The Relevant Population Dynamics to Land Degradation in The Northeast Region

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Introduction

Thailand's total land area is about 513,000 square kilometers. Some 46 percent of the country is currently under agricultural use, while another 28 percent is covered with natural forests. Approximately 68 percent of the population live in rural areas; the majorities are farmers with incomes reliant on subsistence agriculture (The Technical Committee on Global Environment (TCGE), 1992). Thailand consists of four regions: Northern, Central Plain, Southern and Northeastern. Thailand's most important food crops in terms of the planted area and the value of production are rice, maize, sugarcane and cassava. The northeast occupies one-third of the country's total land and is the most populous region where 34 percent of the population resides. Laos bounds the northeastern region to the northeast and Cambodia to the east. It is the largest of the four regions in area, covering slightly over 170,000 square kilometers (about 17 million hectares), with a forest coverage of only 14 percent of total area, and the population, amounting to over one-third of the country total (Phantumvanit and Sathirathai, 1988).

In 1995, the population in the northeast was about 20,242,000 people. This population is well distributed, such that no province has over 200 people per square kilometers. It is the least developed of the four regions. The northeast region or the korat plateau, is a dry plateau at 100 to 200 meters elevation and an arid area characterized by undulating hills. (http://www.mahidol.ac.th/). Harsh climatic conditions often result in this area being subjected to floods and droughts. The land is mainly a semi-arid plateau with relatively infertile soil and insufficient irrigation. Irrigation is restricted to less than 5 percent of the cultivated area (Khon Kaen

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University, 1982). Poor soil and erratic rainfall are cited as chief reasons for poor productivity and, hence, very low per capita income, at some 40 percent of the national level (Krongkaew, 1993). So the area has poorer than average soil conditions with highly seasonal rainfall and suffers severe land degradation. Large parts of this region regularly experience standing floods alternating with period of drought. The average annual rainfall is over 1,000 mm., but it varies greatly in amount and intensity, both within the rainy season and from year to year. Rainfall occurs only occasionally. There is insufficient water during the dry season, followed by soil erosion in the wet season. The soil is quite sandy, with a low nutrient content and low water holding capacity. This is due to the fact that it is mainly derived from sandstone (Fukui, 1993). As a result the productivity of the land is generally low. The resulting low incomes seem to have helped accelerate forest encroachment, whether to gain farmland or to gather forest products. In the process, more forestland on slopes greater than 35 percent was converted into cropland, before eroding away. By 1982, 150,400 hectares on steep slopes had been encroached upon (Arbhabhirama et al., 1988). There are about 11.4 million hectares of land suitable for agriculture. In 1985, about 10 million hectares were used for agriculture, including 6.2 million hectares of rice paddies and 3.4 million hectares of upland rice crops. The main crops include rice, corn, kenaf and tapioca (Phantumvanit and Sathirathai, 1988)

The most important crops in the northeastern region are rice and cassava. Cassava is a very popular crop in the northeast because it is high yield. However, cassava exhausts soil nutrients to a greater degree than rice, which causes land degradation problems. In addition, the erosion process by water or wind as well as the salinization or concentration of salts in the topsoil destroys nutrients. This may occur because insufficient attention to drainage can easily lead to rapid salinization of the soil especially in arid areas where high evaporation rates foster the process. Also the heavy population of the northeastern region suffers from high unemployment in the dry season. So young people, both male and female, move to large cities where they can get a better job. As a result, this research paper reviews the possible linkage between population factors (e.g. population size/growth, in-migration/out-migration, and age/sex structures) and land degradation in the northeastern Thailand.

Objective

- To scrutinize the feasible relationship between population factors and land degradation and help integrate environmental concern and considerations in population policy.
- To promote people's awareness relating to land degradation problems as a public policy on environment management.

Research Question

What is the relationship between population factors and land degradation? In Northeastern Thailand one would think that population factors and agriculture types as well as changes in technology and products cause land degradation.

Methodology and Sources of Data

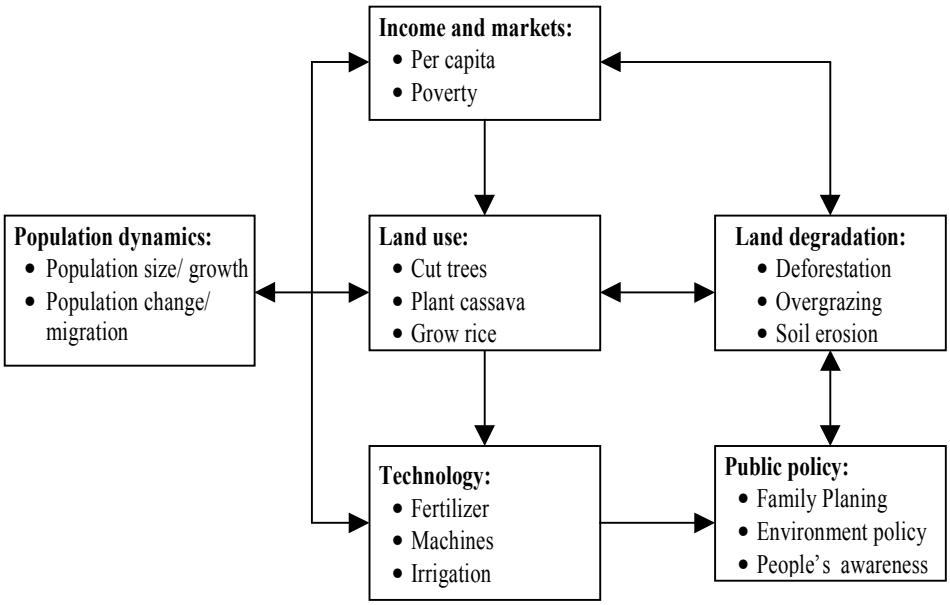
This paper uses both qualitative and quantitative methods. Qualitatively, it analyses both the population dynamics issues and the causes of land degradation problems; public policy and its implementation; population policy; and people's awareness. Quantitatively, it analyzes past and present land clearing deforestation; population growth; economic activities; and soil erosion as related to population factors. Data sources are the secondary data available from the library documents and textbooks as well as papers.

Conceptual Framework

The relationship between population factors and land degradation is a complex one; moreover, a range of factors that vary in importance across areas and social groups as well as over time mediates it. The framework (figure 1) starts by considering the population variables. They include the population size and growth, age/sex structure, and population change/migration (out-migration and in-migration).

Figure 1

Schematic presentation of the linkages between population factors and land degradation



The concept of land degradation refers to the deterioration or total loss of the productive capacity of the soils by wind and water erosion. Erosion is the loss of topsoil under the action of water or wind. Water run off carries the topsoil away. This occurs under most climatic and physical conditions. The loss of topsoil reduces fertility because of three causes. 1) As the soil becomes denser and thinner, it is less penetrable by growing roots and may become too shallow for them. 2) The capacity of the soil to retain water and make it available to plants is reduced. 3) Plant nutrients wash away with soil particles. Deforestation, overgrazing large-scale commercial forestry, and road construction are the causes of land degradation (Table 1).

Table 1: Factors affecting land degradation

Human actions	Natural conditions
• Deforestation	• Topography (slop, high/low land)
• Overgrazing	• Aridity, drought
• Agricultural activities	• Strong wind, rain
• Use of machines	• Flood

Source: http://www.undp.org/popin

A study in southern Honduras, environmental degradation and social problems often attributed to population pressure arise from glaring inequalities in the distribution of land, the lack of decent employment opportunities, and the stark poverty of many of its inhabitants (http://www.undp.org/popin). Yoddumnern-Attig et al., (1998) studied the population and community forestry in northern Thailand. In this case study, people from the northeast moved into the community; people of working-age group moved out to find off-farm jobs. Land was cleared extensively for cassava plantation. Agricultural products shifted home consumption to the marketing of cassava.

Cause of Land Degradation: The Role of Population Factors

Land degradation in the northeast is associated with population factors such as population size/growth, population change/migration. Population factors play a role in land degradation. There are 4 main causes of land degradation relating to population factors: deforestation and population growth; migration; overgrazing and market links; and soil erosion (natural conditions and man-made activities).

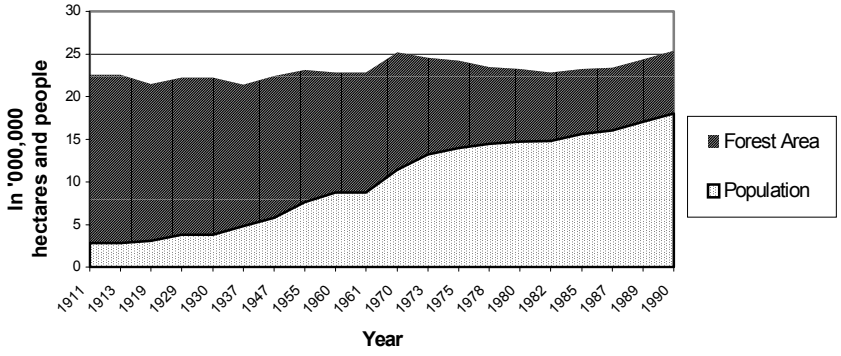
Deforestation and Population Growth

Deforestation is one cause of soil erosion. Trees are cut; nutrients in the topsoil are lost. The extensive deforestation of the northeast has far-reaching consequences, which include the reduction of biodiversity through the destruction of

wildlife habitats and species extinction, increased frequency and duration of droughts and floods, and greater soil erosion. Since the 1960s merchants, millers, traders in forest products, timber companies, speculators and strongmen have encouraged and financed a large proportion of the settlers to clear forests in the northeastern region which are then planted with maize, sugarcane and cassava. At the same time, farmers migrated to the pioneer fronts, cut down trees to build their home and provide fuel, and then opened up the forests to permanent cultivation. In this way 80 percent of forest in the northeast was destroyed. Because of the high population growth rate of the northeast in the past, people have increased the demand to consume the forest products also. The population growth rate should correspond with the forest area decreasing (Figure 2).

Figure 2

Population and Forest Area in the Northeast



Source: Estimate based on TDRI, 1988; Arbhabhirama.et al., 1988; and Onchan, 1990.

As a matter of fact, the depletion rate of forest areas was very rapid during 1977-78; 1.8 million hectares per year, or 2.5 percent of the land area per year (Wongboonsin et al., 1993). The more population increased, the more the forest area decreased. Most timbers, bamboo shots, and mushrooms were exhausted for household consumption. The demand for agricultural land and the harvest of forest products are major causes of deforestation. The northeast is a region where both poverty and deforestation have been most prevalent (Tongpan. et al., 1990). So forest clearing for

agriculture is identified as a prime cause of land degradation because the nutrients in the topsoil were lost.

Migration

Most of the migrants in the northeast move within the country. There are two patterns of migration in the northeast; one is the long distance movement between rural and urban (out-migration); and the other is the short distance movement between rural and other rural areas (in-migration). Out-migration is one of the most important determinants of urban growth, but the important thing that is seasonal unemployment in the rural areas because of environmental degradation. So the young generation both male and female move to urban areas to get better jobs.

Out-migrations

The northeast contributed the largest proportion of out-migration; more than a third of all interregional (e.g. Greater Bangkok, Central, Northeast, North, and South) migration originated from this region. Migration streams from cities are second in importance to interregional migration streams to the rural areas. The largest stream among them was from the northeast, accounting for 12.3 percent of all 430,000 migrants in early 1970s (Varakamin. et. Al., 1985). At present, the out-migration streams from rural areas to cities are still high because people want to get better work in the large city factories (e.g. Greater Bangkok, Chon Buri, Rayong, Khon Kaen, Nakhon Ratsachima, Songkla, and Chiang Mai) that offer more employment opportunities.

In-migration

In 1970-1985, migration from one rural area to another was high in order to search for new land. Migrants sold their land and moved to another place in the northeast or other places in all regions to search new land. In-migration in search of new land is a method of coping with a deterioration in the rice balance and insufficient cash income, and there is no doubt that it has in fact functioned to keep the village population below a certain level. An average household held at least 1.6 hectares, plus 4.8 hectares or more for the new land that the farmer occupied both legally and illegally

(Fukui, 1993). At present, the migration of people in the northeast to search for new land is still taking place in some areas such as in the border between Thailand and Cambodia, but people cannot search for new land in all areas because the Government has banned logging since 1989.

Overgrazing and Market Links

Nutrients in the topsoil were destroyed by the farmer's extensive cultivation of cassava overgrazing. In the northeast, cassava still needs to be processed within a week or so after harvesting; it is a heavy output. Many people are involved in the processing of cassava; chippers, pelletizers, flour manufacturers, and transport workers, exports wholesalers, retailers, and middlemen. The main steps required in the processing of cassava are chipping and pelletizing for starch production. The primary processing plants, the chipping and flour factories are usually situated near the planting area while the pelletizing factories are in the town. Most cassavas is produced in both upper and lower of northeast, which are about 27.89 percent and 34.74 percent in 1980 (Table 2).

Table 2: Production of Cassava and Number of Cassava Plants by Regions:

Region	Production of Cassava, 1970 (1,000 tons)	Production of Cassava, 1980 (1,000 tons)	% of Total Production of Cassava, 1980	Number of Processing Plant		
				Chipping Factories	Pelletizing Factories	Flour Factories
Northeast-Upper	82.3	3,095.7	27.89	57	9	-
Northeast-Lower	424.2	3,856.5	34.74	364	15	3
South-Upper	101.4	2.0	0.02	2	-	-
South-Lower	23.5	3.8	0.03	-	-	-
Central-West	208.0	359.4	3.24	75	11	-
Central-Middle	28.7	81.5	0.73	6	-	-
Central-East	2,706.8	3,435.1	30.94	560	126	124
North-Upper	14.1	3.7	0.03	1	-	1
North-Lower	62.5	263.3	2.37	87	10	-
Greater Bangkok	0.6	0.0	0.00	-	4	-
Whole Kingdom	3,652.1	11,101.0	100.0	1,152	175	128

Source: World Bank, 1983

Cassava roots have to travel more than 60 to 100 kilometers from the farm to the chipping factories. Transportation costs are a constraint to the expansion of cassava production; selling fresh roots is easy for farmers living near roads but difficult for those coming from remote fields. Some chippers send trucks to pick up the roots from the farm. The roots are washed and cut into chips by chipping machines, which are domestically produced. The chips are spread out to dry; this used to be done manually, but there is now a machine, which scoops up the chips and spreads them out, using blades attached to the machine. The labor use in cassava chip production is thus probably falling.

Originally, cassava was destined to human consumption; but the recent rapid increase in production has been stimulated by the demand for cassava by the animal-feed industry, which was made possible by the expansion of the road network into the northeast. Much of the expansion in cultivated areas in the northeast can be accounted for by cassava. As a rule the increase in the areas planted in cassava is not at the expense of paddy land. It is newly cleared and hence represents an absolute increase in cultivated area. Cassava is tolerant of poor soil quality and irregular rainfall, which makes it suitable for newly cleared forest land, especially in areas of the northeast which are subject to drought.

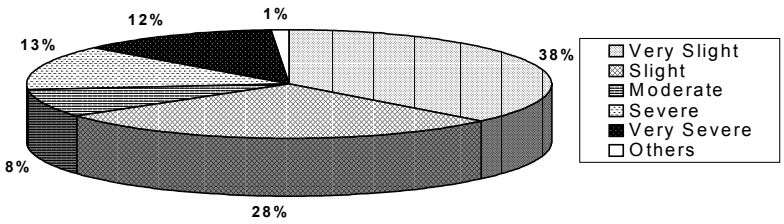
Soil Erosion : Natural Conditions and Man Activities

Physical, chemical, biological, and socio-economic factors can cause soil erosion. Low soil bulk density and high macro-porosity, partly due to the relatively high activity of the soil fauna characterize soils supporting undisturbed tropical forests. Once the forest cover is removed, however, the soil characteristics begin to change. Their bulk density increases in the wake of deforestation and cultivation, as do a number of their other physical and chemical properties. The total infiltration capacity of soil in the older development areas had fallen by 62 percent, when compared with the original forest values. The soil chemistry has also changed. The organic carbon content of the soil in the older areas has dropped by 18 percent, and its calcium, magnesium and

potassium tended to be lower too. Normally upland areas where slopes are greater than 5 percent suffered from a medium or high degree of soil erosion (Figure 3).

Figure 3

Areas Affected by Soil Erosion



Source: Arbhabhirama. et al., 1988.

There are two causes of soil erosion in the northeast. 1) Salt originating in deep rock salt beds is brought up to or near the soil surface with deep groundwater circulation. 2) The salt probably originates in the weathered zone of the shales and siltstones beneath upland areas. It is believed that salt was distributed to lowland areas by interflow. In the past decade, upland areas in the northeast have been cleared for major crops such as cassava. This might be expected to cause an increase in upland groundwater recharge and a rise in groundwater levels in lowland areas (Arbhabhirama. et al., 1988).

Population and Land Degradation Process

Population dynamics appear both as part of the basic conditions within which the socio-economic systems operate and of the forces that affect its patterns of change (population growth/migration). Population growth affects the volume of market demands. Population factors have been viewed as intermediate variables; social variables (e.g. poverty, income/market, and technology) work through population growth, which merely exacerbates the effect land degradation process. The linkage between population factors and land degradation process is affected by various

conditions. Those conditions are; 1) Type of Land Use, 2) Income and Market, and 3) Technology, Fertilizer and Irrigation.

Type of Land Use

The destruction of forests is caused for the most part by land clearance for land use. Both slash and burn agriculture, when land is not allowed to lie fallow as long as traditional practices dictate, and permanent clearing for modern farming, are taking a toll. Cutting trees, shrubs and tall grasses, burning litter, growing crops on the cleared land, allows the natural cover to return and regenerate the soil. Agricultural land areas of northeast consist of lowland and upland. The north is high ground upland and the south lowland. The 1985 land use of the northeast is given in table 3. As indicated, the total area of agricultural land is 9,960,488.6 hectares. The following types of crops can classify agricultural land use: paddy, 6,225,940.2 hectares; upland crops, 3,722,916.9 hectares; and perennial crops, 11,631.5 hectares. The agricultural land use of the northeast is the highest in other regions.

Table 3: Land Use by Regions (hectare)

Land Use	Northeast	South	Central	North	Total (%)
National Forest Reserve	5,407,320.3	2,574,180.0	3,446,199.7	10,370,087.0	21,797,787.0 **(42.5)**
Agricultural Land	9,960,488.6	3,130,873.4	5,667,282.8	5,568,003.8	24,326,648.6 **(47.4)**
Rice	*6,225,940.2*	*1,152,260.0*	*2,674,535.7*	*3,427,394.7*	*13,480,130.6*
Upland Crops	*3,722,916.9*	*51,460.3*	*2,432,532.9*	*2,018,918.9*	*8,225,829.0*
Horticulture	-	-	*10,178.9*	*6,023.0*	*16,201.9*
Para Rubber	-	*1,524,896.8*	*161,816.3*	-	*1,686,713.1*
Oil Palm	-	*61,827.4*	-	-	*61,827.4*
Perennial Crops	*11,631.5*	*340,428.9*	*388,219.0*	*115,667.2*	*855,946.6*
Urban	79,103.8	69,060.3	215,078.1	74,611.4	437,853.6 **(0.9)**
Water Bodies	158,738.1	104,258.9	130,276.3	96,199.8	489,472.9 **(1.0)**
Others (abandoned, rock-outcrop, beach,pasture)	1,272,471.7	1,193,146.2	931,285.4	855,526.7	4,252,430.0 **(8.2)**
Total	**16,878,122.5**	**7,071,518.6**	**10,390,122.3**	**16,964,428.7**	**51,304,192.1(100.0)**

Source: Arbhabhirama et al., 1988 and Onchan, 1990.

The most important lowland crop is transplanted rice, with both glutinous and non-glutinous rice varieties being grown. The soils of flood plains are well suited for transplanted rice, which is also grown on the low terraces and lower part of the middle terraces. They are only moderately suited for the purpose. Upland crops are also grown on the levels of the alluvial flood plains on more fertile soils. The soils have a high salt content. Important perennial crops are mulberry for silk production, mango and kapok. Soil fertility is moderate to low on nearly all soils, both upland and lowland. Water holding capacity is also low and serious crop damage from drought occurs frequently in the dry areas of the northeast, from April through August. Because of the silt and very fine sand content found in the surface soils, soil erosion is a serious problem on sloping cultivated soils during high intensity rainfall.

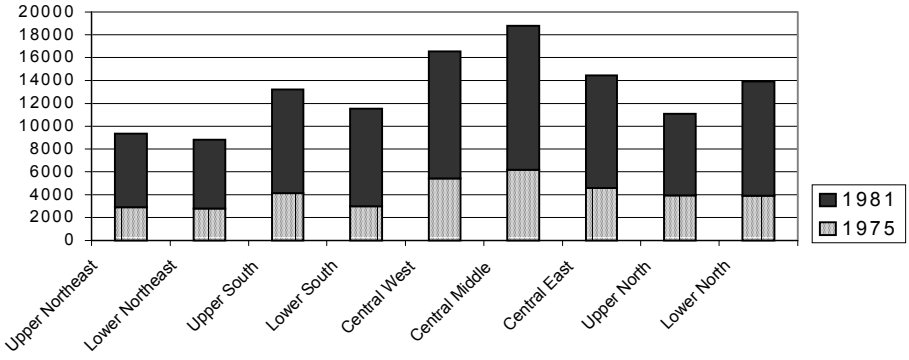
Income and Market

In terms of income, a causal linkage between poverty and land degradation is possible. Poverty has been seen as contributing much to resource overuse in the northeast. Poor households are often virtually forced to overuse natural resources for daily subsistence. Rural households in the fuelwood-deficit northeast strip foliage and burn crop and animal residues for fuel rather than using them for fertilizer. In the northeast, poverty incidence is still the highest in the country. It is the poor who clear the forests for new farms no mater how marginal the land, the poor who use most of the fuelwood, and the poor who depend on forest products for their livelihood. Most households were found to use fuelwood or charcoal for some cooking. Per capita household income of the northeast, both in the lower-northeast and upper-northeast areas, is the lowest in the country. In 1975, per capita household income of the lower northeast area was about 2,841 baht* and about 6,010 baht in 1981. Also, in the upper northeast area it was about 2,891 baht in 1975 and about 6,434 baht in 1981. Figure 4 indicates that major disparities exist in income levels between subregions. Many of the economic changes are typically associated with the idea of modernization, including the economic role of the modern state, both at the local level by community authorities and by individual peasants. In the northeast, extended family structures and their careful

resource management practices have broken down, and local communities have no authority to control resources.

Figure 4

Per Capita Income by Regions (baht per year)



* US$ 1 .00 equals 37.60 baht

Source: Krongkaew, 1993.

In terms of market, the promotion of mono-cash crops (e.g. cassava, maize, and sugarcane) by the government in the pursuit of export gains has also often accelerated soil exhaustion because cassava crops deplete a lot of the soil nutrients. The Government subsidized cassava exports and developed the marketing of cassava. Between 1976-1983, cassava production increased rapidly, mainly in response to demand from the European market. The EEC's Common Agricultural Policy (CAP) increased cereal prices, in the EC, and thus encouraged the use of cereal cassava (TDRI, 1992). During that period cassava exports amounted to about 13 percent of total exports. They formed a very important part of the cash income of the poor farmers in the northeast (Sathirathai and Siamwalla, 1987). Cassava is primarily an export crop, but increases in the future demand for cassava will depend on the domestic animal feed industry.

Technology, Fertilizer, and Irrigation

Technological change may be driven by population growth; population growth changed consumption behavior in the northeast. In term of technology, the agricultural machines are changed because of area expansion. Area expansion has extended annual crop cultivation such as maize, cassava or sugarcane, which led to overall increases in labor demand. In addition, fertilizer is very important for farmers because the nutrients in the topsoil are very low. The Government's Policy since 1970 of protecting the domestic fertilizer industry has greatly interfered with the competitive nature of the fertilizer market. This has meant high fertilizer prices, which have been exacerbated by the dramatic oil price rises. The Government has attempted to overcome the problem by direct distribution of low cost fertilizers both for cash and credit, but fertilizer use remains very low in the northeast (Khon Kaen, 1982). The principal cause of environmental effects is unscientific fertilizer practices and excessively high rates of application. Drought and frequent cropping damage soil fertility. In terms of irrigation, the irrigated area covered 473,950 hectares in the northeast; water shortages usually result from inadequate water regulation, rather than from insufficient rainfall input. The small-scale water resource development projects initiated by the Government in the National Plan have improved water regulation in the northeast to a considerable extent. Rapid rises and falls characterize stream flows in the northeast. The construction of large storage reservoirs is appropriate in these circumstances (Arbhabhirama. et al., 1988). However, irrigation practices and intensive agriculture have led to various forms of soil degradation; soils are polluted primary by pesticides, which are very intensively applied to the fields.

Population Relationship to Land Degradation and Statistical Correlation

Population dynamics (population growth/size, population change) usually appear as the major cause for land degradation in the northeast. The dynamic interplay between population change and land degradation in the 1970s is scrutinized here because the population of the northeast rapidly increased during that decade. Population change in the northeast emerged as a function of the relationship between population

growth/size. 7 variables are analyzed in this section. The dependent variable is Depletion Rate of Forest Land Per Year (VDEPL).

- Depletion Rate of Forestland Percent Per Year (VDEPL)
- Population in the Northeast (VPOP)
- Cassava Crop (VCASS)
- Percent of Population Growth in the Northeast (VPER)
- Forest Area in the Northeast (VFORE)
- Percent of Land Area (VLAND)
- Depleted Forest Area (VDEPF)

For this paper a major cause of land degradation in the northeast is deforestation because it is linked to soil erosion. The statistical relationship between observed forested area change and population dynamics, increasing economic activities (cassava crop, and land area) was analyzed. Analysis within sample units demonstrated a significant relationship between land degradation and both population dynamics and economic factors. The sample analyses showed that the rate of change was influenced by environmental conditions, which play an important role in the man-forest interaction. In the northeast, the topsoil nutrients in topsoil were destroyed by deforestation. The effect of population growth/size on forest cover under different environmental conditions is illustrated. The relationship between population growth rate and yearly percent depletion rate of forestland in the northeast is shown in table 4. The statistical relationship between population dynamics (percent of population growth rate), economic factors (cassava crop, percent of land area) and land erosion (depletion rate of forestland per year) is significantly demonstrated at both the 0.01 and the 0.05 level.

Table 4: Statistical Correlation

Variables	VPOP	VCASS	VPER	VFORE	VDEPL	VLAND	VDEPF
VPOP	1.000 . 7	.989** .000 7	-.947** .001 7	-.973** .000 7	-.716 .070 7	-.976 ** .000 7	-.758* .048 7
VCASS	.989** .000 7	1.000 . 7	-.932** .002 7	.983** .000 7	-.745 .055 7	-.984* .000 7	-.781* .038 7
VPER	-.947** .001 7	-.932** .002 7	1.000 . 7	.879* .009 7	.761* .047 7	.905** .005 7	.795* .033 7
VFORE	-.973** .000 7	-.983** .000 7	.879* .009 7	1.000 . 7	.650 .114 7	.997** .000 7	.691 .085 7
VDEPL	-716 .070 7	-.745 .055 7	.761* .047 7	.650 .114 7	1.000 . 7	.674 .097 7	.997** .000 7
VLAND	-.976** .000 7	-.984** .000 7	.905* .005 7	.997** .000 7	.674 .097 7	1.000 . 7	.714 .071 7
VDEPF	-.758* .048 7	-.781* .038 7	.795* .033 7	.691 .085 7	.997** .000 7	.714 .071 7	1.000 . 7

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

People's Awareness and Public Policy

Rural development through a road extension network involved the land and the forest. Road extension networks, the construction of hydroelectric dams and irrigation dams are the causes of deforestation in the northeast. The government has set a forest conservation target by reforestation, population policy, and people's awareness. It is hoped that a combination of reforestation policy; population policy such as family

planning, and people's awareness incentives such as increased education will help bring about a better balance between people and resources in densely populated resource-poor areas.

Reforestation

In 1989, the Royal Thai Army proposed a reforestation policy to ban forest logging. The government supported the plan and called it the *Green Northeast Project*. About 1.2 million farmers were evacuated from degraded forest zone to be resettled on smaller farms (Rigg, 1995). At the same time, the government initiated two programs to try to increase the forest. The programs are 1) commercial plantation of fast-growing trees and 2) a program of community, or social forestry. The government provides incentives to the private sector to plant fast-growing tree species on encroached and degraded forest land. The incentives include renting encroached land to private companies at competitive rates and granting promotional privileges to participating companies. The government has promoted fast-growing species such as eucalyptus so that the forest cover can be re-established quickly. The community forestry program has been formulated in recognition of the fact that poverty is a major underlying cause of deforestation. Community forestry involves members of the community in all aspects of the decision-making related to that enterprise (TCGE, 1992). The premise is that local people know best how to protect their own forest resources and have the greatest incentive to do so. The Policy for Reforestation Promote Project, funded by the Government and Private Sector is detailed as follows: (http://www.tei.or.th/nrm/projects.htm)

- The first objective is to investigate the feasibility of small landholders planting fast growing trees as an alternative crop.
- The second objective is to identify the incentives needed for both medium scale tree planters and large commercial planters for planting fast growing tree species.
- The third objective is to evaluate the effectiveness of the Reforestation Promotion Act and to recommend necessary amendments.

- The forth objective is to identify the constraints faced in tree marketing activities.
- The fifth objective is to examine tree-planting options for the pulp and paper industry such as planting on corporate land, contracting to small holders, or purchasing from the market.

In addition to the government's program, the FAO initiated a reforestation program in the northeast. This program will allow the rural people in the northeast to obtain fundamental knowledge about the importance of systematic management and utilization of the land's natural resources.

Population Policy

At the beginning of the 20th century the population in Thailand was around 8 million and was growing slowly because of high death rates. In fact, one of the major reasons for setting up the public health service in the early part of the 20th century was to increase population by reducing mortality. After World War II, the rapid decline in mortality resulted in extraordinarily high rates of population growth: the average 3.2 percent annual growth rate during the 1947-1960 intercensal period was one of the highest in the world (United Nations, 1976). In 1960, the population in the northeast was about 8,989,543 people (Varakamin. et al., 1983). At the time, the Thai Government submitted a report to the World Bank pointing out that Thailand's rapidly increasing population was creating many alarming problems such as a shortage of school and public services as well as a shortage of living accommodations. So the solution to the problem was to limit family size through the dissemination of information about birth control techniques. In 1970, the Government issued a plan to bring the annual population growth from the level of 3.0 percent down to approximately 2.5 percent by the end of plan period. The population growth resulted in rapid deforestation especially in the northeast area. Thus the Government has had a national policy officially permitting the promotion of family planning practices. By 1989 Thailand had been highly successful in reducing population growth rates to about 1.44 per cent per year but the growth is still high in some regions. According to the 1989

Survey of Population Change, the natural growth rate of the northeast was 1.59 percent per year. There has been a declining proportion of the population aged under 15 years old, and increasing proportion in the working-age group; 15-59 years; and also in en elderly group; over 60 years (Wongboonsin et al., 1993). In 1989, the Government banned forest logging too because of environmental degradation.

People's Awareness

The fundamental issue between the government and rural households is landing right. While the government wants forestland for conservation purpose, the traditional way of life for rural households needs cultivating area and community forest for survival. Therefore, the government tries to make the people aware that they are the land's natural resources owners because they suffer the direct impact of environmental degradation. So one should focus on the issue of knowledge, attitudes, and practices related to the environment and development. The northeast has too high a rate of deforestation. Ideally, appropriate knowledge leads to appropriate attitudes, which allows appropriate practices to be implemented. The issue of knowledge should be dealt with at the state of the art level in well-established scientific and educational institutions, as a training policy to educate the rural population. There is strong evidence that agricultural productivity is directly related to years of education (World Bank, 1983). Therefore, increased access of the rural population to educational opportunities can be expected to generate agricultural benefits. However, farmers have to learn to develop a vast network of cooperation with other agencies.

Conclusion

In this paper, population changes appear as part of the basic causes of land degradation. Environment conditions and economic factors trigger population changes. Public policy such as family planning, environment policy, and people awareness is a tool for solving the environment problem. There are four conclusions about this study:

Population growth usually appears as the major cause for land degradation. It can easily be misinterpreted as the cause of deforestation when trees are felled to provide additional agricultural land. The main historical causes of deforestation in order of priority have been poverty, population growth, and the price of cassava. Population Growth has contributed to deforestation primarily through harvesting of forest products and through agricultural forestland clearing, both of which have been made easier by expansion of the road network. However, this study indicates that it is not only population growth that results in land degradation, but also the economic factors linked to soil erosion.

Overgrazing especially cassava growing in the northeast has destroyed vegetation and led to the loss of topsoil. The rapid increase in production has been stimulated by the demand for cassava by the animal-feed industry, which in turn stimulated the expansion of the road network into the northeast. The loss of topsoil by overgrazing occurred because farmers used insufficient fertilizer in the soil, because of the drought and inadequate water regulation in the northeast.

The promotion of mono-cash crops by the government increased land clearing for cultivation in the northeast both for the domestics market and for export (e.g. cassava, maize and sugarcane). Cassava is a very popular crop, a part of the cash income of farmers in both upper- northeast and lower-northeast areas, the poorest of all regions. Cassava is higher yield than sugarcane, but it results in soil depletion.

Population dynamics generally appear as the major cause of land degradation in the northeast; the correlation between the yearly percent rate of forestland depletion in the northeast and other variables is significantly demonstrated. To conclude the major cause of land degradation is deforestation, which is linked to soil erosion.

Finally, population factors are viewed as an intermediate variable; social variables such as agricultural technology, fertilizer, irrigation, economic factors (e.g. poverty, market cycles, and public policy) are influenced by the population growth/size, which merely exacerbates the effect of these processes. Of course public policy is needed to attack the root causes of land degradation in the northeast, but it is not easy.

References

Arbhabhirama, Anat, Dhira Phantumvanit, John Elkington and Phaitoon Ingkasuwan. 1988. *Thailand Natural Resources Profile*. Oxford University Press, New York.

Fukui, Hayao. 1993. *Food and Population in A Northeast Thai Village.* Translated by Peter Hawkes, University of Hawaii, Honolulu.

http://www.undp.org/popin

http://www.mahidol.ac.th/

http://www.tei.or.th/nrm/projects.htm

Khon Kaen University. 1982. *An Agroecosystem Analysis of Northeast Thailand.* Cropping Systems Project. 1982, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand.

Krongkaew, Medhi. 1993. "Poverty and Income Distribution", *The Thai Economic in Transition.* Edited by Peter G. Warr, Cambridge University Press, UK.

Onchan, Tongroj. 1990. *A land Policy Study.* Research Monograph No.3, Thailand. Development Research Institute Foundation, Bangkok.

Phuntumvanit, Dhira and Khunying Suthawan Sathirathai. 1988. *Thailand: Degradation and Development in a Resource-Rich Land.* Thailand Development Research Institute Foundation, Bangkok .

Rigg, Jonathan. 1995. *The Counting the Costs: Economics Growth and Environmental Change in Thailand.* Institute of Southeast Asian Studies, Singapore.

Sathirathai, Surakiart and Ammar Siamwalla. 1987. *GATT Law, Agricultural Trade, and Developing Countries: Lessons from Two Case Studies.* Report from The World Bank Economic Reviews, Vol.1, No.4, Thailand Development Research Institute Foundation, Bangkok.

The Technical Committee on the Global Environment (TCGE). 1992. *Thailand Country Report to the United Nations Conference on Environment and Development.* Bangkok.

Thailand Development Research Institute Foundation (TDRI). 1992. *The Effects of Thailand's Logging Ban: A Natural Resource Accounting Approach***. Draft, Sector Economic Program, Thailand Development Research Institute Foundation, Bangkok.**

_____. 1992. *Food Situation Outlook in Asia: Case Study of Thailand.* A Final Report Submitted to In International Food Policy Research Institute, Thailand Development Research Institute Foundation, Bangkok.

_____. 1987. *Productivity and Competitiveness in Thai Agriculture.* Presented at The TDRI 1987 Year-end Conference, Regent Cha-am Beach Hotel, Thailand Development Research Institute Foundation, Bangkok.

_____. 1988. *Forestry and Land Use Policy.* 1988 TDRI Year-end Conference on Income Distribution and Long-term Development, Thailand Development Research Institute Foundation, Bangkok.

Tongpan, Sopin, Theodore Panayotao, Songpol Jetanavanich, Ketty Faichampa and Charlie Mehl. 1990. *Deforestation and Poverty Commercial and Social Forestry Break the Vicious Circle?* Thailand Development Research Institute Foundation, Bangkok.

United Nations. 1976. *Population of Thailand.* ESCAP Country Monograph Series No.3, Economic and Social Commission for Asia and the Pacific, Bangkok.

Varakamin, Somsak, Debhanom Muangman, Morakot Kornkasem, Yaovarat Porapakkham and Kanchana Kanchanasinith. 1983. *Thailand Population Monograph.* Ministry of Health and Mahidol University, Bangkok.

World Bank. 1983. *Thailand Rural Growth and Employment.* Washington D.C. U.S.A.

Wongboonsin, Kua, Kitti Limskul, Wilai Wongserchart, Sunanta Suwannodom and Aurapin Bunnag. 1993. *Population, Environment and Resource Sustainable in Thailand.* Institute of Population Study, Chulalongkorn University, Bangkok.

Yoddumnern-Attig, Bencha, George A. Attig, Thirapong Santiphop, Kriengsak Rojnkureesatien and Yupin Vorasiri-amorn. 1998. *Population and Community Forestry: The Case of Northern Thailand.* A Paper Report Submitted to FAO, Institute for Population and Social Research, Mahidol University, Nakhon Pathom, Thailand.