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COUNTRY REPORTS

THE TECHNICAL COOPERATION IN MAPPING, CADASTRE AND GEODESY

Submitted by Finland **

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The Technical Cooperation in Mapping, Cadastre and Geodesy

by the Government of Finland

by

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Abstract

The Government of Finland, within the Development of International Co-operation in the area of Asia and Pacific has been involved in several projects during the recent years. The Government of Finland and each of the recipient country have jointly financed the projects. Local government agencies and Finnish private consulting firms, supervised in many cases by the National Land Survey of Finland, have carried out activities. Latest projects to mention:

- Lower Mekong River Hydrographic Atlas covering the riparian countries Thailand, Lao PDR, Cambodia and Viet Nam
- Nepal topographical mapping 1:50000 / 1:25000, covering the whole country
- Southern quarter of flood plains of Bangladesh
- Vientiane Plain large scale topographical mapping
- First systematic land registration of Cambodia

Many of the projects have multiple targets. For example 40000 km² coastal zone mapping of Bangladesh with 25 cm contours provides a useful tool for the disaster management. Two last projects in Lao PDR and Cambodia are discussed more in details in this paper are well covering the approach for GIS.

Further more the Finnish Government and the National Land Survey has been co-ordinating the inscription of "The Struve Geodetic Arc" into the UNESCO World Heritage List. The joint project of ten countries along the Arc is commemorating the history of geodesy and surveying. The surveying was done in 1816-1855 to determine the shape and size of the Earth.

TOPOGRAPHICAL MAPPING OF VIENTIANE PLAIN AND SECONDARY TOWNS IN LAO PDR

Digital Large Scale Mapping based on High Resolution Aerial Photography

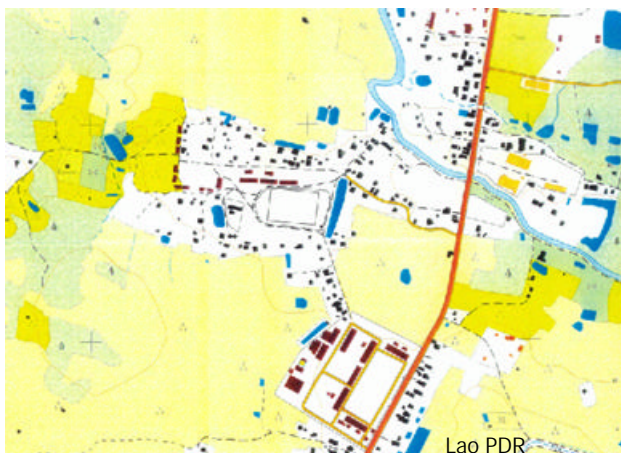
Because of the urgent need for geographical information, the Government of Lao PDR asked the Government of Finland to assist in the topographical mapping of the Vientiane Plain and in building up sufficient capacity to update and produce maps in Lao PDR. Existing topographical maps were old and outdated and the aerial photo coverage was limited. The first phase was to cover Vientiane Plain.

Vientiane Plain is a lowland area along the Mekong River, including Vientiane town and surrounding agricultural land with a high population density. Secondary towns are Savannakhet, Luang Prabang, Thakhek and Pakse in Lao PDR.

The main target was to use the information to increase the rice field area, design of detailed irrigation schemes, improve the land use planning, roads design and construction, and support the land titling etc that all needed large scale maps.

The mapping and produced reliable data was estimated to enhance the future development of Lao PDR regarding the environment, natural resources as well as planning of the infrastructure and agriculture. The future economic potential was largely estimated to concentrate on the capital and the surrounding plains.

The project was financed by the Government of Finland, and National Land Survey of Finland (NLSF) was monitoring and supervising the project on behalf of the Ministry for Foreign Affairs of Finland.



The result, the digital topographical map has the following digital data "layers" and attribute data:

contours of elevation with 1 m contour interval and spot heights
road network with road classification of width and paving situation and accessibility
administrative boundaries, province / district boundaries
buildings classified by use, private / public / commercial / industrial buildings, schools, monasteries,
water towers, power / gasoline stations, hospitals
vegetation / land use information, such as rice field, rocky / sand areas, swamps, sparse / dense
forest, bush / bamboo / grass land, plantations, orchard with growth like teak, eucalyptus, banana,
coffee, kapok, sugar, pineapple, papaya



Each of the layers (indicated by different colour or symbols) can be presented together or separately on computer screen or printed out.

The project activities included institutional development to improve the National Geographic Department capability to coordinate the development and production in the mapping and surveying sector and to be able to produce, maintain and supply maps of national interest.

It also included the development of NGD towards a self-supporting organization to help to finance part of its operations by sale of its products and effective management training aiming to modernizing the administration and management of the NGD. The key issues are long and short term operational planning, budgeting and accounting, expenditure control, business development, marketing, organizational and personnel management and the development of a Quality Management System.

Capacity building of the production units including training programme and continuous on-the-job training during the process of large scale digital mapping of the Government's priority area, Vientiane Plain.

Main figures of the Topographic Mapping of Vientiane Plain, Lao PDR / Finland:

Project period:	1999-2003
Mapping area:	Vientiane city and province, secondary towns
Size of mapping area:	3600 km ²
Scale of aerial photography:	1:15 000
Number of photographs and contact prints:	1200
Number of GPS ground control points:	300
Number of precise levelling points:	100
Project Implementing:	Government of Lao PDR, Prime Minister's Office, National Geographic Department (NGD)
Donor:	Government of Finland

CAMBODIAN SYSTEMATIC LAND REGISTRATION

Participation and Modern Technology Supporting Cost-Effectiveness

Background

During the Pol Pot rule (1975-79) and the following ten years period the structures of normal state were and remained demolished. Land related records were destroyed, private ownership was abolished and the profession of surveyors ceased to exist.

In the post-war situation of Cambodia the clarity of land ownership was considered as one of the key issues on the way to national stability. When private ownership was re-introduced in 1989, 4.5 million applications were filed at Cadastral Offices across the country. In mid 1990's the Royal Government started to develop a systematic land registration system suitable to Cambodian conditions and circumstances with technical assistance from the Governments of Finland and Germany, who to date still remain as the key development partners in the land registration sector of the country.

The activities related to the securing the land ownership have received a wide support of all stakeholders in Cambodia. And indeed, when 80% of the population obtains their livelihood from agriculture, the land related issues are regarded as one of the cornerstones of the development of the society.

It can be clearly seen that the increased security of land tenure has a direct impact on the development of social and economical conditions in the country.

Cadastral Mapping and Systematic Land Registration

On a request by the Government of Cambodia the Ministry for Foreign Affairs of Finland initiated a long-term development of the systematic first registration suitable to the Cambodian conditions in 1997. The work included the development and considerations of the legal framework, land registration process, surveying techniques and cadastral mapping, which were tested and finally adopted in the Provincial Cadastral Offices. The first five years the National Land Survey of Finland (NLSF) was monitoring and supervising the technical assistance work (FINNMAP). At the same time the Government of Germany (GTZ) had parallel land-related project activities, which were closely coordinated with the Finnish support to land registration development.

In 2002, initiated by the Cambodian Government the two projects were converted into a large World Bank, Finland and Germany financed Land Management and Administration Project (LMAP). The project is largely based on the experiences gained and techniques developed during the earlier projects. Presently the project covers large areas of most productive agricultural land and most populated areas of Cambodia.

The aim of LMAP is poverty reduction, stabilisation of the society and securing the economy of the country. The emphasis of the project is to secure the land ownership and efficiency of the land market. On practical level the project emphasizes to good governance, reliable public sector operations and legal praxis to secure human rights and real estate ownership. The project goals are

consistent with the development cooperation strategy of the Government of Finland: poverty alleviation, environmental protection, social equality and good governance.

First five year a program of the LMAP covers five components of the key areas of Cambodian land sector; 1) land policy and land law, 2) institutional development, 3) land registration campaign and development of modern registration, 4) land dispute resolution, 5) land management.

For the financing of the needed procurement and field activities, Cambodian government was granted a loan by the World Bank. Grant financing by the Governments of Finland and Germany cover the advisory of the practical implementation by bilateral contracts.

The project is presently implemented in 11 provinces where 80% of Cambodians live. Three of the project Province offices are covering the capital Phnom Penh, the coastal city of Sihanoukville and the fastly growing tourist destination Siem Reap where the land values are high.

One of the issues the project is likely to facilitate is to reduce the immigration of people from countryside to the bigger cities. It is estimated that by improving livelihood in the rural areas the population will prefer to stay in the countryside, rather than flee to urban areas.

The project component 3 is supposed to register one million parcels in five years and hand the land title certificate to the legal landowners. Besides that the project is aiming at the normal operation of the land register after the first registration, updating the changes in ownership and doing land surveys. There are 800 trained and equipped officers in the Ministry doing adjudication, demarcation and surveying in the field and others compiling the cadastral index map, organizing the public displays and preparing the cadastral and land registration database and final title certificate issuance.

Ministry for Land issues

In 1998 all land issues from mapping to land management were collected under a new ministry: Ministry of Land Management, Urban Planning and Construction, which was the first important step in organizing the land related matters in Cambodia.

At the same time from 1998 the strategy for the land policy, preparation of land law and sub-decree for the first registration were taken under consideration. Sub-decree was approved in early 2000 giving a boost to the official registration. Land Law came into effect in 2001. Land policy was accepted in 2002 at the same time with the starting of the LMAP. Presently the management of the state lands is under consideration.

Systematic First Land Registration in Cambodia has been based from the very beginning on efficient information campaign, participation of citizens and on modern surveying techniques: From the beginning to the end with people.



After the declaration of each registration area the people within the area are informed about their role, rights and obligations during the registration process.

In the field the adjudication will take place first to clarify who owns what, shown concretely by demarcation of the new boundary lines and by surveying the parcel to have the size and shape to be recorded and compiled in the

office on cadastral index map. The demarcation is done in the presence of the landowners and the village chief, who is normally well aware of the situation within his village.

Orthophoto has been found to be the most economical, simple and fast way to identify the boundaries between the parcels. According to the experience gained the orthophotos are also easy to understand by the people. Still in the locations where the terrain is covered by trees the surveying has to be made by total station. Highly priced land areas are surveyed by total station due to higher accuracy requirements. Both methods (orthophoto interpretation and total station surveys are based on GPS ground control and lead to the coordinate information that can be entered into digital database).



A Public Display of 30 days will give the new owners an opportunity to see the final cadastral index map and related documentation and check and comment, possibility to make an appeal to change what has been decided. The appeal will be considered by the Administrative Commission.



Access to land

Undisputed 5 year presence will give an access to the title. The transparency of the system with information and awareness campaign and public display and good cooperation of the local officials is the key for success and small number of complaints.

With the goal of one million parcels methods of latest technology are a must and a roadmap to success. The digitalization is not serving only land registration but will also support the creation of a base for spatial infrastructure that will benefit the development of all sectors of the nation, especially when the data will be available for all. The fees for data and data handling will on the other hand provide a beginning for the cost recovery of state agencies and even create new enterprises.

In Cambodia the land registration fees are low and are as such adding the popularity of the registration. The average cost per title in Cambodian systematic registration is at the moment 9 USD.

The benefit of the LMAP is not only in land registration, but it has seen also a mean to educate large populations to the obedience of the law and democracy. Decentralization is advancing and responsibilities in land registration have been delegated to the provinces.

Project itself is run by the Cambodians who have been fully responsible from the beginning. Technical Assistance provided by the Government of Finland has been beneficial for both parties. Long presence of the consultant company FINNMAP within the country and region has been an asset in steering the land registration together toward s the direction where it is running well today.

Main figures of LMAP, TA Finland, July 2006:

Project provinces:	11
Project districts:	26
Project communes:	144 (completed, ongoing and planned)
Project villages:	1,308 (completed, ongoing and planned)
Project personnel:	Central level 100, provincial level 700, trained, equipped, supported and supervised by LMAP
Technical assistance project personnel:	FINNMAP, average 10 long-term international, regional and local advisors plus short-term Experts
Parcels processed/under process for registration and title certificate issuance:	763,000 (incl. pre-LMAP CCP 81,000)
Production per month:	25,000 parcels
Average cost per parcel:	USD 9
Target in 5 years:	Fieldwork for 1,000,000 parcels, title issuance for 800,000 parcels
Target duration for title issuance:	5 months/village
Digital orthophotos produced by LMAP:	around 60,000 km ² (all blocks' total area)
Digital orthophotos procured and quality controlled by LMAP:	around 199,500 km ²
Ground control points established under LMAP:	total 3,580 - geodetic network points (I-, II, III-order): 629 - photopoints for orthophoto production: 533 - pair points for surveying at village level: 2,418

SURVEYING, A CULTURAL ACTIVITY

Inscription of the Struve Geodetic Arc on the World Heritage List

Abstract

The Struve Geodetic Arc has been inscribed on the UNESCO World Heritage List on July, in the 29th Session of World Heritage Committee in Durban, South Africa. In many respects this nomination and inscription has been exceptional: the Struve Geodetic Arc is the first real multi national proposal in the history of the UNESCO World Heritage, i.e. nomination of ten countries, i.e. Norway, Sweden, Finland, Russian Federation, Estonia, Latvia, Lithuania, Belarus, Republic of Moldova and Ukraine, and as well the first one, which is based on the history of Science.

An arc measurement has been defined as a method for determining the size and shape of the Earth by measurement of the length of the arc of triangulation and the astronomic coordinates of the ends of the arc. The Struve Geodetic Arc is a chain of triangulation survey stretching more or less down the 25° E line of longitude from Hammerfest in North Norway on the Arctic Ocean over 2,820 km south to Ismail on the Black Sea in Ukraine. The Arc was set up and measured from 1816 to 1855. The goal was to determine the dimensions of the Earth, its shape and size.

The Struve Geodetic Arc is one of the foremost scientific and technical achievements of its time. The Arc would add to the diversity of the properties on the World Heritage List and has truly universal significance. And at the same time it is a “cultural arc” from the achievements of the former generations to our days survey discipline.

1. Arc Measurement

An arc measurement has been defined as a method for determining the size and shape of the Earth by measurement of the length of the arc of triangulation and the astronomic coordinates of the ends of the arc. An arc of meridian is a line that runs in the true North-South direction.

Theoretically, a degree of latitude is a constant and would have the same value at the equator as at the pole. But already Isaac Newton believed that the Earth was slightly flattened at the poles. This question of the shape and size of the Earth inspired the astronomer Friedrich George Wilhelm Struve (1793-1864) to come up with his famous Meridian Arc measurement.

2. Struve Geodetic Arc

Struve was born in Altona, Holstein. He graduated in philology from Dorpat and worked at the University Observatory. By the age of 20 he became Professor of Mathematics and Astronomy at Dorpat. He was the founder of Pulkovo Observatory and the director of the Observatory.

The Struve Geodetic Arc is a chain of triangulation survey stretching more or less down the 25° E line of longitude from Hammerfest in North Norway on the Arctic Ocean over 2,820 km south to Ismail on the Black Sea in Ukraine. The Arc was set up and measured from 1816 to 1855.

The scheme of the Struve Arc included 258 main triangles with 265 main and over 60 subsidiary station points. The goal was to determine the dimensions of the Earth, its shape and size. In today's geography it passes through ten countries, i.e. Norway, Sweden, Finland, Russian Federation, Estonia, Latvia, Lithuania, Belarus, Republic of Moldova and Ukraine.

3. Preparation of the nomination

This exercise to have the Struve Arc in the World Heritage List has been long and exceptional. The idea for seeking a declaration to preserve the remaining Struve Arc points as a World Heritage site was originally presented in a Struve Conference in Tartu 1993 in the paper prepared by Mr Aarne Verio, a geodesist from the National Land Survey of Finland.

The resolution made in that conference was as follows:

"Considering the scientific, historical and practical importance of the measurement of the arc of meridian through Tartu, made by F.G.W. Struve,

Urge the governments of those countries that still possess relics of that enterprise to take all possible steps to preserve those relics, including an approach to UNESCO to declare them to be World Heritage sites."

A corresponding resolution was then made at the Congress of the International Association of Surveyors (FIG) at Melbourne in 1994 initiated by the former Deputy Director General of the National Land Survey of Finland, Dr Seppo Härmälä.

Since 1993 the National Survey Organisations within the countries of the Struve Arc and the International Federation of Surveyors has been working on a project of the Struve Geodetic Arc as a UNESCO World Heritage site.

The ten countries have jointly carried out the preserving activities of the Struve Geodetic Arc and supported the preparation of the documentation to recognise the Struve Arc on the World Heritage List. The National Land Survey of Finland coordinated the whole work from the very beginning, because one third of the points are situated in the Finnish territory and because the idea was originally presented by Aarne Verio.

The National Survey Organisations in the countries have been in charge of the preparation under the supervision of the national Cultural Heritage Organisations. It is by this process that the document - "Nomination of the Struve Geodetic Arc for inscription on the World Heritage List" - was prepared according to the guidelines of the World Heritage Centre.

Many international organisations, such as the International Federation of Surveyors (FIG), the International Association of Geodesy (IAG), the International Astronomical Union (IAU) and EuroGeographics, have been active in supporting the preservation of the Struve Arc and advocating its submission for the World Heritage List.

4. Inscribing of the Struve Geodetic Arc on the World Heritage List

In its evaluation report ICOMOS, the advisory body to World Heritage Committee, stated within the comparative evaluation:

"There were earlier arcs than the Struve and there are longer ones now. The Struve Arc though was the longest and most accurate when created and the longest for more than a century. It was the first for which special equipment was created and the first one crossing several countries."

Furthermore ICOMOS described the outstanding value of the Arc as follows:

"The Struve Arc has certainly Outstanding Universal Value, based on its contribution to the development of sciences, and collaboration amongst scientists, monarchs and nations. ICOMOS believes that this nomination has an added value, being based on technological-scientific values and being submitted by ten state parties together."

The World Heritage Committee unanimously agreed in July, 2005 to inscribe the Struve Geodetic Arc on the World Heritage List on the basis of criteria ii, iv and vi:

Criterion ii: "The first accurate measuring of a long segment of a meridian, helping in the establishment of the exact size and shape of the world exhibits an important step in the development of earth sciences. It is also an extraordinary example for interchange of human values in the form of scientific collaboration among scientists from different countries. It is at the same time an example for collaboration between monarchs of different powers, for a scientific cause."

Criterion iv: "The Struve Geodetic Arc is undoubtedly an outstanding example of technological ensemble –presenting the triangulation points of the measuring of the meridian, being the non movable and non tangible part of the measuring technology."

Criterion vi: "The measuring of the arc and its results are directly associated with men wondering about his world, its shape and size. It is linked with Sir Isaac Newton's theory that the world is not an exact sphere."

5. Preservation of the Struve Geodetic Arc

The ten countries through which the Arc passes have co-operated since 1994 for the recovery, verification and monumentation of the survey sites of the Arc.

The selection of points inscribed on the List involves a total of 34 sites of the Struve Geodetic Arc. They are located in the ten countries referred to above. The number of points in each country varies from one to six depending on the original number of points and whether the points have survived to the present day.

In each country, only the most prominent sites have been selected, for example, the Tartu Observatory in Estonia and Alatornio Church in Finland. These two are buildings that were used for observation, and both have remained unchanged since the measurements. Also both terminals, i.e. Fuglenaes at the Arctic Ocean and Staro-Nekrassowka near the Black Sea, are included.

The 34 sites selected will together represent the Struve Geodetic Arc. Other preserved sites of the Arc have, however, been protected nationally.

6. Maintenance Management

Now after the inscription the main objective of the participating State Parties is, by stages through co-operation in the Coordinating Committee, to create rules and good practice to preserve and sustain the World Heritage “Struve Geodetic Arc”. The aim is based on Arc’s proper protection, conservation, management, presentation and understanding. The selected 34 properties will present the whole chain of triangulation survey called the Struve Arc. Besides these selected points, also other survived points will be preserved according to the normal national practice of the country concerned.

The basic responsibility for all kind of management and actions of individual properties must be taken by the individual State Parties and be carried out by each of them in accordance with their legislative and management systems. The role of the Coordinating Committee is to produce common guidelines for management, to monitor the progress of preservation of the sites.

7. Conclusions

The Struve Geodetic Arc as the whole is one of the most prominent scientific and technical achievements of its time. The Arc would extend the diversity of the sites on the World Heritage List. It is truly of universal significance. The Struve Geodetic Arc can be called as a cultural survey monument. Not only due it’s preserved sites inscribed on the World Heritage List but also due the very detailed documentation of the activities and original observation documents made during Arc measurements and preserved in the archives.

The Struve Geodetic Arc has already during almost 200 years’ time connected countries from the Black Sea to the Arctic Ocean and will connect them also in the future having now the status of the UNESCO World Heritage.

More information:

<http://www.maanmittauslaitos.fi/default.asp?id=0&docid=3175>

<http://whc.unesco.org/en/list/1187>

