

**Nils Rennenberg**

**Assessment of land use changes in  
Mukdaham and Nakhon Phanom provinces  
(NE Thailand) by means of Remote Sensing**

**Diploma Thesis**

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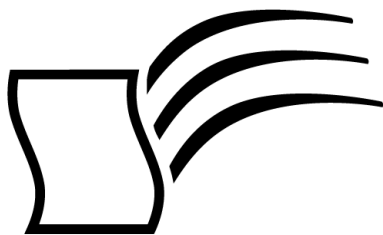


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Nils Rennenberg

# **Assessment of land use changes in Mukdaham and Nakhon Phanom provinces (NE Thailand) by means of Remote Sensing**

Diplomarbeit  
an der Georg-August-Universität Göttingen  
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## List of abbreviations:

A. – Amphoe (=district\*)  
ACRoRS – Asian Center for Research on Remote Sensing  
GAC – GIS Applications Center  
AIT – Asian Institute of Technology, Bangkok  
JICA – Japanese International Cooperation Agency  
PLANET – Plan for Laos and Northeast Thailand  
NBR – Northeastern Border Region [of Thailand]  
Lao P.D.R. – Lao(tian) People's Democratic Republic  
GMS – Greater Mekong Sub-region  
PCI – Pacific Consultants International  
RTG – Royal Thai Government  
RTSD – Royal Thai Survey Department  
NESDB – National Economic and Social Development Board  
OAE – Office of Agricultural Economics  
DMR – Department of Mineral Resources  
FAO – Food and Agriculture Organization of the United Nations  
NGO – non-governmental organization  
GDP – Gross Domestic Product  
MSL (m.s.l.) – Mean Sea Level  
GIS – Geographic Information Systems  
RS – Remote Sensing  
BIL – Band Interleaved (Format)  
BSQ – Band Sequential (Format)  
IFOV – Instantaneous Field of View  
IR – Infrared  
NIR – Near Infrared  
MIR – Middle Infrared  
RGB – Red, Green, Blue  
HSI – Hue, Saturation, Intensity  
NDVI – Normalized Differential Vegetation Index  
MSS – Multi Spectral Scanner  
TM – Thematic Mapper  
UTM – Universal Transverse Mercator (Projection)

## Remark on the quotation of Thai authors

In Thailand, family names are seldom used, only for official purposes (documents etc.). People normally address each other by their first names, which is by no means impolite, even in formal situations. This custom doesn't depend on a person's social status, either. Therefore it is common to cite Thai authors by giving their first **and** their last name (or abbreviated last name) and to arrange them according to their first name in the references list.

## Remarks on the spelling of Thai place names

Transcribing words from Thai script into Roman script can lead to considerable confusion. That is not only due to the fact that the Thai alphabet is rather voluminous with its 44 consonants, 28 vowels (not considering additional complex vowel combinations) and 4 tone marks and not quite easy to read because of particularities such as the distinction between three different consonant classes, complicated tone rules, the absence of punctuation marks and gaps between the words and, finally, many exceptions in pronunciation. Notwithstanding all these difficulties, Thai words could well be reproduced in a slightly modified Roman script (including only a few special signs) without major problems.

The main problem is rather a lack of standardization and the predominance of insufficient or inconsequent transcription systems. And it's exactly the transcriptions based on English writing/pronunciation that have to be regarded as completely unsuitable, especially where the correct rendition of the vowels is concerned.

Besides that, any transcription that tries to manage without the use of tone marks should be disapproved. In this context it has to be underlined that a Thai word can receive up to five different meanings due to different intonation (normal, deep, falling, high or rising). As far as the Thai place names in this study are concerned, tone marks are not really significant, however, and can thus be omitted.

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\* see glossary, p. 152

The most important problems in the writing of place names and map designations will be explained below with the help of some examples:

As there is no standardized transcription and virtually every publishing firm for maps, guidebooks, phrasebooks etc. keeps on inventing new variants all the time, one important factor is whether the writing of the Thai words was mainly intended for an English speaking public or for other people. Hence versions like neua – nüüa, muang/maung – müüang, loei – lööi, yai – jai, djai – dschaa, eeg – iik, Esan – Issaan, Buri Rum – Buri Ram, Ubon Rajthanee – Ubon Ratchathani, amphur – amphoe ("English" vs. "German" transcription) and endings like -ern/-urn/-oen/-ön.

Unlike European languages, Thai has no capital letters or punctuation marks and in addition to that, single words aren't separated from each other by empty spaces within a written sentence. Words are written in one long row and gaps only made to finish phrases or paragraphs. So basically it doesn't matter if certain place names are written separately or in a single word (Pathum Thani – Pathumthani, Samut Prakan – Samutprakan, Nakhon Phanom – Nakhonphanom), though they do consist of two distinct units that carry their own meaning.

Often it is crucial whether a decision between aspirated and unaspirated consonants is made or not, for example by contrasting gk – kh, dt – th, bp – ph. This leads to forms like khlong – klong, Phimai – Pimai.

**Important remark: "ph" is always pronounced as an aspirated "p" in Thai transcriptions, never as "f"!**

The same is true for the discrimination of long and short vowels (a-aa, e-ee, i-ii, o-oo, u-uu), a basic element of the Thai language system. Most transcriptions don't highlight the long vowels.

The soft/unaspirated consonants -b, -bp, -d, -dt, -gk are always pronounced like their "hard" counterparts when occurring at the end of a syllable and are therefore best transcribed as -p, -k, -t in such cases. Not all transcriptions pay attention to this fact, though.

Finally there are certain particularities of Thai writing (or pronunciation, respectively). For example, mute letter combinations (Nakhon Chaisri – Nakhon Chaisi, Surawongse – Surawong); or certain vowels (short "a" and "o") which aren't written and have to be added when pronouncing the word (the Thai word for "street" is written "thnn", but pronounced "thanon"; hence varieties like Ayodhya – Ayutthaya). In addition, there are also consonants that change their pronunciation under certain circumstances. So the letter "l" becomes "n" when ending a syllable (resulting forms: Mahidol – Mahidon, Chonburi – Chonburi), whereas "s", "ch" or "dj" becomes "t" (Thewes – Thewet, Ratchaburi – Ratburi, Phetchaburi – Phetburi, Somdej – Somdet).

Some very special cases include: "-dr" = "-don", "-khr" = "-khon", "-rr" = "-on", "thr-" = "s-", "-aar" = "-aan", "yy" = "nj". The sounds "ao", "iu", "eo", "äo" are written as "aw", "iw", "ew", "äw" because "w" is always pronounced like in English (e.g. "water"), no matter if at the beginning or at the end of a syllable. Then there is an abundance of quite confusing vowel combinations (e.g. ee+oo = öö, ee+aa = au, ee+ii+y = iia). Sometimes the Thai version of writing is kept in the transcription of words with such particularities (e.g. Wat Phra Kaew), meaning the word is transcribed letter by letter, which is not useful at all, sometimes an attempt is made to imitate the corresponding sound (e.g. Wat Phra Kaew/Keo), and sometimes there is even an inconsequent mixture of both, which is maybe the worst of all possibilities: for example, the word "nakhon" (city) is written like "nkhr" in Thai and accordingly rendered as "nakorn" sometimes, though the "r" is mute and produces an "-on" sound in this special case.

In addition to all of this, some very strange spellings are to be found that don't make sense at all, like the insertion of hyphens ("E-san") or the use of "v" ("Sukhumvit") instead of "w", disregarding the fact that there is no such sound in Thai language. A similar case is the use of "-ie" ("Chieng Mai") where there's only an "-ia" sound in Thai. Sounds like "bh" or "dh" ("Bhumibol") simply don't exist either.

So very often there will be an enormous number of possible spellings, as is the case with one of the main boulevards in the centre of Bangkok: Ratchadamnoen / Ratdamnoen / Ratdamnöön / Ratjadamnern / Rajdamnarn / Raachadamnoen / Ratchadamnurn, or any other thinkable combination. There is virtually no "correct" version of this name (which translates as "Royal Route").

Some other random examples for varying spellings:

|                             |                                                             |
|-----------------------------|-------------------------------------------------------------|
| Ayutthaya, Ayudhya, Ayodhya | Isan, Isaan, Issaan, I-san, Esan, E-Sarn, Essarn            |
| Phayathai, Phayathai        | Phaholyothin, Phahonyothin, Phahon Yothin                   |
| Sathorn, Sathon             | Nakhon Si Thammarat, Nakhonsithammarat, Nakorn Si Thammarat |
| Mukdaharn, Mukdahan         | Pathum Thani, Pathumthani, Prathum Thani                    |
| Phetkasem, Petchakasem      | Samut Prakhan, Samut Prakarn, Samutprakan                   |
| Pattunam, Pratunam          | Ubon Ratchathani, Ubon Rajthanee, Ubol Ratchathanee         |
| Chao Phraya, Chao Phya      | Cholburi, Chonburi                                          |
| Chatuchak, Jatujak          | Nakhon Chaisri, Nakhon Chaisi                               |
| Bang Sue, Bangsu            | Chiang Mai, Chiangmai                                       |
| Amphoe, Amphur              | Hat Yai, Haadyai                                            |
| Muang, Mueang               | Phang Nga, Phang-nga, Phangnga                              |
| Buri Ram, Burirum           | Petchaburi, Phetburi                                        |
| Roiet, Roi Et, Roi-Et       | Bhumibol Adulyadej, Phumiphon Adunyadet                     |

The abovementioned facts lead to the following important consequence: Should one find two more or less similar names in different sources or on different maps (e.g. Srinagarind – Si Nakarin), chances are that **exactly** the same thing is meant.

In this study it was attempted to use a **wide-spread** and at the same time **linguistically plausible** spelling for Thai place names in each case and to provide for a certain overall **homogeneity** in writing. One notable exception must be mentioned, though: While the form "Khorat" was preferred over "Korat", it was decided to stick to the internationally common spelling "Mekong", rather than writing "Mekhong" (or "Mae Khong"), which is more accurate, but a bit unfamiliar.

### Remark on Thai administrative units

The expression *changwat* (djangwat) was generally translated as "province" in this study, as it is common practice. The *changwat* (sing./pl.) are the 76 primary administrative units of Thailand with an area strongly varying in size between only 500 km<sup>2</sup> (e.g. Phuket Island or Samut Songkhram) and as much as 20,000 km<sup>2</sup> (e.g. Chiang Mai or Nakhon Ratchasima). The population may be between 130,000 (Ranong) and 2.5 million (Nakhon Ratchasima), not considering the very special case of Bangkok. Thus they sometimes correspond to a German "Landkreis" in size, sometimes to a small or even medium-sized "Bundesland", but in most cases to a "Regierungsbezirk". On the other hand, it has to be considered that they only command a small amount of autonomy and are ruled by a high-ranking professional civil servant (a governor) who is installed by the central government in Bangkok, more precisely the Ministry of the Interior. He is assisted by the Provincial Board, consisting of civil servants providing technical services on behalf of their respective ministries, such as education, agriculture, health, etc. (cf. DONNER 1978:49). The following administrative unit is called an *amphoe* (sometimes abbreviated as "A."), something like a district, or "Kreis" in Germany. They are headed by the District Officer (*nai amphoe*, also appointed by the Ministry of the Interior) and again divided into *tambon* (tambol) (sometimes abbreviated as "T."), i.e. sub-districts or rural communities/ municipalities/ groups of villages. These are administrated by the *kamnan* (Chief of the Commune), elected by the village headmen. The smallest units – and the keystone of local government in Thailand – are the *muban*, or villages. They consist of a group of at least five households and are headed by the elected *pu yai ban* (village headman).

As a general rule, there are roughly about 10 *amphoe* in one province and again 10 *tambon* in one *amphoe*. The terms for these smaller units weren't translated in this study because they are very common in everyday speech in Thailand and because the possible English words wouldn't be very accurate.

A *king amphoe* is an administrative unit that is still under construction: a newly established district that has yet to be recognized as an independent administrative unit, but will become a regular *amphoe* in the future. (NONGLUCK SUPHANCHAIMAT\*, oral comm.)

There has been a general trend in Thailand to split up big provinces and add new ones every 5 or 10 years over the past decades and new districts are still created inside them in a similar way, so their numbers are growing all the time and the presence of one or several *king amphoe* is likely in most of the larger provinces at any given time. DONNER (1978:49) describes them like this: "If the population grows beyond the administrative capacity of one office, sub-districts (king amphoes) may be set up, headed by a Deputy District Officer."

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\* (Dep. of Agriculture Economics, Khon Kaen University.)

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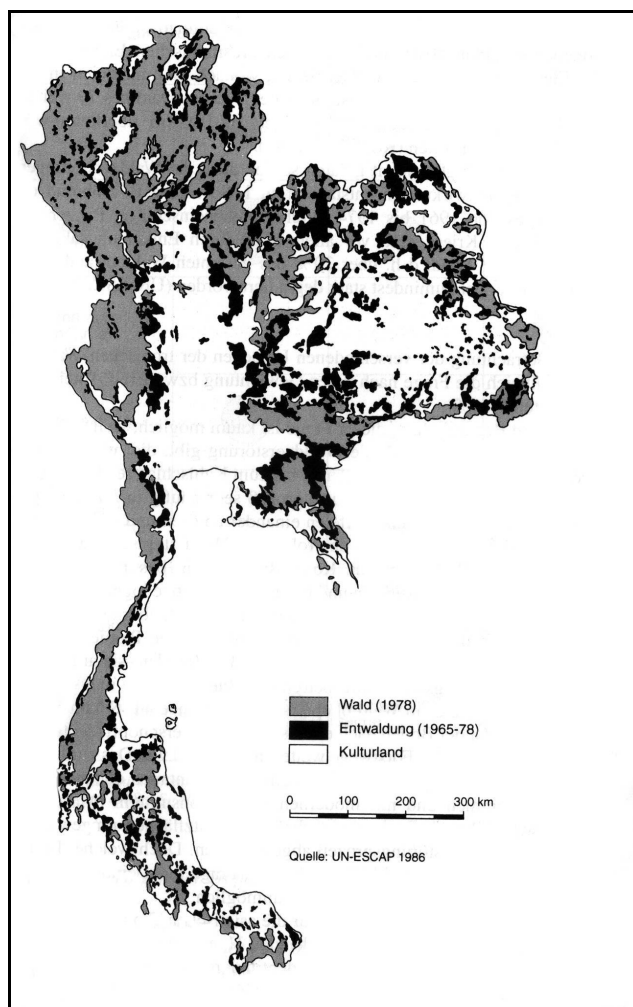
N.R.

# 1. Introduction

## 1.1. Statement of problem: tropical land use changes

Unlike any other interference with the earth's ecosystem, the clearing of tropical rain and monsoon forests has been stirring up the ecological conscience of the world-wide public for about 30 years now. It was with the launching of the very first land observation satellites in 1972 that the actual extent of the tropical forest destruction became clearly visible and measurable. But the devastating process has been advancing ever since; FAO estimated the global loss of rain forest area at 0.6 to 0.9 % per annum in 1993. Half of the original stands have vanished in the meantime. The highest loss has been recorded in West Africa, followed by South East Asia, Amazonia and Central Africa. Without doubt, agriculture is the main culprit for this development. Most of the loss can be attributed to the conversion of forest lands to agricultural areas. (cf. SCHOLZ 1998:141-42)

While the principles of deforestation will be further dealt with in chapter 2.1., it should be noted here that in Southeast Asia, two countries have suffered from this phenomenon more than any other nations: the Philippines and Thailand, whose Northeastern Region was chosen as the general area of interest for this study.



**Figure 1: Forest destruction in Thailand 1965-1978. (Legend: grey = forest 1978; black = deforestation 1965-78; white = cultivated land.) Source: SCHOLZ 1998:147**

The consequences of this trend are dramatic:

"The devastation of huge forest reserves for agricultural purposes has been escalating dramatically within recent years in Thailand. Between 1961 and 1975 the forest reserves of the country have been reduced from 57 % to 37 % of the total area, while at the same time the area put to agricultural use has almost doubled. Only to a very limited extent did the government participate in this process of land reclamation in terms of organized resettlement programmes; to an overwhelming extent the deforestation has been performed 'illegally' by spontaneous activities of the rural population." (SCHOLZ 1980:131)

According to figures from FAO, the share of forests further declined to 28.9 % in 1998, at a current rate of -112,000 ha (-0.7 %) per year (table 1); **Thailand's forest cover has roughly halved since 1960.**

**Table 1: Forest statistics for Thailand, Asia and the world**

|                 | Land area<br>(1000 ha) | Forest Cover 2000<br>(1000 ha) | Forest Cover Change<br>1990-2000 |       | Distribution of Land Cover/Use<br>in % (1998) |                      |               |
|-----------------|------------------------|--------------------------------|----------------------------------|-------|-----------------------------------------------|----------------------|---------------|
|                 |                        |                                | 1000 ha/a                        | %/a   | Forests                                       | Other Wooded<br>Land | Other<br>Land |
| <b>Thailand</b> | 51,089                 | 14,762                         | -112                             | -0.73 | *28.9                                         | 0.0                  | 74.6          |
| <b>Asia</b>     | 3,084,124              | 547,791                        | -287                             | -0.05 | 17.8                                          | 4.6                  | 78.3          |
| <b>World</b>    | 13,139,618             | 3,869,453                      | -9,319                           | -0.24 | 29.4                                          | 11.2                 | 58.6          |

Source: [www.fao.org](http://www.fao.org) \* of which 19.7 % closed, 5.5 % open (dry dipterocarp forests, pine forests)

## 1.2. Objectives, scope and limitation of the study

It was attempted to incorporate problems from the realms of social as well as physical geography, i.e. to maintain a balance between questions of applied geography (regional studies) and remote sensing. This also means that no special focus was put on advanced RS methodology such as the development of new image processing techniques; this study is rather based on a somewhat holistic approach, joining aspects from many different fields of science. The frame was deliberately widened and covers subjects as diverse as geology, geomorphology, climatology, agriculture and agricultural economics, sociology, ethnology, politics and spatial planning.

As a result, the basic objectives of the study were:

- to give a geographical description/characterization of Northeast Thailand in terms of its physical properties as well as its social and economical peculiarities;
- to try a quantification of forest losses since 1972 for a limited area of this region;
- to attempt a change detection, investigating the land cover (and possibly land use) changes within a timeframe of about 30 years;
- to name possible reasons for these changes;
- to find out if there are any connections between the development and socio-economic factors in NE Thailand (e.g. extension of crop area because of poverty/sinking incomes/population growth?);
- to tackle the question if the problem can be solved with the existing data and to make an assessment of the RS methodology that was applied;
- and to address the issue of future prospects and suggest a regional development concept to improve the living standards of the rural population.

When talking about the limitations of the study, it's obvious that the biggest restrictions are associated with the remote sensing part, where the possible findings through the evaluation of satellite images are limited by the characteristics of the available data: their spatial, spectral and radiometric resolutions. Another difficulty arises from the fact that the older data stems from a different sensor type, raising the question of comparability (see also 2.3. and 5.1.).

### 1.3. Cooperation with AIT

The author of this study stayed at the Asian Institute of Technology (AIT) in Pathum Thani Province, immediately north of Bangkok, from November 2000 until April 2001. The AIT is a small international university for graduate studies with students and teachers from more than 40 countries. It comprises 4 "schools" (i.e. faculties): the School of Management (SOM), the School of Civil Engineering (SCE), the School of Environment, Resources and Development (SERD) and the School of Advanced Technologies (SAT), which focuses on Computer Science, Industrial Systems Engineering, Mechatronics-Microelectronics, Space Technology and Telecommunications.

The author was invited as a special program student within the STAR (Space Technology Applications and Research) Program of the School of Advanced Technologies and worked at Asian Center for Research on Remote Sensing (ACRoRS) and GIS Applications Center (GAC) for 6 months. Both these institutions are directed by Associate Professor Dr. Kiyoshi Honda who kindly agreed upon receiving a fellow researcher at his center. The author was also provided with the necessary satellite and GIS data by ACRoRS/GAC staff. Field work in Northeast Thailand was carried out in February and in April 2001, with some helpful assistance by a Thai colleague from ACRoRS in the first case.

## 2. Theory/literature review

### 2.1. Deforestation and agro-colonization

The term "forest destruction" can be interpreted in different ways, necessitating a differentiation in at least two basic forms (SCHOLZ 1998:142):

1. *Forest degradation*, i.e. the qualitative change and gradual reduction of an original timber stand;
2. *Deforestation*, i.e. the quick and complete cutting down of a forest area in order to use it for different purposes, mostly for agriculture.

What are the **reasons** for the development described in the introductory chapter?

As SCHOLZ (1998:126) states, there's a strong public notion that the quick population growth in many tropical countries leads to a growing demand for new land around the existing settlement areas, land that is only used to secure the food basis of the local population. However, this simple explanation is only partly correct. Though population growth remains of course an important point, the actual reasons for the advancement of agro-colonization are much more complex than that and also involve some other important factors:

- National economies have to obtain foreign exchange to pay back foreign debts;
- There is a rising demand on the world market for certain agricultural products such as soy beans, tapioca, beef, and others;
- National governments strive for economic integration and/or strategic control of unaccessed/undeveloped peripheral areas of their countries;

- Forest clearing and cultivation of soils have been facilitated by ever-increasing mechanization (chainsaw, tractor);
- Improved traffic infrastructures brought about an improved connection of peripheral areas to the regional markets, thus permitting the cultivation of cash crops;
- Speculation with land titles.

While these are merely the underlying reasons, the most important **processes** of forest destruction can be summarized as follows:

- Fuelwood and charcoal consumption;
- Commercial logging;
- Traditional shifting cultivation;
- Modern agricultural colonization;
- Other human interventions affecting only relatively small forest areas, such as open-cast mining for metal ores, gold washing, rubber tapping, construction of dams, roads, industrial complexes and human settlements and, finally, war actions.

Accordingly, the array of acting persons comprises many different groups such as small farmers (peasants), land workers, owners of large estates, land speculators, entrepreneurs from the timber and plantation business, ranch owners, mining companies and even adventurers or fortune-hunters.

The **effects** of forest destruction can be very grave; it should suffice to mention a few keywords here, for example:

- Extinction of animal and plant species;
- Influences on the global climate (green house effect);
- Influences on the regional climate (changes in the water balance, altered transpiration, interception, insolation, evaporation, precipitation, run-off, soil moisture, temperature; usually resulting in lower groundwater levels, more floods and longer droughts);
- Soil degradation and erosion, growing sediment load of rivers, silting up of reservoirs and irrigation channels;
- Economic effects (economic profits, improvement of infrastructures, creation of new jobs, as well as a loss of traditional forest-related occupations);
- Social effects (displacement of indigenous peoples, social conflicts).

Contrary to a widespread misconception, the main process responsible for deforestation is without doubt that of modern agricultural colonization and **not** the traditional shifting cultivation. In any case, the so-called "slash and burn" clearing practice should not be mixed up with the term "shifting cultivation", as the former is mainly employed for the development of permanent farmland, plantations or grazing land, whereas the latter is a form of subsistence economy and usually doesn't lead to a complete destruction of the forests.

The process of agro-colonization doesn't only affect the largest areas, but also has a special quality to it. It doesn't simply mean a degradation of the forest lands, but their complete clearing with the aim of a permanent use for crop cultivation or other agricultural activities, excluding the possibility of re-forestation in the long run.

As a matter of principle, three forms have to be distinguished, namely:

1. the state-controlled land development and transmigration programs;
2. the spontaneous colonization processes of unorganized, individual pioneer settlers;
3. colonization through large agricultural enterprises (plantations and ranches).

Within these three movements, the spontaneous clearing colonization by small farmers and pioneer settlers definitely has the highest impact on natural environments; it is the single most important factor for the destruction of tropical forests world-wide.

(Summary after SCHOLZ 1998:126, 142-53.)

The corresponding conditions in Thailand are very similar to the developments described above (cf. SCHOLZ 1998:136): As opposed to the common belief that spontaneous clearing colonization in the tropics mainly serves to extend the food basis of a constantly growing and impoverished rural population, this practice has predominantly *commercial* purposes in Thailand. The newly cleared areas are almost exclusively used for the cultivation of cash crops (cassava, maize, sugarcane, pineapple, rubber), not for the production of staple foods on a subsistence principle.

## 2.2. Spontaneous versus planned colonization in Thailand

UHLIG (1980, 1984) described the (then) recent development of clearing-colonization in the ASEAN countries of Southeast Asia and himself conducted interesting studies of this phenomenon in areas of Southeast Thailand and on the Khorat escarpment. Citing F.W. Fuhs, he states that "agricultural development in Thailand depended mainly upon area expansion in the form of undirected spontaneous land settlement". Compared to neighbouring countries, a different historical background and different landownership policies, including liberal property laws, facilitated the step-by-step opening up of the agricultural land. People were permitted to retain the land they had cleared of forest and taken into permanent cultivation. This gradual expansion of the farming areas by continuous clearance can especially be seen on the Khorat Plateau in Northeast Thailand, where the study area of this thesis is located. There is a tradition of sons-in-law marrying into the farms of the bride's parents, then having to clear new ground in the forest as soon as possible, in order to prevent the inheritance from too rapid a fragmentation of property. Strong ties with the old village community offered opportunities of reporting back about the chances in the newly opened up areas and to draw more and more settlers, usually from the same closely defined area of origin, to the new clearance zones. The traditional forms of agriculture largely focused on wet-rice cultivation. Pioneer settlements were easily to be recognized by recently planted rice fields with numerous burnt stumps and "carry-over" trees, remains of the cleared forests (cf. the photograph in 3.5.3). In more recent times, however, a new socio-economic development has led to the wide-spread abandonment of traditional wet-rice cultivation in favour of marketable dry-field crops, namely maize, cassava and sugarcane. They are solely commercial products, with maize and cassava (as tapioca) being exported to Japan and Europe as feeding stuffs and sugarcane going to the recently expanded sugar industry of the country itself. This rapidly increasing permanent dry field cultivation has widely transformed the classical picture of Thailand's agrarian landscape which was characterized by the juxtaposition of pure paddy cultivation of the sedentary Thais in the basins and plains with the shifting cultivation of the mountain tribes. Nowadays, it is also the rice cultivators who promote the expansion of land under cultivation and the diversification of agriculture by dry-field cropping and tree cultivation in fringe areas that were formerly used for additional shifting cultivation and extensive forest pasture.

Migration is a critical factor in the rural economy of Thailand; poverty, a lack of employment opportunities and landlessness being the main causes. Between 1960 and 1970, out of the 1,700,000 migrants all over Thailand, only 35 % were from urban, but 65 % from rural areas. The movements occurred mostly within regions and between nearby provinces. Increasing pressure from population growth and improving transportation and communication facilities added to this trend in the 1970s and 1980s. Another factor is unwanted migration caused by the construction of dams and reservoirs, especially in the North and Northeast.

It wasn't before 1940 that the Thai government recognized the necessity of a public settlement policy and passed an initial law. But it became effective in the 1960s only, when the continuing growth of the population and the corresponding demand for employment and land-reserves, with four-fifths of the population still living in the countryside, finally led to the establishment of a "Land Settlement Division" of the Public Welfare Department (Ministry of Interior). Its "Self-Help Land Settlement Schemes" cover the majority of the state-directed projects and are the most thoroughly organized ones. Besides this, the Ministry of Agriculture and Cooperatives created its own "Cooperatives Settlement Scheme" and there are at least six other departments engaging themselves in this field, partly assisted by international organizations. The scope and extent of the programmes are not well-defined and clear-cut, however. Some of them have been implemented independently, some in cooperation with other agencies. Frequent government changes added to the inconsistency of the official settlement policy. The schemes aim at economic, social and political objectives; common means include the introduction of new crops and rotations as well as cattle breeding in mixed farms, the development of agricultural purchasing and sales organizations and the agricultural training of settlers and settlement officials. The average number of families in the settlement schemes is about 3,000, but ranges from 150 to 18,000 in individual cases. Farmers are usually allotted about 2 ½ to 4 hectares of land each. There are two types of settlements: the village system and the line system. The form of ownership causes some problems. State-owned land has been assigned to two broad classes: as suitable for cultivation and as forest reserve. In the former, title deeds may be issued to the settlers, but in the latter case, when farmers squat in forest reserves, land titles cannot be given to them and they become tenants to the state. This is meant to discourage migration and to prevent further infringement upon remaining forests; but it may as well have negative side-effects as landownership is the most valuable asset to the farmers, implying both wealth and security. Own land is more likely to provide for a feeling of responsibility, the willingness to invest etc., than rented land. Another point of concern is that the growing number of landless farmers is often excluded from the selection process for new settlers within the official schemes. Instead of them, authorities are preoccupied with squatters or farmers who already live inside the settlement area.

(after UHLIG 1984:27-35)

Summarizing, the success or effectivity of the government schemes has to be questioned and the phenomenon of spontaneous land clearing and colonization remains an urgent issue:

"In view not only of pressure on the land, which continues to rise together with the growth of population, but also in the face of indebtedness of farmers or the hardship of stringent rent conditions in many excessively small farms, the relatively slow development of planned settlements, restricted to certain areas, state controlled by a mechanism of selection which remains foreign to the Thai mentality, was bypassed by many spontaneous clearings, the extent of which is probably unsurpassed anywhere in Southeast Asia." (UHLIG 1984:32)