A PROJECT FOR UPGRAISING THE CADASTRAL SYSTEM IN THAILAND

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PART 2
PROPOSED CADASTRAL SURVEYING AND MAPPING PROGRAMME

The Project—Mapping and Surveying

The Land Titling project covers the first five years of a 20-year programme. During these five years it is planned to complete mapping and titling in four provinces in the North-eastern Region and five provinces in the Northern Region. The criteria for choosing the provinces to be covered in the project are:

1. areas where land titling could have a significant effect on the availability of credit and ultimately on the level of agricultural production;
2. areas where there is a large amount of undocumented land;
3. areas included in a rural poverty eradication programme; and
4. areas where the number of boundary disputes is high.

The programme has been designed to provide cadastral map coverage of the public domain and private land throughout Thailand, exclusive of forests and national parks. It is designed to produce coverage of rural areas in 20 years and of urban areas in ten years. It is estimated that from eight to ten million parcels will have to be surveyed over the 20-year programme.

In rural areas a new national cadastral map series at a scale of 1:4000 based on the UTM projection is proposed. The series will be based on rectified photomaps using new aerial photography together with cadastral overlays showing all legal parcels. The cadastral overlays will be prepared by a combination of new mapping (NS3, 50 per cent NS3K, government and undocumented land) and map transformation (50 per cent NS3K and NS4). Eighty thousand 1:4000 sheets are programmed for completion over the 20-year period. Some large scale mapping of village areas will also be included in the programme. At the end of the first five-year stage, the present output of the Department of Lands of 500 sheets/year will have been progressively increased to approximately 4,000 sheets per year.

The urban mapping programme will be designed to cover Bangkok and the major regional urban centres in Thailand. It is estimated that in the ten-year programme about 7,000 sheets of scales of 1:1000 and 1:500 will be produced. Approximately 4,400 of these will be in Bangkok area. Towards the end of the first five-year stage, 1,000 sheets will be produced per year. As with the rural

*During a period in 1983-84 the authors were consultants to the Royal Thai Government in a joint project of the World Bank and the Australian Development Assistance Bureau.
programme, the urban cadastral series will be based on rectified photomaps. It is recognised that the production of cadastral overlays in some high density urban areas will require supplementary ground surveys. Further details of the urban mapping are given in a later Section.

Both the rural and urban cadastral map series will form the map basis for the title registration system in Thailand. Consequently each series will be automatically updated as part of the normal subdivision process.

Choice of Strategies

A number of strategies were considered for achieving the project’s principal objectives. By using the existing methods and manpower it was estimated that it would take 85 years to complete the issue of full titles to landholders. This approach is clearly unacceptable. Another approach was to introduce into the project, in the first two years, the high technology of Doppler satellite position fixing, electronic distance measuring (EDM) equipment, analytical plotters for photogrammetric block adjustment, and digitising work stations, interactive graphic editing and computer plotting. The planned full production rate would be achieved soon after the introduction of the technology, with production being totally dependent on the performance of the new equipment. Due to the difficulties involved with the introduction of high technology into such a large organisation in a developing country, this approach appeared to be inadvisable.

The strategy adopted for the rural programme is to begin the project using “manual” methods instead of block adjustment and digitising, and to phase the required technology into the system during the five-year implementation period. The introduction of Doppler satellite positioning and EDM equipment is not seen as a major problem. It is considered that this approach is feasible and has the advantage that the project can begin to achieve its objectives within the fourth year, irrespective of any problems associated with the use of the high technology equipment. However, it is recognised that in the long term, the introduction of the technology is the only way in which the Department can realistically achieve the aims within the proposed 20-year programme. The proposed methods are based on the following general principles:

(1) all change will be incremental and evolutionary and will be based on the existing operational administrative structure;
(2) existing technical and administrative procedures will be adopted as far as possible;
(3) computerisation will only be introduced into proven and operational systems; and
(4) the approach will require minimal legislative amendments.

Manual Methods

Operations involved in the “manual” approach are:

(1) an annual programme of aerial photography will be carried out each year by the RTSD. Each yearly sortie, covering about 20,000 sq. km, will provide photography for the following year's control and rectification programme.
The photography should be at a scale of 1:12,500 with 60 per cent end lap and 34 per cent side lap;

(2) the first order RTSD control will be extended into the project area using Doppler satellite position fixing equipment and translocation techniques (see Figure 4.) It is estimated that about 150 to 200 stations per year will be established, with UTM co-ordinates having an accuracy of $\pm 1.5 \text{ m (1\sigma)}$ in relation to the closest first order station;

(3) EDM traverses between the Doppler control and RTSD control (where suitable) will establish the major control network for areas to be mapped in following years. This control will be carried out by ten survey teams with each team completing about 15 km of monumented control per week;

(4) minor control will be surveyed for rectification of each photomap. All traverse stations will be monumented, and traverses will run through each village to form control for second class surveys not based on the aerial photography. This control will require up to 50 survey parties with each party expected to survey control for at least eight photomaps per month;

(5) 1:4000 rectified photomaps will be produced on existing Zeiss SEG V and new Zeiss SEG VI rectifiers. Output will be about 4,000 photomaps per year. Transparent overlays showing co-ordinate grids and control traverses, plotted by computer, will be prepared for each photomap. In every village or area which requires a more detailed survey, a large scale transparent sheet
similar to the above will be produced. These sheets will be used for non-
photogrammetric ground surveys and will be part of the systematic
breakdown of the 1:4000 mapping series;

(6) once districts have been selected for systematic conversion, all existing
NS3K and NS4 maps will be sent to Bangkok. Copies will be returned to
the respective Land Offices;

(7) all NS3K parcels which have boundaries visible on the photomaps and all
NS4 parcels, will be transformed manually onto the new transparent
overlays at the scale of 1:4000. Areas of parcels will be determined with
digital planimeters. All parcels will be renumbered on the new map sheets
and cross-indexed to the existing records. The new cadastral plans will be
returned to the district Land Offices;

(8) during the above transformation process, all NS4 records for a district will
be microfilmed and sent to that district Land Office;

(9) conversion teams in district Land Offices will convert existing NS3K
certificates to NS4 titles. The diagram of the parcel in question will not be
drafted on the NS4 certificate as before, but will be a photocopy of the
section of the cadastral map showing the parcel; and

(10) the survey will be completed, the boundaries adjudicated and titles issued
for all remaining land parcels in the district, in a systematic manner. The
most important feature of the process is that every land parcel is surveyed
and recorded in the system, irrespective of whether it is state or private land.

Two survey methods will be used, one where the physical boundaries are
visible from the air and the other where the boundaries are obscured, as in villages
or in dense vegetation. The methods are modified versions of the present
approaches, already described, for second class surveys for land titles, one utilising
the rectified aerial photomaps and one based on field surveys using co-ordinated
traverses for control and graphical methods for surveying the land parcels.

The consequences of implementing the above procedures are as follows:

(1) all land titles (NS4) and documents for government land in each district will
be located in the local district Land Office;

(2) the cadastral system will be complete. All land parcels, whether privately
owned or state owned, will be recorded in the same system; and

(3) all land parcels in each area will appear on one official cadastral map. The
maps will range from the standard scale of 1:4000 up to 1:500 in dense
urban areas. All maps will be based on the UTM system and will
consequently be related accurately to the national topographic map series,
including the 1:50,000, which covers the whole country.

Technology Introduced

The use of analytical photogrammetry, applied in obtaining photogrammetric
control by block adjustment, should enable the project to increase productivity
and complete the programme within 20 years. Such techniques and equipment
will be phased into the project during the five-year implementation period. The Department of Lands will purchase a proven "turnkey" system using analytical plotters which will be supported by foreign technical consultants for the first five years. The block adjustment will be used to determine the control for the rectification of the photomaps and for the digitisation process described below. The adjustment will be carried out in blocks of up to 400 models. The project will require one such adjustment to be undertaken every two weeks when the equipment is fully operational. A schematic diagram showing the ground control for a typical block is depicted in Figure 4.

High technology will also be phased in for the conversion of the existing NS4 cadastral maps at a scale of 1:4000, and the NS3K cadastral maps based on unrectified photomaps at the scale of 1:5000, onto one overall cadastral map at 1:4000 based on the UTM co-ordinate system. The proposed system will use computerised digitising work stations, an interactive graphics capability and output on a computer driven plotter. The resulting cadastral map will be on a transparent base such that it forms an overlay for the 1:4000 rectified photomaps.

Procedures Chosen

In arriving at the above approach for the project, the Department of Lands had to consider and resolve a number of important issues. A brief summary of these issues and their resolution is given below:

1. whether to adopt a basic cadastral scale of 1:4000 or 1:5000: for several reasons the 1:4000 scale was considered preferable for the system in Thailand;

2. whether corners should be marked or boundaries measured, when the boundaries could be clearly distinguished on an aerial photomap: it was decided to continue marking corners but to cease numbering the corner monuments. Boundaries will continue to be measured; angles will not be measured, as at present;

3. what survey method should be adopted in villages and other areas where physical boundaries are not visible on the rectified photomap: the existing second class survey method for NS4 surveys will continue;

4. what scale of aerial photography should be adopted for the 1:4000 mapping: photography will be at scale of 1:12,500, with flight lines 2,000 m apart, over the centres of the future 1:4000 map sheets. The spacing of the photographs will be 1,000 m, or a 60 per cent end lap, so that every alternate photograph will be centred over a map sheet area. As an extra precaution, 80 per cent end laps could also be flown;

5. what control network and co-ordinate reference system should be adopted—should the existing system based on 29 local origins continue: the project will adopt the UTM co-ordinates of the national first order network as the basis for all positions. Using modern technology, Doppler satellite position fixing for major control, and EDM and theodolite traverses to extend the control. U.T.M. positions will be determined where required:
(6) which methods should be adopted for 1 : 4000 mapping: The full range of options was reviewed. A system similar to the present system, rectified photomaps, will be adopted. Methods for controlling the rectification were considered with control by photogrammetric block adjustment seen as the optimum choice. Control by field techniques will be used in the short term;

(7) which photogrammetric instruments should be used: stereo-comparators, analogue plotters and analytical plotters were considered. The analytical plotter was chosen as the most suitable instrument for aerial triangulation measurements, because it will be the fastest and most cost effective, and being a recent development, it should be well supported by the manufacturer; and

(8) whether to use a large central computer for the system or provide separate computers for the different operations: the Department of Lands decided that the latter approach will give the greatest flexibility and independence and will provide the most effective system.

**Urban Mapping**

Although cadastral mapping in urban areas has its primary function as a record in the land registration system, it has important uses in many other aspects of land administration and particularly in land valuation. As has been mentioned, cadastral plans in Bangkok and other urban centres are generally in an unsatisfactory state and not able to fulfill these functions.

As a result it is planned in the project to include a complete remapping of the urban areas. Bearing in mind cost factors and the large number of sheets to be surveyed, it has been decided to use rectified air photographs as the basis for overlays which will form the cadastral sheets, as in rural areas.

It is estimated that 7,000 map sheets will be required at scales of 1 : 1000 and 1 : 500. A 1 : 1000 sheet will cover an area of 500 m by 500 m. Bangkok will require some 4,400 sheets, two-thirds of which will be at 1 : 1000, and the remainder at the larger scale. Air photography for the 1 : 1000 mapping will be at a scale of 1 : 5000 and will be taken using a special long focus lens (305 mm) to minimise the lean-over effect of buildings at the edges of photographs.

Wherever practicable the control for rectification will be by block adjustment, with ground control provided by EDM traverse. There are some parts of the Bangkok metropolis where even EDM traverses would be impossible, because of heavy traffic and crowds of pedestrians. Inertial surveying systems might be considered for control in these areas.

Production of the cadastral overlays will be by office compilation, using the extensive and essentially complete records in the Land Offices. This will need to be supplemented by ground surveys in some areas where the densities are high and the boundaries complex.

After a period for developing the systems and providing control, urban cadastral maps should be produced in full numbers by the fourth and fifth years of the project. A rate of production of 1,000 sheets per year is planned, and the operation should be complete within ten years.
Because of the rapid rate of urban development, it is essential that an efficient routine be set up to record all new subdivisions on the cadastral sheets. In addition the photography and rectification of the base photomaps will have to be repeated at intervals which will vary in different types of urban areas. In areas of very rapid development this interval may be as short as ten years.

It would be desirable for the urban mapping programme to be completed ahead of the national programme of valuation of land and property, so as to make up-to-date urban maps available for the valuation programme. Unfortunately, this will not be possible, but the mapping needs for valuation will have to be given due weight when assigning priorities for urban cadastral mapping.

**LAND ADMINISTRATION COMPONENT**

The aim of the programme is to map all land parcels outside the forest reserves, whether private or government land, and to issue title deeds for all privately owned parcels. The decision to issue only one form of title involves a substantial reorganisation and decentralisation. This arises because present district Land Offices handle only certificates of utilisation, and these certificates are being phased out. Under the land titling programme, as a province is covered, each district Land Office will take over the handling of the title deeds and State land certificates of all land parcels in its own district.

The area to be covered during the five-year project will comprise four provinces of the North-eastern Region and five provinces of the Northern Region. As the mapping and surveying progresses, complementary processes of land administration will be carried out. For land parcels being newly surveyed and mapped, land adjudication and administration staff form part of the surveying team, whose task culminates in the issue of title deeds. Other land administration components in the project are:

1. as the new cadastral mapping is completed, issuing title deeds to replace NS3K certificates;
2. arranging for transfer of the appropriate title deeds from the provincial Land Office to individual district Land Offices;
3. construction and expansion of district Land Offices, providing them with additional staff, staff housing, equipment and furniture;
4. construction of strong rooms for the safe storage of records in Land Offices outside the project area; and
5. moving three of the four Bangkok metropolitan Land Offices out of the Department of Lands headquarters complex to new buildings within the metropolitan district covered. Some of these buildings are already under construction. The space provided at the headquarters site will be used for a new building for surveying and mapping.

**VALUATION OF LANDED PROPERTY**

Land valuation has strong links with the land record system since both deal with land parcels as their basic units and require cadastral plans as basic tools.
This was recognised when the Central Valuation Authority was established in the Department of Lands in 1981.

In Thailand, land and property taxes are fixed at the same rate throughout the country. Two property taxes are levied locally, one based on land value and the other on annual rental value. When properties are transferred, the transfer fee and stamp duty, amounting to 2½ per cent of the declared sale price, must be paid. Since 1982 a “Tax on Immovable Property” has been levied under the Income Tax System. It is based on the declared sale price but the rate varies according to a complicated formula.

The sale prices and rentals declared by the property owners are widely used as the basis for taxes, but under-declaration is a common practice, with few officials qualified to challenge the declarations. In property valuations the methods applied are seriously deficient in many respects. With minor exceptions, there are no complete property rolls and as a result an enormous number of taxable properties are not taxed. These problems all stem from the basic fact that there are few qualified or experienced real property valuers; that property valuation, as a profession, barely exists in Thailand.

The RTG has recognised for some time that there are serious shortcomings in the system. Besides establishing the Central Valuation Authority, now known as the National Valuation Authority (NVA), it has set up a programme to assist local authorities in improving their valuation procedures, related to the UNDP-sponsored Regional Cities Development Project.

Clearly the NVA is faced with an enormous task. It is called on to provide valuation rolls for all local authorities, yet neither qualified personnel nor base maps are available for the task. Components of the land titling project are directed at filling these needs, but the solution will take some time. There is a strong incentive, since an equitable property taxation system can effectively redistribute the extreme inequalities of wealth which exist in Thailand and channel investment into productive public activities.

Within the project, components related to land valuation include:

1. technical aid, training and education. Provision is made for overseas consultants who will assist in drafting new legislation and in setting up in-house training programmes. A technical college course in valuation will be established and staff will be sent overseas to gain tertiary qualifications in valuation. These measures can be seen as the first steps in establishing a valuation profession;

2. building up the NVA. Provision has been made to improve the structure and increase the staff and facilities of the Authority; and

3. mapping. The urban mapping programme will take ten years to complete. The valuation programme cannot wait, so as an interim measure it has been proposed that unrectified air photos at appropriate large scales should be used as basic reference maps.

Since it will take some time for the NVA to build up its resources and capabilities, local authorities will continue to undertake valuations. The NVA will take on an advisory role, and will develop standard methods, for example standard field sheets and methods of referencing. Eventually it will be able to take over the tasks
of providing the local authorities with valuation rolls, and keeping them up to date.

**Conclusions**

*Achieving the Programme's Aims*

The Department of Lands, assisted by the aid agencies and consultants, has studied the goal of the programme, to issue title deeds to all landholders, and has investigated methods of achieving it. The Department has concluded that, given the assistance requested, it should indeed be possible to achieve the goal within 20 years. This will be done by building up the capabilities of the Department, initially assisted by a World Bank loan and an ADAB grant. The project will involve developing and extending existing procedures, increasing staffing levels in key areas and adding new technology in control surveys, cartographic transformations and computing.

Some procedures will remain virtually unchanged. For example, the present second class surveys and adjudication for titles are effective and will continue to be used, though the number of field parties will be greatly increased. Corners of parcels will still be monumented, but the procedure of numbering each monument and marking the numbers on the plans will fall away.

The programme will proceed systematically, covering a selected group of provinces in each year. The operation will start with the air photography and survey of control, in the year before the province is to be covered. New control will be surveyed and new rectified photomaps produced at 1 : 4000. The cadastral overlays will be compiled from several sources:

1. for parcels which already have title deeds, boundaries will be transferred from existing 1 : 4000 maps;
2. for NS3K parcels, boundaries will be transformed by matching detail from unrectified 1 : 5000 photographs. Digital work stations with computer graphic capabilities will be used; and
3. unmapped parcels and areas where details are obscured on the photographs will be surveyed by ground methods and adjudicated. Where required by the density of detail, larger scale maps, at 1 : 2000 or 1 : 1000, will be compiled.

New title deeds will be issued, at no cost to the owners, to holders of certificates of utilisation and to owners of undocumented land. Government land will be recorded and State land certificates prepared in a format similar to title deeds.

Decentralisation of Land Office functions will take place at this stage. Each district Land Office in an affected province will take over the handling of records of all parcels in its district. These include existing title deeds and other records held in the provincial Land Office, as well as the newly issued title deeds and records. New Land Offices will be built or existing Offices upgraded, and additional staff and equipment provided as required by the volume of records. A new building will be constructed at the headquarters site in Bangkok to accommodate surveying and mapping operations.

*Implementation*

Support for the above programme will be in the form of external financing, through the World Bank loan, for new buildings and improvements to existing
buildings; equipment for field surveying, mapping and land administration; and vehicles, in support of survey and adjudication operations. This will amount to nearly 50 per cent of the total cost. Technical assistance in photogrammetric mapping, management reviews and support, and advice and training in valuation is expected to be provided in the form of bilateral aid from ADAB. Costs of a non-capital nature, such as salaries and materials, will be covered by “counterpart funds” provided by Thailand.

It is expected that in the first year of the project the organisation and management will be reviewed, major equipment items will be purchased and the contracts let for the major buildings. Construction will take place mainly in Years 2 and 3 of the project, and the accelerated programmes of cadastral mapping and titling will get underway in Year 3.

By improving Thailand’s cadastral system and the security of tenure for landholders, the programme should lead to many substantial benefits, including:

1. fewer land disputes;
2. a more ordered land market;
3. increased incentives for productive investment;
4. improved access to credit;
5. quicker land acquisition for government and private projects;
6. more efficient land administration;
7. improved cadastral information;
8. rationalisation of coordinate systems for cadastral mapping;
9. more equitable property taxation; and
10. uniform and complete property value information.

**Author’s Note (February, 1985)**

Since 1983 when this paper was written there have been some changes in the proposals, brought about by altered circumstances or by more detailed study. For example, the Royal Thai Survey Department no longer has planes for aerial photography, so this will be flown by contractors chosen by competitive bidding. Because of building height restrictions at the Department’s headquarters the new surveying and mapping building is being constructed on another site. Investigations have shown it is possible to produce four 1:4000 photomaps per photograph, using smaller scale photography, high resolution film, and a greater enlargement.

The World Bank completed arrangements for the loan to the point where the project was able to start on 1 October 1984, coinciding with the beginning of Thailand’s fiscal year 1984-85. The Australian Development Assistance Bureau (ADAB) agreed to provide funds for the technical assistance component of the project in 1983, and began an exhaustive process to select the consultants. In August 1984 they announced that the consultancy had been awarded to a group headed
by BHP Engineering and including Unisearch (owned by the University of New South Wales) and three other consulting firms. The group will field a team of 40 advisers, who will be in Thailand for periods from five years down to a few weeks, with about a dozen team members in Thailand at any one time. After an Inception Study in November 1984, the team is starting work in Bangkok in March 1985. The authors of this paper are involved, one, full-time, as Project Coordinator and Planner (PVAL) and the other as Project Adviser (IPW).

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