

COST OF PHOTOGRAMMETRIC AND CADASTRAL SURVEYS FOR THE COMPILATION OF THE HELLENIC CADASTRE

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ABSTRACT

The use for many years of inadequate data for the definition and the transfer of property, like the lack of updated/proper topographic plans, the lack of unique specifications for the topographic plans that accompany ownership contracts, the lack of guarantee of titles etc, has created a complex situation, making the task of establishing the Hellenic Cadastre extremely difficult. Even in comparatively small areas of Greece where a cadastral system has been established since the 1920's, many problems have been created due to the old legislative status still in force, the lack of updated cadastral maps, the lack of personnel and the use of non-computerised techniques.

Among the many other parameters which should be determined for the efficient planning of the National Cadastral System as a simple and clear system, easily accessible and providing security of tenure, and current and reliable information at low cost, is the estimation of the cost of the whole work, both for the establishment and for the maintaining of the cadastral system.

In this paper a brief description of the whole project of the Hellenic Cadastre is given and an analysis of the cost of its establishment and maintenance is attempted. Then, an estimation is made of its direct income during operation and a rough estimate is given for a cost-recovering perspective.

1. INTRODUCTION

Greece has tried many times to establish a National Cadastral System (N.C.) but unfortunately has not yet managed to device and operate a reliable system. Now Greece is making a new effort to establish uniform cadastral system for the entire country.

Until now all the legal rights concerning land (surface, subsurface resources, buildings etc), such as land ownership, lease, mortgage, charge, easement, seizure, claiming etc, are registered and available but not guaranteed by the approximately 400 Mortgage Bureaux which are functioning throughout Greece; some of them since 1856. In parallel, cadastral bureaux were established and operate in comparatively small areas of Greece:

- the Island of Rhodes in Southern Greece (area of 140,000 hectares)
- the Islands of Kos and Leros also in Southern Greece (area of 30,000 hectares)
- a district of two counties in the vicinity of Athens (area of 1,200 hectares).

In July 1994 the Ministry of the Environment, Physical Planning and Public Works of Greece and the European Union (E.U.) ratified a proposal for the establishment of the Hellenic Cadastre. The proposal was prepared by the Hellenic Mapping and Cadastral Organization (HEMCO) in collaboration with the Technical Chamber of Greece and the National Union of Surveyors. According to this proposal, the N.C. is designed to be a modern Land Information System which will improve the efficiency of land transactions and guarantee land tenure. In addition, it will provide all levels of information to both the private and the public sector, necessary for land development, urban and rural planning, agricultural policy, land management and environmental monitoring. Some of its main features are, that it will

- secure publicly owned land, which is estimated at a minimum value of a trillion drachmas (about US\$ 4 billion)

- create about 2,000 new employment positions per year of its establishment
- eliminate costly and time-consuming paper-work and bureaucratic procedures
- facilitate the detection of fires and illegal building, which are matters of vital importance to Greece.

The project is considered to be among the most significant projects executed in Greece in recent years. During 1995, cadastral surveys began in 66 municipalities, which belong to 30 out of the 54 prefectures of the country. They cover an area of 0.22 million hectares, with an outlay of 7 billion drachmas (about US\$ 30 million). They refer to both urban and rural areas, areas of special natural beauty and environmental interest, including wetlands with extensive flora and fauna. For the time being the project is financed partially by the E.U. (75%) and partially through governmental funding (25%). The total of the available funds for the next 5 years for the compilation of the N.C. project is US\$ 200 million, which is equivalent to 50 billion drachmas. However, the future strategy is to achieve financing more directly from the users, by selling titles, from transaction duties and from the purchase of digital data by the private and public sectors.

In the following, an attempt to estimate the total cost both for compilation and for maintenance is made and an estimate of cost-recoverability is given, not taking into account the forementioned available funds already existing.

2. COST ANALYSIS FOR THE ESTABLISHMENT OF THE HELLENIC CADASTRE

2.1 General Considerations

According to the technical specifications drawn up by HEMCO the compilation of cadastral maps of urban and suburban areas will be based on topographic maps on a scale of 1:1.000, which can be (alternatively):

- a. photogrammetric maps in digital form

- b. topographic diagrams, produced by field surveying methods, in digital form
- c. existing reliable topographic diagrams
- d. existing reliable cadastral maps, which have been produced during related activities (i.e. Urban Planning Implementation Acts etc).

The compilation of cadastral maps in rural areas will be based, according to the terrain relief and the available topographic diagrams, on a scale of 1:5.000, which can be (alternatively):

- a. photogrammetric diagrams in digital form
- b. digital orthophotomaps
- c. existing reliable topographic diagrams
- d. existing reliable cadastral maps

The series 1:1.000 and 1:5.000 cover one third of the total land surface of the country.

The cadastral maps of the rest of the areas will be based on maps at a scale of 1:10.000 or 1:20.000.

The basic principle in the philosophy of the technical specifications, which will govern the execution of the cadastral work for the N.C., is the clear description and objective moderation of the final product, not the description of the methods to be used in its production. It is the emphasis on product rather than method, which contrasts with topographic surveying works in our country at the present time (e.g. P.D. 696/74, various ministry decisions etc). HEMCO has selected the degree of accuracy and the content of the final cadastral diagrams, entrusting to the responsible agency (private firm / company / surveyor etc) the choice of the methods and instrumentation to be used to achieve the desired results. Naturally in all cases a ratification will be needed.

Greece is among the countries where survey works are estimated and paid for at fixed prices and are not based on tenders. This arises from the assumption that survey works are scientific works where competition is not desirable because it may result in poor execution.

This situation has created several problems since, according to the specifications for every kind of work involved in the project of the compilation of N.C., fixed price approved by the Ministry of the Environment, which is responsible for public works and public surveying and mapping, had to be defined.

One serious and constant problem in the application of this particular system of payment for works is the tardiness of the Ministry in producing new fixed prices for works related to the new technologies, for special works that are a combination of technical and other scientific fields (i.e. legal) and for works executed in the past usually by public institutions. Photogrammetric surveys of urban areas or related to satellite images and cadastral work for all types of land are examples of this kind of work.

It is clear then that the compilation of a list of fixed prices, to be applied for pricing the works related to the developing project of the N.C. is very difficult. The list of prices consists of only twenty five prices, most of which relate to photogrammetric surveys and to photogrammetric Cadastral Surveys. The innovation introduced by these prices is that they are related to the technical specifications for the N.C..

The list of prices for the N.C. is completely new for the country and it will be tested during the pilot phase of the N.C. project.

2.2 Cost Analysis for the Compilation of the National Cadastre

The estimate of the total cost for the compilation of the N.C. is related primarily to the total area of the cadastral survey. The determination of the cost is given in unit values per hectare and is based on:

- I. the statistical information concerning the mean landparcel area on rural land, the mean density of buildings on urban land, the mean average of ownerships / co-ownerships in the Hellenic jurisdiction
- II. empirical estimates, derived from experience acquired in the past during the execution of similar works in Greece, concerning the mean average of the disputes submitted
- III. the prices defined in the official price-list for the following works:
 - photogrammetric surveys of various landtypes on scales of 1:1.000 (for urban land), 1:2.000 (rural), 1:5.000 (rural), 1:10.000 (pastures-forests) and 1:20.000 (pastures-forests-other)
 - field and cadastral surveys of special urban, rural and other land
 - processing of ownership statements and the accompanying certificates (titles, transaction certificates, diagrams, etc) and compilation of draft cadastral mapsheets and registers
 - work to be carried out for the processing and judgment of the disputes, submitted by the owners after the first publishment of the cadastral maps and registers, by the first degree committee and the correction of the cadastral survey according to the committee's decisions and the most recent data provided by the Mortgage Bureau
 - work to be carried out for the processing of the disputes submitted by the owners after the second publishment and the judgment by the first and the second degree committee's and the compilation of the cadastral registers and the temporary titles
 - work to be carried out for the transfer of digital data and the creation of the Geographic Information System (GIS)

IV. The estimates offered by the National Statistical Service (NSS) of Greece concerning the municipalities, population, area, land types etc.

In total, under the Hellenic jurisdiction there are 5.900 municipalities, with population approximately 10 million, in area of 13 million he, which consists of :

4 he rural land, 5 he pastures, 3 he forests, 0.5 he urban land, 0.3 he water, and 0.2 he other land types.

For a more efficient approach, the total number of urban areas has been classified into 3 categories according to their population and the rural areas into 2 categories according to the mean landparcel area (MLA).

The estimated cost values, by HEMCO, for various land types are :

- \$ 1,300/he for urban land with a population over 5.000 inhabitants
- \$ 900/he for urban land with a population between 2,000 & 5,000 inhabitants
- \$ 700/he for urban land with a population less than 2,000 inhabitants
- \$ 135/he for rural land with a mean landparcel area 0.3 he
- \$ 100/he for rural land with a mean landparcel area 0.7 he
- \$ 25/he for pastures
- \$ 16/he for forests

In Table 1. is shown the cost estimate for the various land types.

Land types		Area (he)	Cost unit (\$ / he)	Total cost (\$ US)
Urban	P > 5,000	130,663	1,300	169,861,900
	2,000 < P < 5,000	70,037	900	63,033,300
	P < 2,000	319,004	700	223,302,800
Rural	MLA = 0.3 he		135	158,428,440
	MLA = 0.7 he		100	273,826,800
Pastures		5,192,586	25	129,814,650
Forests		3,164,995	16	50,639,920
			TOTAL	1,068,907,810

Table 1. Cost estimate for the various land types

To the above estimated cost for the works mentioned in 2.1.iii., the fee for the presence of one member, from the company/firm responsible for the survey, during the ownership statements' submission and the disputes' first and second publication should be added. This cost is estimated to be approximately \$41 million.

For these expenses there is a taxation charge by the government which accounts for 18%. The total cost for the compilation of the photogrammetric and the cadastral works is:

$\$ 1.069 \text{ billion} + \$ 41 \text{ million} + 18\% = \$ 1.3 \text{ billion.}$

According to previous international experience, the cost of preparation of the cadastral maps and registers accounts approximately to 40% of the overall cost of the establishment of a cadastral system. The other 60% of the total cost includes installation, instrumentation, educational training, personnel, project management, quality control etc. So, the total cost for the compilation of the N.C. is estimated to be \$ 3.25 billion.

2.2. Operational and Maintenance Cost for the National Cadastre

The structure of the decentralised system that will support the N.C. has not yet been decided by HEMCO. Nevertheless, according to the proposal made by the Technical Chamber of Greece and the Union of Surveyors an approximate estimation of the operational and maintenance cost can be made. The system in general may be comprised of a central administrative unit, 13 regional units, and if necessary of 170 local administrative units, 54 of them with full operational structure and 116 of them with limited structure.

The central administrative unit is estimated to need : 155 personnel (60 administrative, 15 legislative, and 80 technicians), a central unit, 20 workstations & 40 PC's, software support, peripheral units (20 printers, 10 plotters, 10 fax), furniture, other. The annual estimated expenses for this unit is estimated to be \$ 4 million (included the annual recovery for the purchase of instrumentation).

The 13 regional administrative units, one for each geographical region of Greece, are estimated to need each :

- 8 personnel (4-administrative/operators, 4-technicians)
- 2 workstations, software, 3 PC's, 5 printers, 2 plotters, 5 fax, furniture, other.

The annual cost for all the 13 units is estimated to be \$2.65 million.

The local administrative units will need:

- 8 personnel (4-administrative/operators, 3 technicians, 1 legislative)
- 4 PC's, software, 3 printers, 1 fax, furniture, etc

which is estimated to be annually for the 54 local units \$11,4 million and for the 116 local units of limited construction \$ 9 million.

To the above estimate some non expected expenses should be added for 10%. So, the total operational cost accounts for \$ 30 million.

3. EXPECTED INCOME FROM THE NATIONAL CADASTRE

Since the procedure for the establishment of the N.C. has already partially commenced, the whole work will also be completed partially. In each region, where the procedure is completed, the operation of the N.C. begins. During this operational and maintenance period the N.C. will start making some profit. This profit will come from two different sources: firstly the recovery charge and secondly the transaction duties, and the indirect income acquired by selling digital geometric data to the private and public sectors.

3.1 Recovery Charge

Once the N.C. is established, it will be able to give the final titles to the owners. On receipt of the Title from the N.C., the owner must pay a "recovery charge" proportional to the landparcel value (land unit value, area of the landparcel, buildings, etc.). This charge is defined to be between min 10,000 drch (\$40) and max 300,000 drch (\$1,225).

To calculate the income from the recovery charge, the number of titles has to be estimated first. Based on the statistical information derived from the N.S.S. of Greece, the total number of buildings (in 1990) was 3,821,175, of which 2,850,517 were registered as dwellings. In the following Table 2. the number of separate dwellings and consequently the number of the titles for this use in the above mentioned 2,850,517 buildings (block of flats) are shown.

Number of buildings	Number of Dwellings per building	Number of titles
2,168,354	1	2,168,354
379,404	2	758,808
164,845	3.5	576,957
80,444	7	563,108
23,087	18	415,566
3,900	33	128,700
30,483	1.5	45,725
Total		4,657,218

Table 2. Number of titles for buildings

The remaining 970,658 buildings are registered under other uses (such as office, store, mine, restaurant, shop,

factory, waterhouse, hospital, clinic, welfare institution, asylum for incurables, almshouse, police station, prison, stable, poultry farm, etc.) and are considered to the correspond to one title each.

The total number of titles (for buildings in 1990) is 5,628,000, so for 1996 there could be 6,000,000 titles, which according to the N.S.S. belong to 3,500,000 landparcels. Knowing that the total number of landparcels in the jurisdiction is estimated to be 15,000,000, it can be concluded that the remaining 11,500,000 landparcels correspond to an equal number of titles for rural or urban parcels which have no building on them.

The total 6,000,000 titles referring to building titles have been classified into three classes. Building of small landparcel value are estimated to be the 30% of the total, where buildings of medium landparcel value account to the 50% and of large landparcel value to the 20% of the total. By considering an average recovery charge for each class, it is given:

$6,000,000 \times 30\% \times 30,000 \text{ drch} = 54 \text{ billion drch} (\$220 \text{ M})$
 $6,000,000 \times 50\% \times 70,000 \text{ drch} = 210 \text{ billion drch} (\$857 \text{ M})$
 $6,000,000 \times 20\% \times 200,000 \text{ drch} = 240 \text{ billion drch} (\$980 \text{ M})$

For the remaining 11,500,000 landparcels without buildings, it is estimated that the 10% of them is barren land, the 30% is of small mean landparcel area, the 50% is the mean landparcel ownership in Greece and the 10% is large ownerships. This classification gives:

$11,500,000 \times 10\% \times 10,000 \text{ drch} = 11.5 \text{ billion drch} (\$ 47 \text{ M})$
 $11,500,000 \times 30\% \times 20,000 \text{ drch} = 69.0 \text{ billion drch} (\$282 \text{ M})$
 $11,500,000 \times 50\% \times 30,000 \text{ drch} = 172.5 \text{ billion drch} (\$704 \text{ M})$
 $11,500,000 \times 10\% \times 80,000 \text{ drch} = 92.0 \text{ billion drch} (\$375 \text{ M})$

In total, it is estimated that the recovery charge will be 845 billion drch (\$ 3.45 billion). Yet, the cost for the collection fees for this charge should be subtracted. These fees will be the 5% of the total, so the final recovery charge will be approximately 800 billion drch or \$ 3.3 billion.

3.2 Transaction Duties

The income of the Cadastral Bureau can be derived from the following sources:

- the right to sell to the owners, cadastral information concerning their ownership. This information can be either documentation certificates such as title copies, mortgages etc, or cadastral diagrams and maps of the ownership
- the right to sell digital data, geometric information (i.e. network information, utilities, roads etc, useful to the local authorities and other agencies) and thematic information (i.e. land uses, land values etc) which will be collected during the compilation phase. The Cadastre could also sell cartographic information of high accuracy for the whole country, such as DTM, orthophotos, orthophotomaps or other products useful for regional planning etc.

The income derived from the transaction duties are comparatively equivalent to the income of the Mortgage Bureau for similar services. According to very recent statistical data, the mean annual average of this profit for the period 1991-1993 was approximately 8 billion drch or \$ 32.5 million, with an increasing tendency, for the whole country. Taking into account that the Cadastral Bureau will provide much more information, i.e. cadastral maps, it is rational to be expected that the income of the Cadastral Bureau will be bigger at least to 15%. This gives a total annual income of at least 9 billion drch or \$ 37 million.

The income of the other sources can not be added to this amount, because there is not yet such decision taken by HEMCO for selling the information to the private and public sector. If this is to be decided there is a need for special legislation about the ownership rights over this information and a cost policy has to be defined.

4. COST-RECOVERABILITY OF THE CADASTRE

According to the international experience, it can be said that traditionally there has been a recognition that the State has the responsibility for the provision of fundamental mapping. So, Cadastral systems are usually financed through government funding. However the general trend in developed countries is to seek financing towards other sources, such as privatisation or cost-recoverability.

For the investigation of the recoverability of the N.C. through the recovery charge, the following consideration has been made.

It is presupposed that the total of the necessary money is acquired through a loan from international banking sources, at a fixed interest rate of 6.5%, repayable in annual instalments.

The amount of money given in the following will be referred to an area of 1 hectare:

- The compilation of the Cadastre will last for 3 years in total and will cost \$ 100. The money for the payment of the responsible companies/firms should be found in three stages: 1/3 at the beginning, 1/3 by the end of the first year and 1/3 by the end of the second year.
- In parallel with the compilation of the Cadastre, the other expenses for the installation, instrumentation etc of a total of \$ 149 will begin: 50% by the end of the second year and 50% by the end of the third year.
- The collection of the recovery charge is expected to start by the end of the fourth year (one year after the completion of the compilation work) and will account to \$ 251 (mean average for the whole country).
- 80% of the owners is expected to be known by the completion of the compilation work for the Cadastre and it is expected that the recovery payment will be completed in three years: 70% of them will pay by the end of the first year, and the remaining 30% of them 10% annually.
- 20% of the owners is expected to be unknown persons (a pessimistic suggestion) and the recovery payment when they appear is expected to be completed: for the 50% of them during the next five years and for the remaining 50% in the next two years after the first five.

According to this consideration the whole system is completed eleven years after the beginning of the cadastral survey. Then there is a remaining deficit of \$ 83 per ha, which accounts to 33% of the total cost per ha for the establishment of the N.C. This amount should be covered by other funding, i.e. governmental investment, so that the N.C. to be completed.

However, the establishment of the system is a "one off" cost which usually is supported by the State. On the contrary the maintenance of the system or the provision of information from the system is more often, internationally based on cost recovery or even designed to generate government revenue.

A simple comparison of the forementioned estimations for the maintenance expenses of the N.C. and the expected income through the transaction duties shows:

- maintenance expenses \$ 30 million per year
 - expected income \$ 37 million per year
- that there is a profit, which accounts to \$ 7 million annually. This amount can be easily invested to reform works, corrections, new instrumentation and very possibly to be increasingly part of the cost recovery programme.

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