86,936.72	1,982.00	172,308,579.04	2.0	344,617,158	344,617
13	Grapes	9,891.74	2,471.41	24,446,545.15	2.0	48,893,090	48,893
14	Watermelons	5,332.93	3,098.93	16,526,376.76	1.3	21,484,290	21,484
15	Mangosteen	41.80	1,227.00	51,288.60	1.1	56,417	56

LDD.2 (Liquid manure)

Table 3 (continue) A large number of crop residues in Thailand

Order	Succulents	Area[1/] (rai)	Average yield per area per year[2/] (kg/rai/year)	Total average yield per year (kg/year)	Residue/Crop product Ratio[3/]	Succulents residues	
						(kg/year)	(ton/year)
		(1)	(2)	(3) = (1)*(2)	(4)	(5) = (3)*(4)	(6) = (5)/1000
16	Orange	354,301.17	2,780.00	984,957,252.60	2.0	1,969,914,505	1,969,915
17	Custard apple	15,886.24	900.00	14,297,616.00	1.5	21,446,424	21,446
18	Guava	1,754.71	3,000.00	5,264,130.00	0.9	4,737,717	4,738
19	Papaya	2,367.70	2,966.00	7,022,598.20	1.0	7,022,598	7,023
20	Jack Fruit	1,269.23	3,000.00	3,807,690.00	1.2	4,569,228	4,569
21	Rambutan	1,985.96	1,681.00	3,338,398.76	1.5	5,007,598	5,008
22	Peanut	2,662.43	235.00	625,671.05	1.0	625,671	626
23	Langsat	838.91	1,268.32	1,064,006.33	2.0	2,128,013	2,128
24	Potatoes	2,588.33	1,931.00	4,998,065.23	0.4	1,999,226	1,999
25	Santol	415.14	1,414.88	587,373.28	1.2	704,848	705
26	Cashew Nut	52,005.82	268.46	13,961,482.44	2.0	27,922,965	27,923
Total		16,838,957				146,493,174,877	146,493,175

LDD.2 (Liquid manure)

Table 4 LDD.2 Soil microorganism requirement and cost for making the compost in Thailand

Level	Quantity of economic crops residues (ton/year)		Quantity of succulents residues (ton/year)		Agricultural residues for liquid manure (ton/year)	LDD.2 (unit)	liquid manure production rate (litre/year)	liquid manure cover area (rai)	LDD.2 cost (Baht/year)
	Total	liquid manure	Total	liquid manure					
	(7)	(8) = (7)*0.01	(9) = sum (6)	(10) = (9) * 0.1	(11) = (8) + (10)	(12) = (11)/0.04	(13) = (11)*50/0.04	(14) = (13)*1/10	(15) = (14)*20
Thailand	255,274,543	2,552,745	146,493,175	14,649,317	17,202,063	430,051,573	21,502,578,653	2,150,257,865	8,601,031,461

Remarks: LDD.2 = soil microorganism which isolated from LDD

Area 6.25 rai = 1 ha

50 Thai baht = 1 EURO

LDD.2 1 unit = 25 g

Sources: [1/] Landuse map on AgZone 2.0 Program, Land Development Department (2003)

[2/] Office of Agricultural Economics (2002)

[3/] Daniela Jolli and Stefan Giljum. Unused biomass extraction in agriculture, forestry and fishery. Nr.3, March 2005. SERI Studies.

Assumptions for calculation:

1) Using economic crops residues 1 percentage of total agricultural residue for Liquid manure
2) Using succulents residues 10 percentage of total succulents residue for Liquid manure
3) 50 litre Liquid manure = 0.04 ton agricultural residues: 1 unit LDD.2
4) Recommended Liquid manure 10 litre per rai
5) LDD.2 cost = 20 baht per unit

Calculations:

1) Total average yield per year (kg/year) = area (rai) X average yield per area per year (kg/rai/year)
2) Agricultural residues (kg/year) = residue/crop product ratio X total average yield per year (kg/year)
3) Quantity of economic crops residues for Liquid manure (ton/year) = total economic crops residues (ton/year) x 0.01
4) Quantity of succulents residues for Liquid manure (ton/year) = total succulents residues (ton/year) x 0.1
5) Quantity of agricultural residues for Liquid manure (ton/year) = economic crops residues + succulents residues
6) Quantity of LDD.2 used for Liquid manure (unit/year) = agricultural residues (ton/year) /0.04 (ton/unit)
7) Liquid manure production rate (litre/year) = agricultural residues (ton/year) x 50 (litre) / 0.04 (ton)
8) Liquid manure cover area (rai) = Liquid manure production rate (litre/year) x 1(rai) / 10 (litre/year)
9) LDD.2 cost for Liquid manure (baht/year) = quantity of LDD.2 (unit/year) x 20 (baht/unit)

LDD.3 (Disease Control: root and collar rot)

Table 5 LDD.3 **Soil microorganism requirement and cost for making** for disease control production in Thailand

Level	Compost (ton/year)		Disease control production rate (ton/year)	LDD.3 (unit)	Disease control cover area (rai)	LDD.3 cost (Baht/year)
	Total	Disease control production				
	(1)	(2) = (1)*0.01	(3) = (2)	(4) = (2)/0.1	(5) = (3)*1/0.1	(6) = (4)*20
Thailand	15,316,473	153,165	153,165	1,531,647	1,531,647	30,632,945

Remarks: LDD.3 = soil microorganism which isolated from LDD

Area 6.25 rai = 1 ha

50 Thai baht = 1 EURO

LDD.3 1 unit = 25 g

Assumptions for calculation:

1) Using compost 1 percentage of total compost (by LDD.1) for disease control

2) 0.1 ton disease control = 0.1 ton compost: 1 unit LDD.3

3) Recommended disease control 0.1 ton per rai

4) LDD.3 cost = 20 baht per unit

Calculations:

1) Quantity of compost for disease control (ton/year) = total compost (ton/year) x 0.01

2) Disease control production rate (ton/year) = quantity of compost for disease control (ton/year)

3) Quantity of LDD.3 used for disease control (unit/year) = quantity of compost for disease control (ton/year) /0.1 (ton/unit)

4) Disease control cover area (rai) = disease control production rate (ton/year) x 1(rai) / 0.1 (ton/year)

5) LDD.3 cost for disease control (baht/year) = quantity of LDD.3 (unit/year) x 20 (baht/unit)

LDD. 7(Organic Pesticide)

Table 6 A large number of herbal and spicy for making organic pesticide

Order	Herbs	Area[1/] (rai)	Average yield per area per year[21/] (kg/rai/year)	Total average yield per year (kg/year)	Residue/ Crop product Ratio[3/]	Herbs residues	
						(kg/year)	(ton/year)
		(1)	(2)	(3) = (1)*(2)	(4)	(5) = (3)*(4)	(6) = (5)/1000
1	Tamarind	537,552.25	242.00	130,087,644.50	3.0	390,262,934	390,263
2	Coconut	1,285,265.93	1,016.00	1,305,830,184.88	1.0	1,305,830,185	1,305,830
3	Lemon	1,216.43	1,000.00	1,216,430.00	2.0	2,432,860	2,433
4	Mangosteen	41.80	1,227.00	51,288.60	1.1	56,417	56
5	Ginger	9,975.96	2,447.00	24,411,174.12	1.1	26,852,292	26,852
6	Chilli	203,303.80	1,128.00	229,326,686.40	1.5	343,990,030	343,990
7	Custard apple	15,886.24	900.00	14,297,616.00	1.5	21,446,424	21,446
8	Guava	1,754.71	3,000.00	5,264,130.00	0.9	4,737,717	4,738
9	Neem	6,263.58	700.00	4,384,506.00	1.2	5,261,407	5,261
10	Pepper	1,217.93	600.00	730,758.00	1.2	876,910	877
11	Santol	415.14	1,414.88	587,373.28	1.2	704,848	705
12	Tea	2,791.01	476.00	1,328,520.76	2.0	2,657,042	2,657
Total		2,065,684.78				2,105,109,064	2,105,109

LDD. 7(Organic Pesticide)

Table7 LDD.7 Soil microorganism requirement and cost for making organic pesticide in Thailand

Level	Quantity of herbs residues (ton/year)		LDD.7 (unit)	pest preventing production rate (litre/year)	pest preventing cover area (rai)	LDD.7 cost (Baht/year)
	Total	pest preventing production				
	(7) = sum (6)	(8) = (7)*0.1	(9) = (8)/0.03	(10) = (8)*50/0.03	(11) = (10)*1/10	(12) = (9)*20
Thailand	2,105,109	210,511	7,017,030	350,851,511	35,085,151	140,340,604

Remarks: LDD.7 = soil microorganism which isolated from LDD

Area 6.25 rai = 1 ha

50 Thai baht = 1 EURO

LDD.7 1 unit = 25 g

Sources: [1/] Landuse map on AgZone 2.0 Program, Land Development Department (2003)

[21/] Office of Agricultural Economics (2002)

[3/] Daniela Jolli and Stefan Giljum. Unused biomass extraction in agriculture, forestry and fishery. Nr.3, March 2005. SERI Studies.

Assumptions for calculation:

1) Using herbs residues 10 percentage of total herbs residue for pest preventing

2) 50 litre pest preventing = 0.03 ton herbs residues: 1 unit LDD.7

3) Recommended pest preventing 10 litre per rai

4) LDD.7 cost = 20 baht per unit

Calculations:

1) Total average yield per year (kg/year) = area (rai) X average yield per area per year (kg/rai/year)

2) Agricultural residues (kg/year) = residue/crop product ratio X total average yield per year (kg/year)

3) Quantity of herbs residues for pest preventing (ton/year) = total herbs residues (ton/year) x 0.1

4) Quantity of LDD.7 used for pest preventing (unit/year) = herbs residues (ton/year) /0.03 (ton/unit)

5) Pest preventing production rate (litre/year) = herbs residues (ton/year) x 50 (litre) / 0.03 (ton)

6) Pest preventing cover area (rai) = pest preventing production rate (litre/year) x 1(rai) / 10 (litre/year)

7) LDD.7 cost for pest preventing (baht/year) = quantity of LDD.7 (unit/year) x 20 (baht/unit)

Table 8 Summarize Organic residues and cost for producing soil microorganisms LDD. type 1, 2, 3, 7

No.	Organic residues		LDD.		
	Crop residue types	Quantity (ton/year)	LDD. type	Quantity (ton)	Cost
1	Economic crops	25,527,454	1	2,553	510,549,087
2	Agricultural residues	17,202,063	2	10,751	8,601,031,461
3	Compost	153,165	3	38	30,632,945
4	Spicy, herbs	210,511	7	175	140,340,604
5	Manure	2,193,690			
Total		43,093,193		13,518	8,772,005,011

Remark: LDD type 1=20,000 THB/Ton, LDD type 2,3 and 7 = 80,000THB/Ton

The organic farming criteria and land degradation in Thailand

In addition to the harvested crop itself, large quantities of residues are generated in agricultural production systems. Cultivation of rice, potato, sugarcane, and other crops, fruits and vegetables generate considerable amounts of residues. These residues constitute a major part of total annual production of biomass residues and are an important source of energy both for domestic as well as industrial purposes. Unused biomass from agriculture can be divided into two categories: (1) parts of the plant which are retained to the field and (2) losses of parts of the plant due to harvest methods. In this paper we only deal with the first category of unused extractions of agriculture. The second one can be disregarded because the amounts are insignificantly small due to the use of modern harvesting machines in industrialized countries, but also increasingly in developing countries. However, not all residues from agriculture are unused extractions. Today, these biomass extractions are reused for a number of purposes, such as energy production (biogas), forage and bio-fuels. This share has to be excluded from the calculations, as it enters the economic system for further use. In the course of our literature reviews and internet searches, we found no existing comprehensive databases or publications which deal with this field of research and therefore had to elaborate a procedure to calculate unused extractions based on numbers for single species available in the literature. We identified two main ways to calculate residues from agriculture, which shall be discussed in more detail. According to the first method, unused domestic extraction is calculated by multiplying the used harvest by a conversion factor of unused extraction per harvested production. The second approach multiplies the harvested area with a coefficient of unused biomass per area. All data and estimations which are used for our methods of calculation are listed.

Organic farming is an approach to agriculture that emphasises environmental protection, animal welfare, food quality and health, sustainable resource use and social justice objectives, and which utilises the market to help support these objectives and compensate for the internalisation of externalities (Lampkin et.,al. 1999) Organic farming by neglect without inputs, but a developed approach to agriculture, based on science, with the selective use of modern technologies. forinstance:

- nitrogen self-sufficiency through reliance on biological nitrogen fixation using legumes, and no synthetic nitrogen fertilizers application.

- maintaining soil fertility by maximising return of organic matter from crop residues, livestock manures and recycling of organic waste products from the food chain, with measures to minimise risks of pollution or contamination from heavy metals, disease pathogens and other chemicals problem, and GMOs

- keeping nutrient cycles as closed as possible, to minimise pollution risk and to limit the need for permitted supplementary mineral fertilizers (phosphorus, potassium, calcium, magnesium and trace elements)

- achieving protection of crops from weeds, pests and diseases primarily through cultural and ecosystem management approaches, thus minimising the need for direct biological, mechanical or manual intervention, and eliminating nearly all chemical biocides (a very restricted range of products are permitted on an occasional basis);

- specific attention is also paid to environmental and social issues, include provision of wildlife habitats, minimising potential for environmental damage, and links to social justice initiatives such as fair trade standards for trade with developing countries.

The organic farming, and the practices adopted, represent one approach among several to achieving greater sustainability in agriculture. While sharing common goals with many of the other approaches, such as integrated crop management, that also emphasise the selective use of modern technologies to optimise production systems, organic farming represents a more critical approach and involves greater restrictions on the use of some of the technologies, in particular agro-chemicals and genetic engineering. Research has shown that the greater restrictions do result in additional environmental and resource use sustainability benefits compared with less restrictive approaches such as integrated crop management.

Regulation of organic farming

A unique feature of organic farming among other approaches to agricultural sustainability is the reliance on specialist markets to help maintain financial viability. The organic farming received little official recognition and no direct financial support from government, which meant that producers had to rely on consumers' willingness to pay for the perceived benefits of organic food in order to compensate for restricting the technologies used and the lower yields and higher costs that resulted.

The development of specialist markets requires that organic products can be reliably identified, in order to protect consumers and genuine producers, and to prevent fraudulent claims. Because the outputs of organic farming cannot be distinguished by specific characteristics of the end product, it is the production process that is used to distinguish organic products in the market place. This requires detailed production standards, inspection procedures and control systems to ensure traceability in the supply chain.

Initially, production standards were developed by producer associations in individual countries. These efforts were co-ordinated internationally by the International Federation of Organic Agriculture Movements (IFOAM) which has become the global voice for the organic movement and the key NGO partner in international discussions. IFOAM sets baseline standards, which are used by national organisations to develop their own standards, and has established an international accreditation programme, to facilitate international trade.

Calculation using harvest indexes

The harvest index (HI) is defined as the ratio between economic yield and total biomass. A number of sources and publications exists dealing with these aspects, but data vary significantly and are incomplete. However, some publications contain useful data and be discussed the most important sources. In some papers the HI is described as corn to straw ratio, which is defined as the proportion of the straw to the grain, and the so called RPR-value (Residue-to-Product Ratio). Following the first approach, the Unused Agricultural Residues [t/y] are calculated

Production [t/y] x Unused Biomass Factor (Koopmans and Koppejan,1997)

Depending on the type of manure and how it is stored and applied, the nitrogen and phosphorus in manure may supply crop needs for an entire growing season. In addition to these nutrients, manure contains potash, several trace elements and large amounts of organic matter. Organic matter from manure can increase the organic matter content of the soil which can improve the water holding capacity, aeration, infiltration, soil tilth, biological quality and resistance to erosion. Any fertilizer, a proper application rate must be calculated to ensure optimum agronomic and economic benefit. This information is calculated using manure analysis information and should be monitored by soil testing where manure has been applied. Nutrient Availability.

Nutrients in manure exist in two forms: organic and inorganic. Since only inorganic forms of nitrogen and phosphorus are available to plants, only a portion of the total nutrients can be utilized in the year of application. The organic forms must first be converted to an inorganic form (mineralized) which occurs naturally in the soil. This can be advantageous for the crop because not all of the nutrients from manure are immediately available. The slow release of nutrients minimizes possible crop damage and prevents excess nutrients from being lost before plant uptake occurs.

Availability of manure nutrients to the crop depends on the organic/inorganic makeup of the manure. Approximately 50% of the total phosphorus in manure is in the organic form, with only a small portion available to plants in the year of application. The remaining 50% of the total phosphorus is inorganic phosphorus, similar to commercial fertilizer. In general, 50% of the total phosphorus in manure is available to plants in the first year. To ensure enough phosphorus is available to a growing crop, add 14-17 kg/rai of P2O5 as a starter fertilizer with the seed. Check the fertilizer recommendations of specific crops for any seed placed fertilizer restrictions. With nitrogen, three different measurements are given in a manure analysis:

- Total Kjeldahl Nitrogen (TKN) is the total amount of organic and ammonia nitrogen in the sample.
- Ammonia nitrogen (NH3) is the amount of inorganic nitrogen that is readily converted to plant available forms.
- Organic nitrogen is determined by the difference between total nitrogen and ammonia nitrogen.

The general rule of thumb for nitrogen mineralization from manure is to expect 25-30% of the organic nitrogen to be available to plants in the first year, the residue becoming available during the next three years at a decreasing rate. Soil testing should be conducted to confirm the actual amount of available nitrogen in any specific situation. When considering application rates of manure based on nitrogen content, consider the amount of readily available nitrogen (ammonia) relative to the amount of gradually available organic nitrogen. In some cases, it may be necessary to add a starter fertilizer to ensure the crop has enough nutrients available during the early growth stages of plants.

Organic residue and organic recycling for usage

Regular additions of organic materials such as animal manures and crop residues are of utmost importance in maintaining the tilth, fertility and productivity of agricultural soils, protecting them from wind and water erosion, and preventing nutrient losses through runoff and leaching. These materials have predictable beneficial effects on soil physical properties such as increased water-holding capacity, soil aggregation, soil aeration and permeability, and decreased soil crusting and bulk density (USDA, 1978). Failure to recycle organic wastes and residues, intensive row crop production, and lack of sod-based crop rotations can result in extensive soil degradation and a decline in productivity due to excessive soil erosion and loss of fertility. When organic materials, such as compost, animal manures, crop residues and sewage sludges are used as the primary sources of plant nutrients, the management system has often been referred to as "organic farming" (USDA, 1980). More recently, the terms alternative, regenerative, low-input, and sustainable have been used to describe farming systems that recycle available on-farm organic resources and sometimes off-farm materials such as municipal wastes, to maintain or improve soil productivity. In addition, organic materials can be used effectively for land reclamation purposes. For example, the mining of topsoil and sand and graver deposits in urban areas has left extensive tracts of exposed, highly erosion of subsoils which are not conducive to the support of plant growth because of their adverse chemical and physical properties. Such areas detract from the aesthetic value of an urban environment and are major contributors to environmental pollution through surface runoff, eutrophication (i.e., nutrient enrichment) of lakes and streams and sedimentation from soil erosion. Thus, there is a need to develop sound practices for restoring the productivity and value of these lands in the most economic and expedient way. A wide variety of different organic wastes and residues can be used as soil conditioners and sources of plant nutrients on agricultural soils, with little or no adverse effects on public health and the environment. The purpose of this paper is to discuss how some organic amendments can provide an effective means of restoring the productivity of marginal, degraded, and infertile soils and how changes in cultural practices may affect crop quality.

Organic materials can differ widely in their properties and characteristics. Some materials, such as uncomposted animal manures, green manures, and sewage sludges, are subject to rapid microbial decomposition (i.e., mineralization) in soils and tend to release their plant nutrients rapidly. This is desirable for soils that are already at a relatively high lever of fertility and productivity. On the other hand, some other materials, such as cereal straws, wood bark, and composted animal manures and sewage sludges, would be more resistant to microbial attack and release their nutrients at a relatively slower rate. This higher lever of organic stability provides a distinct advantage in the initial reclamation of marginal soils because it imparts a beneficial and long-term residual improvement of soil physical properties. Unless the physical nature of these soils is improved first, the plant Use efficiency of nutrients, whether from organic amendments or chemical fertilizers, will be unacceptably low (Parr et al., 1986). In many developing countries there is a scarcity of suitable organic materials for composting or direct recycling on agricultural lands because of competitive uses. Thus, treating the entire soil-root zone with an organic amendment is often not feasible because of limited amounts of material. Consequently, the farmer must seek colt-effective methods of utilizing these materials to enhance soil productivity and crop yields. It is noteworthy that the productivity of marginal lands can be improved substantially with relatively small amounts of materials. This can be accomplished through localized placement techniques such as side-dressing, banding, bed and furrow systems, vertical mulching and slot-mulching (Saxton et al., 1981). Composting or co-composting an organic waste results in a more stable product that is easier to store and use. Co-composting of wastes that vary widely in their carbon to nitrogen ratios or solids content may produce a higher quality product and allows recycling of some wastes that could not be utilized as the only source of organic master due to some inherent chemical or physical property (Parr et al., 1986). Possible wastes that could be co-composted are municipal refuse or garbage, pit latrine wastes, sewage sludges, animal manures and crop residues. Fertilizer use efficiency can be very low in strictly monoculture systems or where organic recycling is not practiced. This inefficiency allows for the movement of nutrients through the soil profile. Due to heavy use of pesticides and nitrogen fertilizer, contamination of water is evident in our major agricultural areas (Hallberg,1987). The possibility of Federal and State regulatory agencies enacting legislation to control these chemical inputs is also a major concern to the agricultural community.

Spatial analysis for Site Selection

We have used spatial analyst of Arc View for selection of the suitability of organic farming sites. As well known that GIS is a system of computer hardware, and software, designed to allow users to collect manage analyze and retrieve large volume of spatially referenced data and associated attribute data collected from a variety of sources. It plays a special role in the context of generating and managing complex environmental database system. The use of GIS is found ideal for preliminary suitability of organic farming sites selection studies. This technology makes it possible to relate the present land used of a site with the parameters of its inhabitants. The ability of overlay gives it a unique power in helping us to make decision about the identification of crop type. Once a GIS Database is developed, it can provide an efficient and cost effective means of analyzing the best site for the decompose rate and residue per crop yield ratio of the biomass. Manual method of selection of such sites is very slow and take a long time to operate. Integration and correlation of the information related to the factors considered for site selection, which is very complex, can be handled easily with GIS. We have taken experts opinion from various fields, which was required to finalize the parameters, which governs the selection of such site.

Geographic information systems (GIS) provide a powerful analytical tool for understanding the spatial distribution of soil organic residue as organic carbon turn to the soil and related environmental factors. The integration of spatially explicit data with models allows us to understand how different scenarios for land use management and may affect carbon dynamics.

Millions hectares of land a year are being degraded in all climatic regions. The current rate of soil degradation is estimated at five to seven million ha per year and it may go up to ten million ha by the end of the century (FAO/UNEP 1983). Oldeman (1994) estimated that human induced soil degradation has affected 24 percent of the inhabited land area. UNEP (1986) reported that as much as two billion ha of land that were once productive have become unproductive through soil degradation. Soil degradation is clearly the largest component of land degradation. Water erosion is the dominant human-induced global soil degradation process, affecting nearly 11 million km2 of land surface. Deforestation, overgrazing and intensive agriculture, resulting from population pressure, are often the causal factors of soil erosion and mass movement. More than 50 percent (ranges between 54 to 74 percent) of the dry areas of the world are affected by land degradation (Dregne and Chou 1994). About 0.8 million km2 suffer from secondary salinization, caused by land mismanagement, with 58 percent of these in irrigated areas. Nearly 20 percent of all irrigated land is salt-affected (Ghassemi et al. 1995). Land degradation in Thailand have caused decline land quality and most of all caused by misused of land and wrong human activities, has been a major global issue since the 20th century (Eswaran et al. 2001). In Thailand all lands suitable for arable cropping are already being used and the trend is to encroach on marginal lands, leading to land degradation problems. LDD (2001) has been categorized four main items

- **Misused of Land**, i.e., residential and industrial construction on agricultural land, deforestation and encroachment into the watershed conserved area, cultivation of plants that are not suitable to land. The total area of misused land is 4.8 million hectare.
- **The results of land mismanagement** are as the following:

- Soil erosion loss of nutrients, minerals and organic matter. There are approximately 17.12 million hectare or 33% of the whole country (51,311,502 hectare) accounted to this problem alone.

- Low organic matters. This problem is commonly found covering as high as 30.56 million hectare or 59.5 % of the total area in the country.

- **Topology and environment** : Examples of this type of problem are as follows:

- Tung Kula Rong Hai: this is the classic example of severe soil problem contributed both from natural soil condition, topology and environment. About 0.336 million hectare of land is unfertile resulted from its salinity. Moreover, it is flooded in the rainy season but drought cover the whole area in the dry season.
- Coastal land area: A total of 1.6 million hectare is not fully productive. The problem is mainly soil itself as well as the natural environment of that area.
- Peat swamp: The area is severely flooded all year round and contains too much organic matters.
- Old mining soil: It is mainly gravel soil, fertility is too low while its structure is not suitable for cultivation.

- **Problem Soils** : natural condition of soil as the problem soils are always to be seen together with the envisaged or practiced land use system and the classification of different problem soils will always depend on the contemplate or given land use. Thus, a problem soils are always related to a specific land use situation. However, there are soil types with specific common characteristics that dominate frequently agricultural land use. These soil types may be broadly classified into problem soil categories. Different types of agricultural problem soils have been selected for consideration

- The steepness land are areas where a high slope inclination dominates the problems related to agricultural land use. Steep lands are characterized by slope inclinations of more than 35 %. Moreover, soils of steeplands are often very shallow because of active erosion processes.The soil classification system steeplands may occur in the following Reference Soil Groups: Andosols, Arenosols, Calcisols, Leptosols, Regosols and Cambisols. Steeplands' soils are usually extremely variable, due to site specific differences in geology, geomorphology, vegetation and rainfall. However, much of the steeply sloping lands in the mountainous parts of the world carry Leptosols. The soils on slopes are often young because of natural and accelerated erosion processes which either cause that the top most layers are continually being lost, or that they are continually being overlain by the deposition of materials moving down slope. Mass movements such as landslides and mud flows are specific to steep lands. They may be released by seismic activity or by exceptionally prolonged and heavy rainstorms, and may be caused by the undercutting of riverbanks, or by excavations into hillsides for quarrying or road construction. Mass movements are also common in areas where there have been geologically-recent changes in the hydrological base level. The physical, chemical and biological characteristics of steep lands soils are strongly conditioned by the nature of the parent material. Calcareous parent materials are richer than the non-calcareous ones. However, the types of soil parent material in steep lands are very varying and because of geological folding and faulting in hilly and mountainous areas, rapid changes in the parent material may occur over short distances. Furthermore, soils of steep lands are strongly influenced by a number of specific factors such as slope aspect and climate – elevation interactions. In Thailand, soil erosion are estimated that soil loss ranges from 300.6 to 462.6 Million tons per year (Anuluxtipun, et. al 2004). LDD 2001 reported that there is the peat soil 15.40 Million hectare (29.98 % of the total land area) in Thailand and most of these is occurred in the northern, the southern and the north-east. **- Acid soil**: In the central low land region alone there are 35 provinces facing this problem. The area of moderately to severely acid soil is 18.05 million hectare and estimated by Somrang, et.al. 2005 (in map 1.)

- akaline soils are soils in which a high sodium content dominates the problems related to agricultural land use. They are characterized by a <u>natric horizon</u> associated with humus-rich surface horizons and saline subsoils. A bleached layer (an <u>albic horizon</u>) may be present between the surface and the natric horizon. Soil classification system, sodic soils mainly occur in the Reference Soil Group of Solonetz. However, Solonetz may be associated with Histosols, Gleysols, Chernozems, Kastonozems, Vertisols and

Solonchaks The area of slightly, moderately to severely alkaline soil is 0.45 million hectare. The area of alkaline soil in Thailand is estimated by Somrang, et.al. 2005. in map 2

- **shallow soil** is the soil where pebble layers, stone layers and laterite layers are found 50 cm. from the soil surface. Such soil are found almost every parts of Thailand expect rainy zone in the South. The total area is 6.56 million hectare (12.78 % of the total land area in map 5). Soil series which shallow soil and laterite are found are Tayang series, Maerim series, Payao series, Namchun etc,. Since the soil consists of much pebble pieces and stone pieces, an amount of soil texture is decreased. It is not good at holding water and it is hard for ploughing. Soil surface is easy to be leached and soil fertility is less.

- **sandy soils** are soils in which a coarse texture dominates the problems related to agricultural land use. Sandy soils are characterized by less than 18% clay and more than 65% sand in the first 100 cm of the solum. The soil classification system sandy soils may occur in the following Reference Soil Groups: Arenosols, Regosols, Leptosols and Fluvisols. In the following the focus is laid on the consideration of Arenosols as the main Reference Group for actual "sandy" soils. Sandy soils are weakly developed soils with only weak profile horizon formation because of the slow chemical weathering in these normally dry soils. Physical weathering predominates in response to extreme variations in temperature. Wind erosion is dominant. The A-horizon is only weakly developed and can hardly be seen in a desert sandy soil, but becomes more distinct in the semi-arid sandy soils. Soil structure is very weak and unstable. Absence of vegetation cover results in an extremely low production of organic material which leads to the very low organic matter contents of sandy soils. However, the actual soil moisture content of the sandy soils determines the rate and duration of the chemical reactions, the production of organic matter and biological activity. LDD 2001 reported that there is the peat soil 7.46 Million hectare (14.52 % of the total land area) in Thailand and most of these is occurred in the north-east (in map 6).

-Salt affected soil: In the northeastern part of Thailand, this type of soil is scattered all over. The total area ranging from slightly, moderately, to severely are amounted of 4.80 million hectare or 28.59 % of the northeastern land area, for the recharge area that is a huge rock salt underneath as a highly potential salt source are 4.54 million hectare or 19.45 % of the northeastern and estimated by Anuluxtipun, et.al. 2003 (in map 7.)

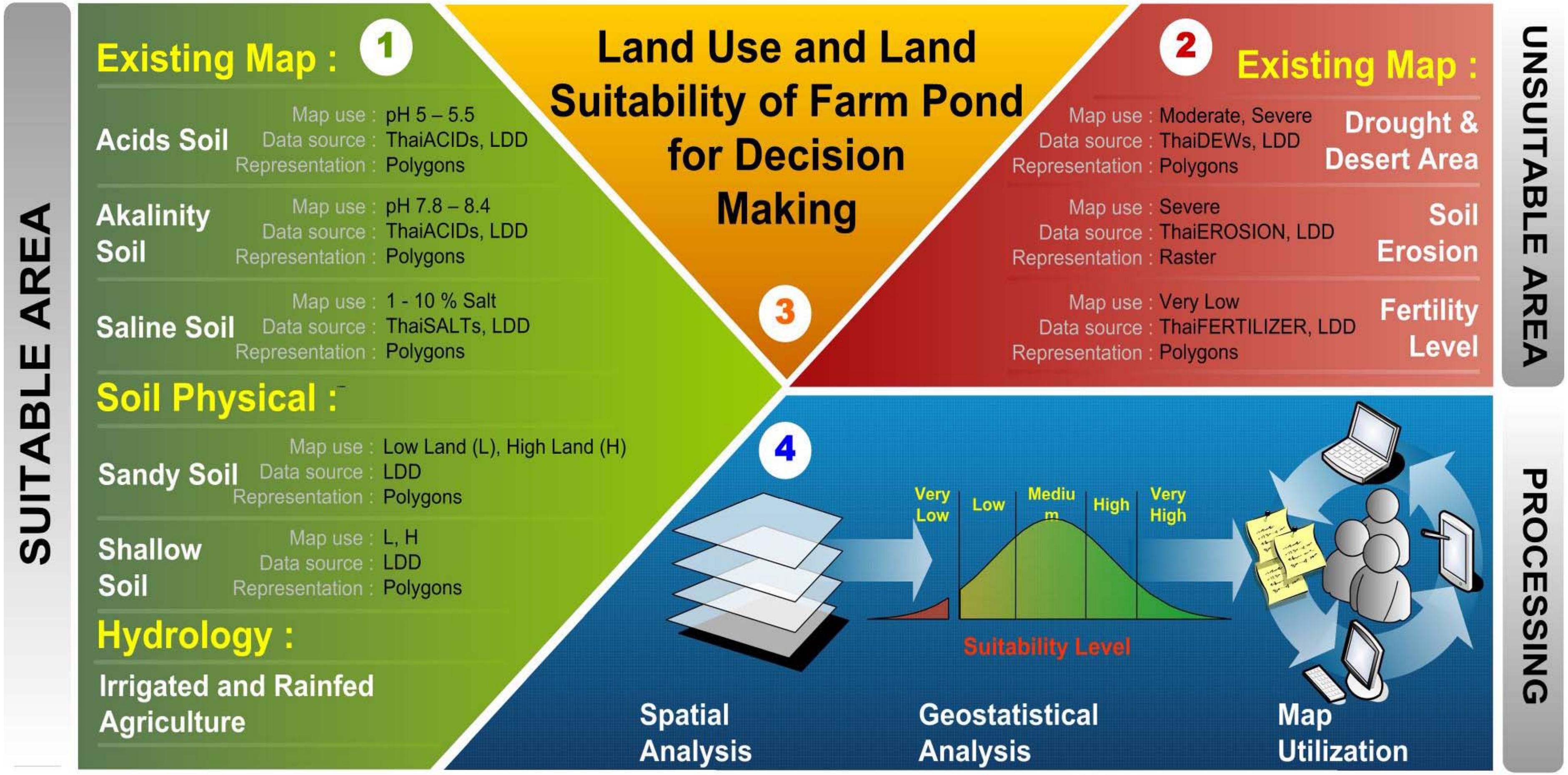
- Histosols or peat soil are soils in which the organic matter content dominates the problems related to agricultural land use. They are characterized by a layer of organic matter (>30%) of more than 40 cm either extending down from the surface or taken cumulatively within the upper 80 cm of the soil. LDD 2001 reported that there is the peat soil 0.05 (0.09 % of the total land area) Million hectare in Thailand and most of these is occurred in the south. (histic horizon)

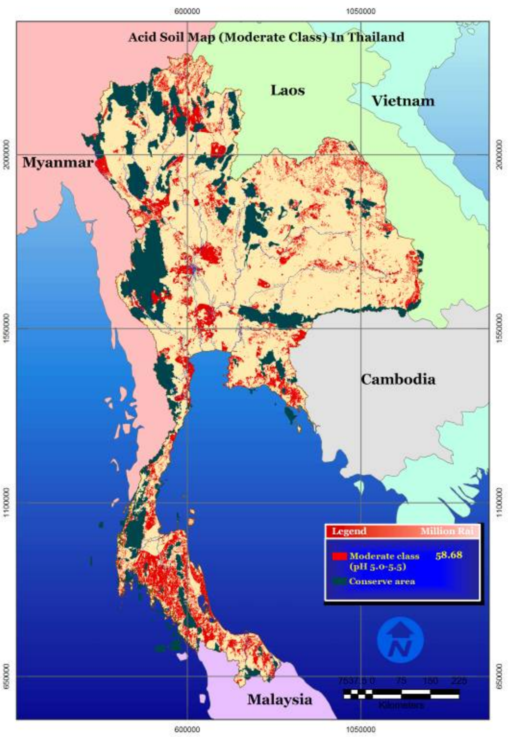
- Vertisols are dark montmorillonite-rich clays with characteristic shrinking/swelling properties. This group of soils with a high clay content (>30% to at least 50 cm from the surface) and in dry state with typical cracks which are at least 1 cm wide and reach a depth of 50 cm or more, are often also called heavy cracking clay soils. Vertisols are a Reference Soil Group of the World Reference Base (WRB) soil classification system. Vertisols owe their specific properties to the presence of swelling clay minerals, mainly montmorillonite. As a result of wetting and drying, expansion and contraction of the clay minerals take place. Contraction leads to the formation of the wide and deep cracks. The cracks close after rain when the clay minerals swell. During expansion of the clay minerals high pressures are developed within these soils, causing a characteristic soil structure with wedge-shaped aggregates in the surface soil and planar soil blocks in the subsoil. The slippage of one soil block over the other leads to the formation of typical polished surfaces, "slickensides" on the blocks. Expansion and contraction also cause the formation of micro-topographic features as distinctive microrelief of knolls and basins that develops by internal mass movements in the soil and heaving of the underlying material to the surface.

Irrigation infrastructure

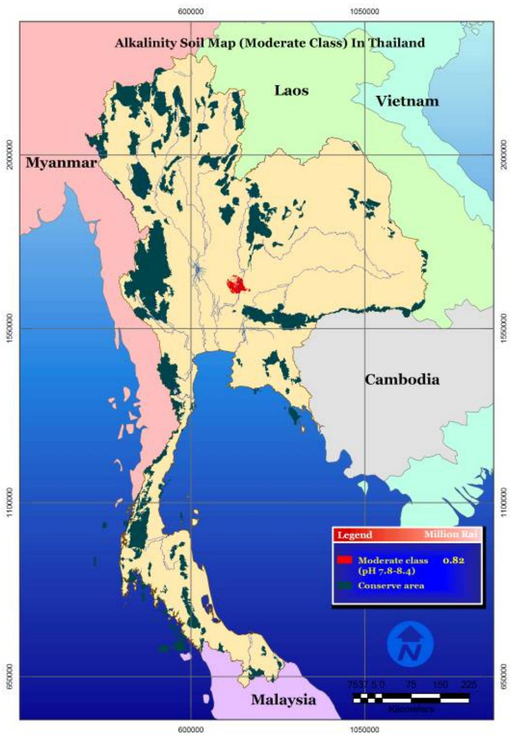
Irrigation is a most important infrastructure for modern agriculture. If farming is to rely on natural rain, intensive farming systems cannot be established. Irrigation not only prolongs the farming period but also allows farmers to regulate water levels according to the requirements of their crops. The Thai Government has recognized this importance and has undertaken many irrigation projects. Their performance, however, has been relatively poor. In 1970, around 12.45 million rai of farmland were irrigated (Donner 1982: 163), but 25 years later, the irrigated land has merely increased to 28.69 million rai (map10), amounting to less than a quarter of total cultivated land. Not only is the total land under irrigation small, the quality of irrigation service is also disappointing. According to official records, the efficiency of large and medium-scale irrigation is as low as 19.68 per cent during the dry season and 81.35 per cent for the rainy season (Office of Agricultural Economics 1997: 25).

Organic Land Suitability and Mapping Diagram

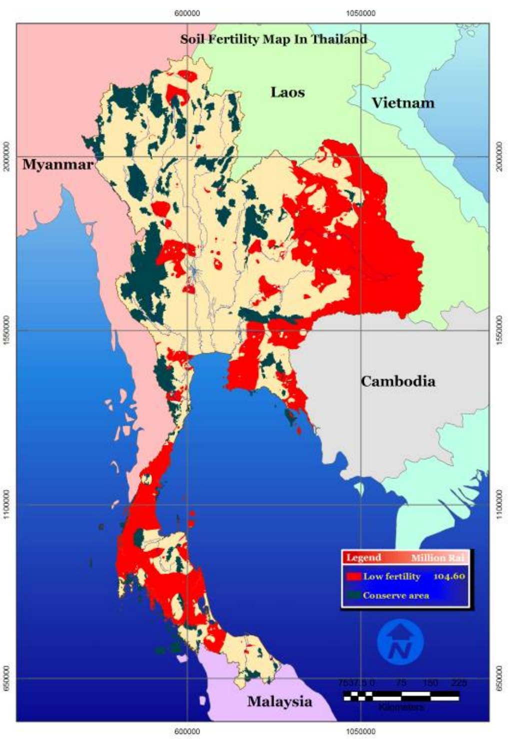




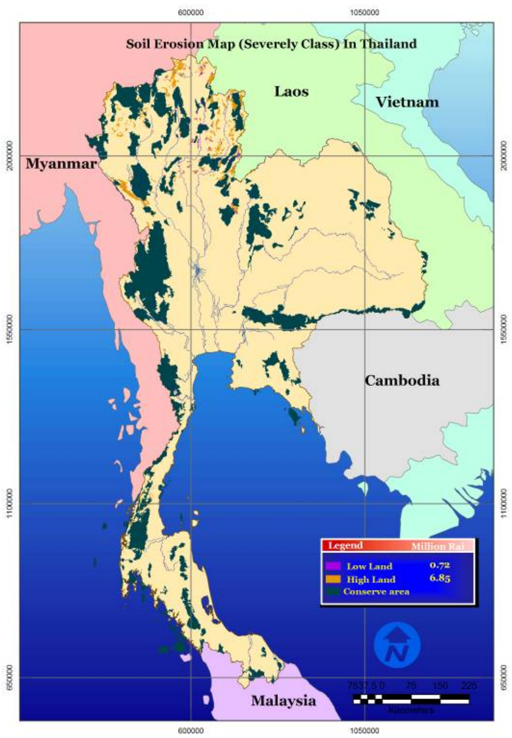
Map1 Acid soil map for Organic land suit
(Source: Somrang, et.al. 2005 ;THAIAcids)



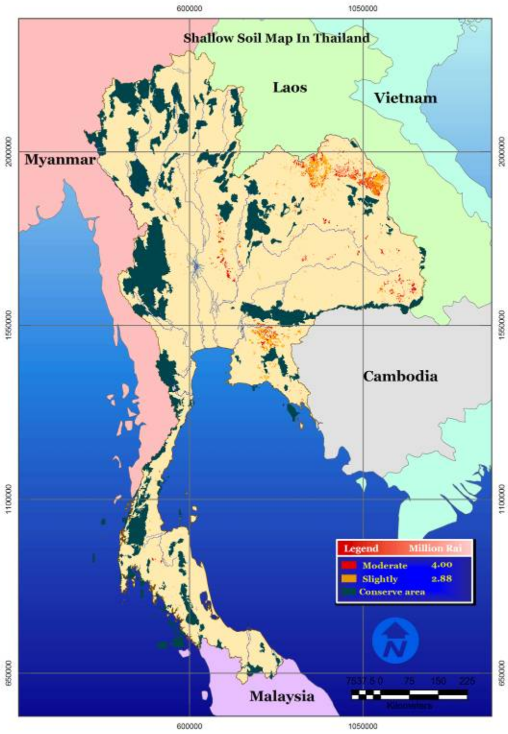
Map2 Alkalinity soil map for Organic land suit
(Source: Somrang, et.al. 2005;THAIAcids)



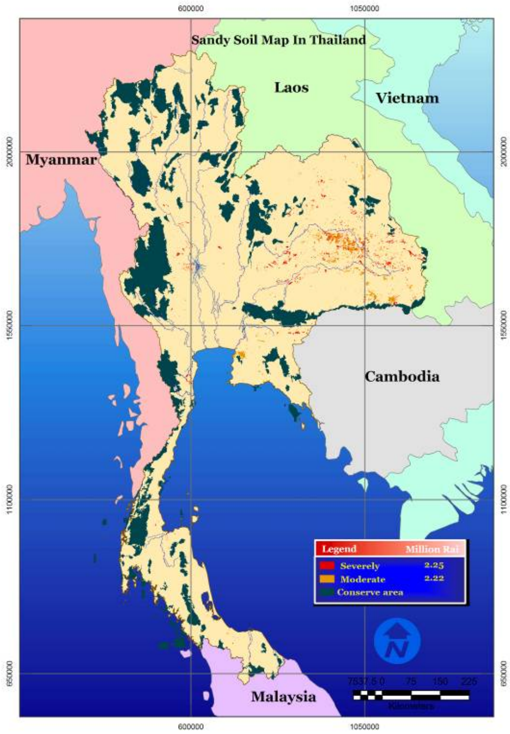
Map3 Soil Fertility map for Organic land suit
(Source: Anuluxtipun, et. al. 2004)



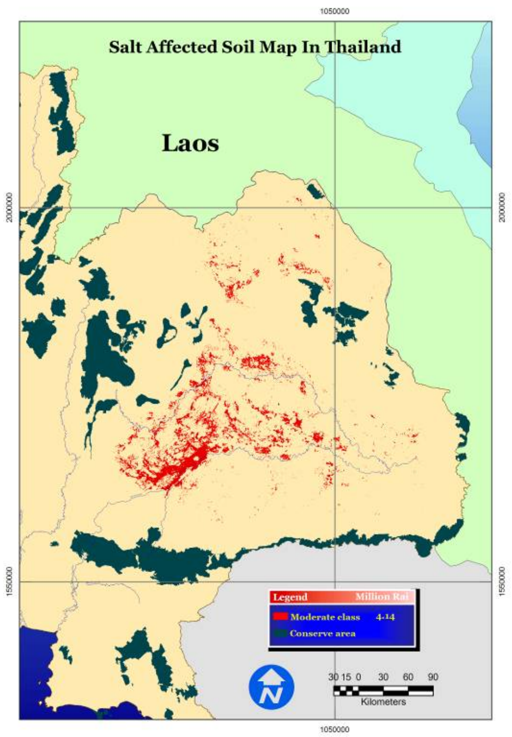
Map4 Soil Erosion map for Organic land suit
(Source: Anuluxtipun , et . al. 2004;THAIErosion MMF)



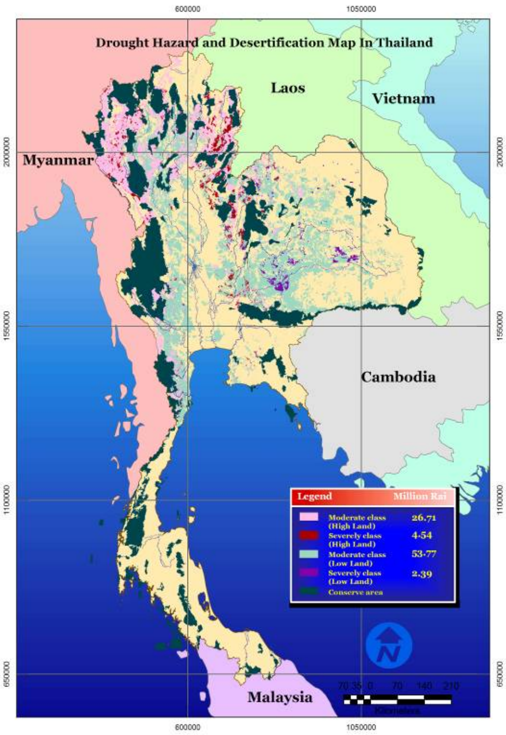
Map5 Shallow soil map for Organic land suit
(Source: SoilMan 1.0)



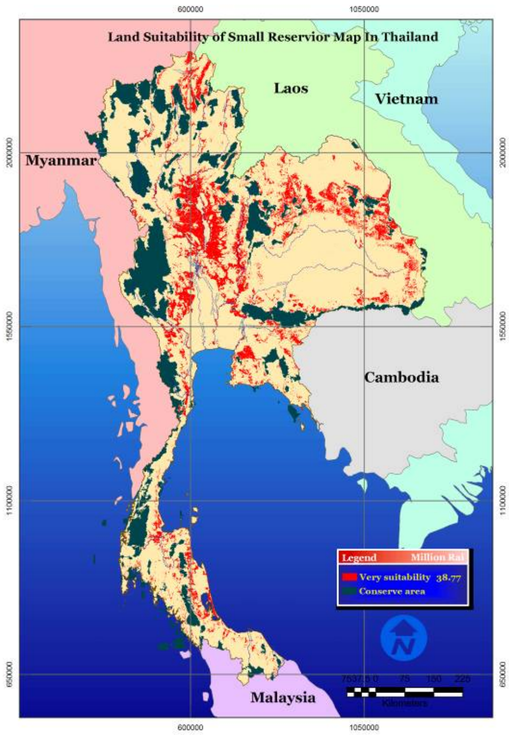
Map6 Sandy soil map for Organic land suit
(Source: SoilMan 1.0)



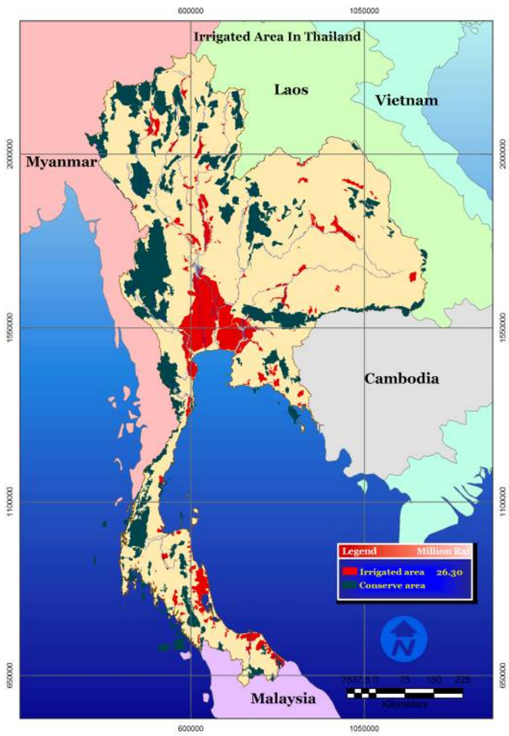
Map7 Salt Affected soil map for Organic land suit
(Source: Anuluxtipun and Thianpopirug . 2003)



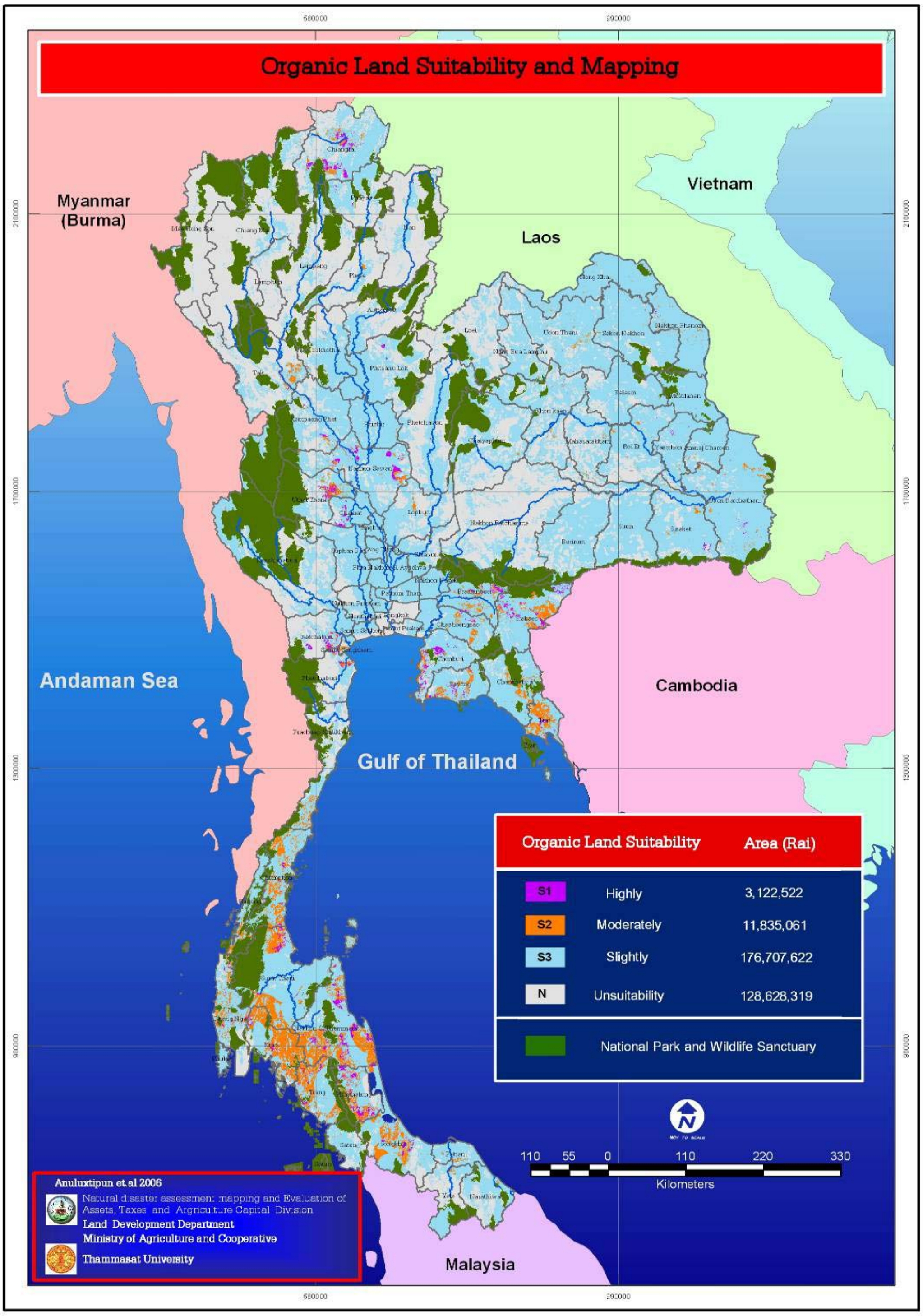
Map8 Drought Hazard and Desertification soil map for Organic land suit (Source:Anuluxtipun and Thianpopirug . 2003 ; THAIDEWs)



Map9 Land Suitability of Small Reservior map for Organic land suit (Source: Anuluxtipun, et.al. 2005;THAIPond)



Map10 Irrigated Areas map for Organic land suit (Source: AgZone 3.0)



Map10 Organic Land Suitability and mapping

(Source: Anuluxtipun, et.al. 2006)

Table 9 Organic Suitability and mapping in Thailand

Clusters	Area (rai)	suitability area (rai)					
		S1			S2	S3	N
		Irrigated	Rainfed	Total			
1	17,716,159.2	5,386.4	60,804.3	66,190.7	44,974.4	13,398,784.5	4,206,209.6
2	21,533,668.3	685.2	504,089.0	504,774.2	2,225,441.1	15,837,407.6	2,966,045.4
3	32,756,763.6	3.5	3.8	7.3	14,899.2	15,677,814.6	17,064,042.5
4	30,978,109.0	302.7	56,211.5	56,514.2	347,251.3	27,323,800.1	3,250,543.4
5	34,444,749.9	2,988.8	6,339.2	9,328.0	211,059.4	25,515,250.4	8,709,112.1
6	32,340,322.6	0.0	600.0	600.0	342,160.5	5,606,579.4	26,390,982.7
7	22,823,519.0	246,853.7	246,853.7	493,707.4	52,953.8	8,402,380.1	13,874,477.7
8	28,657,767.4	3.1	17,126.7	17,129.8	11,474.6	12,921,327.1	15,707,835.9
9	30,426,184.0	105,661.5	214,595.4	320,256.9	794,194.9	14,083,956.0	15,227,776.2
10	24,652,480.3	46,816.8	105,757.3	152,574.1	467,573.2	9,256,935.1	14,775,397.9
11	25,917,572.7	581,654.9	581,654.9	1,163,309.8	5,219,541.8	17,877,666.8	1,657,054.3
12	18,046,230.3	0.0	338,130.4	338,130.4	2,103,536.9	10,805,721.0	4,798,842.0
Total	320,293,526.3	990,356.6	2,132,166.2	3,122,522.8	11,835,061.1	176,707,622.7	128,628,319.7

Remark: 6.25 rai = 1 ha

Note: Cluster = Provinces Groups in Thailand grouped by Land Development Department

Clusters 1: Pathum Thani, Nakhon Nayok, Saraburi, Lopburi, Chainat, Nakhon Prathom, Suphan Buri, Ang Thong, Nonthaburi, Phra Nakhon Si Ayudhya, Samut Prakarn and Singburi

Clusters 2: Chonburi, Chanthaburi, Chachoengsao, Rayong, Trat, Srakaeo and Prachinburi

Clusters 3: Nakhon Ratchasima, Burirum, Chaiyaphum and Surin

Clusters 4: Ubon Ratchathani, Nakhon Phanom, Sisaket, Roi Et, Mukdahan, Yasothon and Amnaj Charoen

Clusters 5: Khon kaen, Udon Thani, Nong Khai, Mahasarakham, Kalasin, Sakon Nakhon and Nong Bua Lamphu

Clusters 6: Chiang Mai, Lamphun, Lampang and Mae Hong Son

Clusters 7: Nan, Phayao, Phrae and Chiangrai

Clusters 8: Phitsanu Lok, Phetchabun, Auttaradit, Loei and Phichit

Clusters 9: Nakhon Sawan, Tak, Kampaeng Phet, Uthai Thani and Sukhothai

Clusters 10: Ratchaburi, Phetchaburi, Prachuap Khilikhan, Kanchanaburi, Samut Sakhon, Samut Songkham

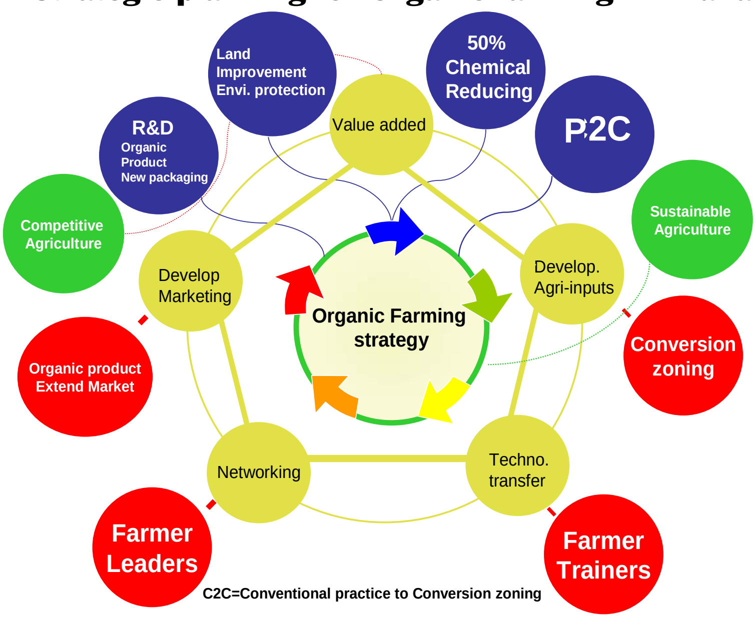
Clusters 11: Surat Thani, Ranong, Phang Nga, Nakhon Si Thammarat, Chumphon, Krabi and Phuket

Clusters 12: Trang, Phatthalung, Satun, Songkhla, Yala, Narathiwat and Pattani

Organic Farming in Thailand and Strategy

National agricultural policy in relation to small-scale farmers, The main feature of Thai agriculture has always been small-scale farmers. The average land holding size is 25.24 rai per family (equivalent to 4.04 hectare/family). There were several agricultural policies that were supposed to improve the well-being of small scale farmers, but they were unsuccessful. The failure of the national agricultural policy to support small scale farmers stems mainly from the misconception about agricultural development strategies. The Green Revolution policy was adopted to improve the productivity of the farming sector, and thus contribute to an improvement in the economic situation of farmers. But instead, experience has shown that the Green Revolution further aggravated rural impoverishment and has had tremendous negative impacts on rural natural resources, undermining the basic livelihood of rural farmers. Another factor that contributes to the failure of government policies for small-scale farmers is the inefficiency and even widespread corruption among the Thai bureaucracy. A need for bureaucratic reform is well recognized, but the implementation has always been slow and sometimes even moved backward. It is rather pessimistic to expect that national agricultural policy will, in the foreseeable future,contribute to a substantial improvement in the lives of small-scale.

Strategic planning for Organic farming in Thailand



There has been a recent concept of organic production in Thailand. The pioneer organic site has been done in the highlands in the North, together with Tungkularonghi in the Northeast to be made into an organic agro-industrial domain. Thailand's Department of Export Promotion along with the Food & Drug Administration established a five-year project in 1999 to set up a World Class Standard for Organic and chemical-free food. Organic agriculture has found favor with many in government who have been either convince by the apparent opportunities for Thai exporters in countries like Germany where estimates of retail sales of organic produce topped 3 billion Euro in 2001 (International Federation of Organic Agricultura IMovements - IFOAM). Policy makers have also fed vociferously on pesticide.

There is a need to accurately study the scale and extent of the problem of defined classes of pesticides poisoning (whether they be exposure, mild discomfort to hospital admission and fatality) at the community and admissions level across Thailand and in surrounding countries in order to develop the appropriate solutions. It is show that the plant science industry indeed recognizes the problems with pesticide use in developing countries but that the scale of the problems is not currently accurately recorded. Critically, the industry does recognize its role in solving such problems and working together with partners to look for sustainable solutions. The driving forces behind a concerted move towards chemical-free agriculture may be open to debate. The niche organic produce sector is growing, but the market is exactly that, a niche market. The organic market is currently centred in the USA, Japan and EU, with national markets such as Germany and the UK registering double digit annual growth in organic produce sales. Many of these countries are however developing policy to source organic produce domestically. Despite the impressive sales figures (estimates) from IFOAM. However, even within the cautious confines of the EU, all is not so easy within the organic industry. A number of EU countries lobbied in Brussels that the issue of organic seeds was much more complicated that initially believed, and thus the Commission had to backtrack on its strict regulations. IFOAM set up a draft standard for the development of new organic varieties, strictly for organic farming. Several techniques would be banned from the development of 'organic varieties': with immediate effect, genetic engineering, cytoplasm male sterile hybrids without restorer genes, protoplast fusion, radiated mentor pollen and induced mutations; then possibly in the future, embryo culture, ovary culture and in-vitro pollination. 'Organic breeding' programs would need to be certified, in order to guarantee that only allowed techniques have been used. In some interpretation the exchange of plant material between organic breeding programs and other breeding programs would not be allowed. It is clear that if such breeding regulations come into force in 2006 there will be a number of serious consequences for the seed industry:

• The necessary time for breeding an 'organic' variety will be prolonged and a lower efficiency will be reached.

• Because it is less efficient, breeding will be more expensive. This extra expense would need to be carried by the organic market.

• Restricting the exchange of material between traditional and organic breeding programs will strongly limit the possible access to genetic resources, essential for progress in plant breeding.

• Quick reactions to new biotic and abiotic stresses will be complicated and limited, because of the restricted use of efficient techniques and of the restricted exchange of breeding material.

•The implications for the Thai government's organic strategy are profound, and neither the Thai seed industry nor Thai growers are in any position to meet the criteria as being touted for the major organic produce market, the EU. There are a number of reasons for this:

• The Thai seed industry is under extreme price pressure due to farmer risk perception and illegally multiplied varieties; increases in breeding costs and time to market would be unacceptable to seed companies.

• The extra cost of developing organic seeds would be difficult to pass to growers, who are currently buying on price rather than quality (farmer risk perception skewed).

• There is little incentive to develop for a niche market given the above risks, and given there is no enforceable intellectual property protection for plant varieties in Thailand.

• Pest and disease pressures in Thailand make organic approaches to cultivation extremely challenging and more expensive than conventional GAP.

• Thai grower co-operatives are for the most part inefficient, they are not well equipped to market organic produce either domestically and especially for export.

• Post harvest handling facilities and logistics are a major constraint to organic production, making Thai organic produce unlikely to meet major market requirements.

• Production in the open field would be seasonal and geographically isolated. From the experience of Tropical Seeds and its affiliate company US Global Resources Asia, which builds greenhouses, there are a few highly professional growers who have invested significant amounts in protected cultivation systems that could benefit from the high value organic markets available in Europe. These professional companies use adbiatic cooling systems (evaporative cooling) and retractable shade to keep greenhouse growing conditions as close to 25 degrees during the day.

Movement of air across the plant canopy decreases the likelihood of fungal diseases. However, such installations can approach very expensive and operating costs are high. They are far removed from the mainstream agricultural growers who must rely on conventional methods. Government policy on organic farming and chemical-free food is a populist reaction to misunderstandings about pesticide residues in food and the gross misinterpretation (often being deliberately diffused) that maximum residue limits in food are food safety limits. In addition, policy makers are short sighted in equating organic food with nutritious food, and also developing a national strategy aimed at a market which represents barely 2 % of food supply in Europe and currently in regulatory turmoil. Thailand as a world class exporter of organic and chemical-free food. The lessons learned from the setback should be assimilated. Organic or chemical-free foods cannot be irradiated or treated with fungicides, and even with the best post harvest handling can retain plant fungi which sometimes produce lethal natural poisons. Without fungicides, per capita consumption of fruit and vegetables, vital to healthy diets, would decrease by 24 % (National Research Council, 1989).

The future and Policy recommendations: National context

Despite the sustained opposition of fringe groups, NGOs, and certain corridors of government, improved varieties and underpin the Thai agricultural sector. The way forward under the political situation is clearly to consolidate the impressive economic gains made in agriculture, and make further moves to strengthen the foundations of this growth through sustained seed breeding & production, education and training on Integrated Pest Management (IPM), GAP, and introduction of further improved characteristic through biotechnology. With over 200 private seed companies in Thailand, mainly concentrating on vegetable crops, the industry has made a massive impact on rural communities.

- A strong political will and policy consistency is needed for organic agriculture. At present, there is little coherence within different government agencies for supporting organic agriculture. In fact, many agencies appear to initiate projects on their own account without seeking cooperation with existing organic projects already developed by farmers, NGOs and the private sector.
- The authorities responsible also seem to have little knowledge about organic agriculture and many of them continue to have serious doubts about the viability of organic farming. Before they can become effective promoters of organic agriculture, the authorities themselves need to undergo further training and education on the subject.
- Government cooperation with NGOs and farmer's organizations is strategically important to create synergy in project implementation. The Alternative Agriculture Network has accumulated invaluable experiences and lessons over 15 years of promoting sustainable agriculture at the community level. The network's input would be valuable for informed policy formulation as well as project implementation.

- Other supporting policies are inseparable from a direct organic agriculture promotion policy. Equally important are favorable macro policies to support the private sector for post-harvest technological development and trade. Suggested policy tools are subsidies and tax policies.

References

Agzone 3.0, 2005 Application program of Agzone version 3.0. Land development department, Ministry of agriculture.

Anuluxtipun, Y., Songrukkiat, K. and Somrang, A. 2004. Soil erosion modeling. Land development department, Ministry of agriculture, ISBN:974-9537-30-0, 95 pp.

Anuluxtipun, Y., Thianpopirug S. 2003. Application program of THAISalt . Land development department, Ministry of agriculture.

Donner, W., 1982. The Five Faces of Thailand: An Economic Geography. (University of Queensland Press).

Dregne, H.E. and Chou, N.T. 1994. Global desertification dimensions and costs. p. 20–35 in: Dregne, H.E. (ed.). Degradation and restoration of arid lands. Texas Technical University, Lubbock, TX

Eswaran, H., Lal, R. & Reich, P.F. 2001. Land degradation, an overview. In: Bridges, E.M.,Hannam, I.D., Oldeman, L.R., Penning de Vries, F.W.T., Scherr, S.J. & Sombatpanit, S.(eds). Response to Land Degradation. Science Publishers, NH, USA.

FAO/UNEP 1983. *Guidelines for the control of soil degradation.* FAO, Rome.

Lampkin, N., C. Foster, S. Padel and P. Midmore (1999) The policy and regulatory environment for organic farming in Europe. Organic Farming in Europe: Economics and Policy, Vols. 1 and 2, University of Hohenheim.

Ghassemi, F., Jakeman, A.J. & Nix, H.A. 1995. Salinization of land and water resources: human causes, extent, management and case studies. The Australian National University,Canberra, Australia, and CAB International, Wallingford, Oxon, UK

Hallberg, G. R. 1987. Agricultural chemicals in groundwater: Extent and implications. Amer. J. Alternative Agriculture 2(1):3-15.

IFOAM International Federation of Organic Agriculture Movements: www.ifoam.org

Koopmans, A., Koppejan, J. (1997): Agricultural and Forest Residues – Generation, Utilization and Availability. Regional Consultation on Modern Application of Biomass Energy, Kuala Lumpur, Malaysia (see FAO, 1998) http://www.rwedp.org/acrobat/p_residues.pdf

LDD 2001. Soil potential for agriculture in Thailand (in Thai). Ministry of Agriculture and Cooperatives, Bangkok, Thailand.

National Research Council. 1989. Diet and health: implications for reducing chronic disease risk.Washington, DC: National Academy Press.

Office of Agricultural Economic, 1997. Action Plan for Ministry of Agriculture and Cooperative During the Eighth National Economic and Social Development Plan (1997-2001*),* first edition according to the Cabinet Resolution on March 18, 1997, Ministry of Agriculture andCooperatives, Bangkok.

Oldeman, L.R. 1994. The global extent of land degradation. p. 99–118 in: Greenland, D.J. and Szabolcs, I. (eds). Land resilience and sustainable land use. CABI, Wallingford.

Parr, J. F., R. 1. Papendick, and D. Colacicco. 1986 Recycling of organic wastes for a sustainable agriculture. Bio. Ag. Hort. 3:115-130.

Saxton, K. E., D. K. McCool, and R. 1. Papendick 1981. Slot mulch for runoff and erosion control. I Soil Water Conserv. 36:44-47.

Somrang, A., Anuluxtipun, Y. And Aekarkararungroj, A. 2005. Lime requirement, Acid and Acid sulfate soil modeling in Thailand, Land development department, Ministry of agriculture, ISBN:974-9537-403-230-8, 130 p.

SoilMAN 1.0, 2002 Application program of Agzone version 3.0. Land development department, Ministry of agriculture

UNEP 1986. Farming systems principles for improved forest production and the control of soil degradation in the arid, semi-arid and humid tropics. Expert meeting, sponsored by UNEP, 20–30 June 1983. ICRISAT,Hyderabad, India.

U.S. Department of Agriculture. 1978. Improving Soils with Organic Wastes. Report to the Congress in response to Section 1461 of the Food and Agriculture Act of 1977 (PL 95-113). U.S. GPO, Washington, DC. 157 pp.

U.S. Department of Agriculture. 1980. Report an' Recommendations on Organic Farming. U.S. GPC Washington, DC. 94 pp.