

THE PLACE OF PHOTOGRAMMETRY IN LAND REFORM AND CADASTRE IN BULGARIA
LA PLACE DE LA PHOTOGRAMMÉTRIE DANS LA RÉFORME FONCIÈRE ET LE CADASTRE EN BULGARIE
DER PLATZ DER PHOTOGRAMMETRIE IN DER BODENREFORM UND DEM KATASTER IN BULGARIEN

Dr Ivan Katzarsky
Head of Main Department of Cadastre and Geodesy
at the Ministry of Regional Development and Construction, Bulgaria

Dr Lilia Koleva
Terra-F Company for Surveying and Photogrammetry, Bulgaria

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ABSTRACT

The place of photogrammetry in land reform and cadastre in Bulgaria is determined by some of its main features:

- Use of retrospective aerial photographs;
- Production of orthophotomaps;
- Production of large-scale topographic maps;
- Production of photomosaics for interpretation;
- Determination of points by aerial triangulation.
- Numerical mapping of aerial photographs.

RÉSUMÉ

La place de la photogrammétrie dans la réforme foncière et le cadastre en Bulgarie se détermine par les possibilités principales:

- Usage des photographies aériennes rétrospectives;
- Production des orthophotocartes;
- Production des photomosaïques pour interprétation;
- Production des cartes topographiques a grande échelle;
- Détermination des points par l'aérotriangulation.

KURZFASSUNG

Der Platz, den die Photogrammetrie in der Bodenreform und dem Kataster in Bulgarien einnimmt, wird von ihrer wichtigsten Merkmale bestimmt, die wie folgt sind:

- Benutzung retrospektiver Luftbilder;
- Herstellung von Orthophotokarten;
- Herstellung von grossmassstaebigen topographischen Karten;
- Herstellung von Luftbildmosaikern zur Interpretation;
- Punktbestimmung mit Hilfe der Aerotriangulation.

1. INTRODUCTION

The changes in Bulgaria at the end of 1989 strongly influence the economy of the country. The economic structures are changing, the participation of the government in the economy is decreasing considerably, the relations between it and the private physical and legal entities are changing, the private incentives in the trade, commerce and banking are stimulated.

The economic changes are accomplished in three directions:

- (i) Restitution of ownership of urban property and industrial enterprises,
- (ii) Privatization of state-owned industrial enterprises,
- (iii) Restitution of private ownership of agricultural lands.
- (iv) The restitution of private ownership of forests.

The territory of Bulgaria is 111 thousand sq. km, 60% of which are farming lands and 40% are arable lands. The settlements are above 5 thousand and occupy 4.5% of the territory. The population of Bulgaria is 8.5 million.

2. LAND REFORM AND CADASTRE

2.1. Land Reform

The Law of Property and Use of Agricultural Lands was adopted by the Bulgarian Parliament in February 1991 and was updated several times. On the basis of this Law the Bulgarian Government issued Rules for its application in April 1991. In June 1992 the Main Department of Lands and Land Property at the Ministry of Agriculture and Food Industry issued Methodical Guidelines and Technical Standards for application of the Law on Property and Use of Agricultural Lands on the basis of elaboration of the Main Department of Cadastre and Geodesy at the Ministry of Regional Development and Construction.

The Law initiates the land reform in Bulgaria, and other acts indicate the ways for the accomplishment of the reform in technical and legal aspect.

According to the Law, the Rules for its application and the Methodical Guidelines:

- (i) The property rights of the owners or their heirs on the agricultural lands, owned before the formation of the cooperatives and state owned farms are restored.
- (ii) The landless and poor citizens are given lands from the state and communal land funds.
- (iii) The land reform is financed entirely by the state budget.
- (iv) The restitution of ownership of agricultural lands is done within the limits of the territories belonging to one village by qualified companies or individuals.

The Law of Property and Use of Agricultural Lands liquidated about 2300 large agricultural farms, each managing formally 20-60 sq. km of land. The rights on them for managing and mastering will be restituted to the former owners of the land before its co-operation 40 years ago. These owners number over about one million.

Together with their heirs the total number of persons whose ownership of land will be restituted may reach three million.

The land reform affects the interests of many people and its accomplishment depends on different state institutions. The activities on restitution of ownership of agricultural lands are run and controlled mainly by the Ministry of Agriculture and Food Industry and the Ministry of Regional Development and Construction not underestimating, however, the role of the Ministry of Justice and the Ministry of Finance.

Some 273 Municipal Land Commissions to the Main Department of Lands and Land Property, which was formed within the Ministry of Agriculture and Food Industry especially for the restitution of ownership of agricultural lands, are established on the territory of the country. Their task is the accomplishment of the land reform on 4700 lands. For this purpose contracts were signed with 600 companies most of which have surveying as the main subject of activity. The portion of the technical activities on the land reform which are done by the state companies is 75% and by the private companies – 25%. The work force engaged this task numbers 1800 state administrative officials and 3000 specialists.

The statistical data show that the applications for restitution of ownership of agricultural lands, are 2.4 million for about 8 million real estates with a total land area of 57 thousand sq. km, the applications of private persons being for 51 thousand sq. km of it, and those of legal entities for the rest 6 thousand sq. km. It is expected that until the end of 1996 about 89% of the lands is to be returned to the owners.

The restitution of ownership of agricultural lands is a great challenge for the Bulgarian surveyors. There has never been and will probably never be another case for the state to invest in a short time considerable funds in an activity which is in fact surveying. Bulgaria cannot allow the use of the measurements and the resulting information, connected with the land reform, to be limited only to the restitution of ownership of land. The data collected will be used for the development of up-to-date cadastre and for the creation of Land Information System (LIS) with the purpose of its development into a Geographic Information System (GIS), as well as for solution of ecological problems. The cadastre and the information system for the land are necessary for the future land market.

2.2. Cadastre

The first Cadastre Law in Bulgaria is from 1908 and the second one is from 1941. The third Law for Uniform Cadastre from 1979 is active now together with the Rules for its application from 1983. For obvious reasons the operative Law cannot satisfy the present requirements and a draft for a fourth cadastre law is in process of active preparation to be put forward in Parliament.

According to the operating Law and Rules for the application:

- (i) The Uniform Cadastre provides data for the territory of the country with its natural resources overgrown and underground material wealth.
- (ii) The data are presented on cadastral maps, photo mosaics, papers, graphs, alpha-numeric and other materials.
- (iii) The National Center of Cadastre makes and revises the Uniform Cadastre by organizing, creating and maintaining a data base, produces orthophotomaps and other products, provides ministries and other institutions and companies with space and aerial photographs, geodetic and cartographic materials, provides the Territorial Cadastres with inputs, necessary for making and maintenance of the Uniform Cadastre.

The requirements of the Law and Rules impose the provision of respective primary information which can be in semi-ton, graphic or digital form. The new attitude to the ownership and the transition to market economy require a cadastre with legal and technical indicators, actuality and effectiveness, different from those established by the presently operating Law.

The cadastre is managed by the Main Department of Cadastre and Geodesy at the Ministry of Regional Development and Construction. Some 28 Regional Offices of Cadastre and Geodesy are established on the territory of the country which are local bodies of the Department of Cadastre and Geodesy. The Main Department, together with its Regional Offices carry out the state policy, planning, financing, control and approval of all technical activities on cadastre, geodesy, photogrammetry and cartography, which are for civil purposes.

3. GEODETIC, CARTOGRAPHIC AND CADASTRAL MATERIALS AND DATA

Except for some attempts in the remote past for mapping the area occupied by present Bulgaria, as well as the plane-table survey at scale of 1:42 000 made by the Russian Topographic Corps during and right after the Russian-Turkish Liberation War of 1877-1878, the surveying and mapping activities in the country have more than hundred year history. In comparison with some other countries of similar size, historical fate and economic potential, Bulgaria is well provided in geodetic and cartographic aspect.

3.1. Geodetic Networks

On the territory of Bulgaria geodetic networks are constructed consisting of about 60 thousand triangulation points, 15 thousand bench marks, as well as 335 fundamental bench marks, about 400 gravimetric and 800 magnetic points. Due to the intensive development of particular regions about 15% of the triangulation points were destroyed and the portion of the destroyed triangulation points in the settlements and in the industrial areas may reach 40%.

Four tide gauge stations on the Black Sea coast, two control measurement bases, one magnetic station and one gravimetric polygon were built. A space station for observation of earth artificial satellites for geodetic purposes as well as a geodynamic station were built.

3.2. Topographic Maps

The country is covered with a topographic map at scale of 1:25 000 with contour interval 5 and 10 m, as well as with by-product maps at smaller scales. The maps are five-coloured and are revised every 8-10 years.

The compilation of a large-scale topographic map began in 1954 and was completed in 1984. About 90% of the map for the intensive regions of the country is at scale of 1:5000 and about 10% of map for the high mountain and forest regions is at scale of 1:10 000. The contour interval is 1, 2, 5 and 10 m depending on the scale and the terrain configuration. The map is five and three-coloured and about 40% of it is updated.

For some specific purposes (mainly for investigation of linear and hydro-technical projects) maps of scale of 1:2000 and larger are made.

3.3. Orthophotomaps

In the period 1981-1991 orthophotomaps without contours were made at scale of 1:5000 of 60 thousand sq. km and at scale of 1:10 000 of 24 thousand sq. km of the territory of the country. Orthophotomaps at scale of 1:2000 are prepared for some parts of the country.

3.4. Urban Maps

In Bulgaria there are above 5 thousand settlements of different size and type as well as other settlement formations (hamlets, railway stations, industrial zones). For most of them maps at scale of 1:1000 and 1:500 are made and for some central parts of the towns - also maps at scale of 1:250. About 50-60% of the urban maps are actual. The maps are three-coloured with contour interval 1 and 0.5 m

3.5. Cadastral Information

Orthophotomaps at scale of 1:2000, 1:5000 and 1:10 000 serve mainly as a basis of the rural cadastre. Maps at scales of 1:1000, 1:500 and 1:250 serve as a basis of urban cadastre.

A cadastral information system is created for about 20 thousand sq. km of the territory of Bulgaria and for another 30 thousand sq. km input cadastral data are collected to be entered into the system. The main products of the cadastral information system are about 20 types of balances which contain summarized data on definite indicators for each object. For those communes, for which an information system is created (18% of the territory of the country) 80% of the data necessary for the land reform are available. The cadastral maps included in the information system, are ready maps of the land and serve as a basis of the land reform.

3.6. Land Consolidation Maps

For the needs of the land consolidation which began in 1911 but was carried out on a mass footing in Bulgaria during the period 1932-1942, land consolidation maps at scale of 1:2000 are compiled for some lands with total area of about 1.5 thousand sq. km.

4. PHOTOGRAMMETRY

4.1. The Beginning

Bulgaria was probably the first country on the Balkan Peninsula to begin to apply photogrammetry. Terrestrial photogrammetric photographs were taken during 1907-1908 and were plotted in the Vienna Cartographic Institute by Eduard von Orel by means of a Stereograph designed by him. During the Balkan War (1912) and the World War I (1914-1918) aerial and terrestrial photographs were taken for military reconnaissance and road construction.

More considerable attempt to apply terrestrial photogrammetry for the purpose of compilation a topographic map at scale of 1:25 000 was done in 1928. For the same purpose in 1930 began the implementation of single-image aerial photogrammetry and in 1940 of aerial stereophotogrammetry. For large-scale mapping single-image photogrammetry was applied after the end of World War II and stereophotogrammetry - since 1954.

4.2. Current Practice

The aerial photogrammetry for civil production purposes in Bulgaria is concentrated in the following state enterprises:

- Geoplanproject Co., Sofia,
- Geodesia Co., Plovdiv,
- National Center of Cadastre Ltd., Sofia,
- Research in Geodesy and Photogrammetry Ltd., Sofia,
- Patproject Ltd. Sofia,
- Transproject Ltd. Sofia.

Geoplanproject and Geodesia implement analogue stereoplotting of aerophotographs for compilation and revision rural and urban topographic maps at scales of 10 000 up to 1:500. The National Center of Cadastre makes orthophotomaps at scales of 1:10 000 up to 1:2000. Research in Geodesy and Photogrammetry Ltd. accomplishes mainly specific photogrammetric works.

Patproject and Transproject make maps at scales of 1:2000, 1:1000 and larger, as well as digital models for the purposes of design and reconstruction of motor-ways for the purposes of design and reconstruction of motor-ways, railways and structures as well as for inventory of the road and railway network.

4.3. The Place of Photogrammetry

The place of photogrammetry in the land reform and cadastre in Bulgaria is determined mainly by six of its

multiple potentials:

- (i) Use of retrospective aerial photographs taken over the territory of Bulgaria for compilation of the topographic map at 1:25 000 scale before pooling of private farms into large collective farms. These aerial photographs are taken by normal-angle aerial survey camera (focal length 21 cm, format 18x18 cm) and are at approximate scale of 1:20 000. In the prevailing cases real boundaries of ownership at that time in mountain and hilly regions can be distinguished on them, i.e. where presumably these boundaries have been preserved up to now.
- (ii) Production of large scale orthophotomaps without contours as basis of the rural cadastre. The orthophotomap is cheaper and is produced considerably faster than the conventional topographic map which make it more up-to-date. The semantic information contained on it is of the same quality and quantity as that on the aerial photographs from which it is made.
- (iii) Production and revision of very large-scale topographic maps in graphical and digital forms as basis of urban cadastre. This is a slower and more expensive process but it is inevitable in view of its high precision necessary for the compilation and updating of the respective graphical and digital maps.
- (iv) Production of photomosaics and other intermediate photogrammetric products for the purposes of the land reform. The photogrammetry has the advantage that from the instant of taking the aerial photography up to the production of the final product for which it is intended, several intermediate products can be made with different accuracy, serving some intermediate phases of the land reform.
- (v) Determination of terrain points by aerial triangulation for the needs of land reform and cadastre. Photogrammetry disposes of powerful means for high precision determination of points on the terrain.
- (vi) Numerical mapping of aerial photographs for compilation of land maps at scale of 1:5000 and larger, necessary for the restitution of ownership of agricultural lands in the existing real boundaries mainly in mountain and hilly regions of the country.

Here one should add also the topographic map at scale of 1:5000 which is produced and periodically updated by aerial photogrammetry.

4.4. Basis of Rural Cadastre

The orthophotomaps without contours at scales of 1:5000 and 1:10 000 serve as basis for the rural cadastre. For this purpose aerial photographs are taken by a wide-angle aerial camera (focal length 15 cm and format 23x23 cm) from altitude 2.4 or 4.5 km above the terrain where aerial photographs are obtained at approximate scale of 1:16 000 or 1:30 000 respectively. The orthophotocopy is accomplished by the systems Zeiss Topocart-Orthophot and Topomat. The necessary control points for absolute orientation of stereomodels

are determined by analytical block aerial triangulation. When necessary, contours can be superimposed from the existing topographic map on the orthophotonegative.

4.5. Basis of Urban Cadastre

The compilation and updating of maps at scales of 1:1000 and 1:500 as basis of urban cadastre is done by analogue stereoplotting. For this purpose aerial photographs are taken most frequently by wide-angle aerial survey camera (15/23 cm) and in the case of high and densely built sites - by normal-angle aerial survey camera (30/23 cm) from altitude from 1.2 to 0.5 km above the terrain. This altitude depends on the parameters of the aerial photography determined by its purpose. Because of this the scale of the serial photographs varies in rather wide range - from 1:6000 to 1:1700.

The analogue stereoplotting is done by stereoplotters of the type Stereometrograph of Zeiss. The necessary control points for absolute orientation of the stereo models are determined by land survey as well as by analytical aerial block triangulation by bundle adjustment.

4.6. Determination of Terrain Points for Land Reform

In applying the Law of Property and Use of Agricultural Lands it is necessary to determine the coordinates of a considerable number of points, monumented on the terrain. Traditionally this determination is done by land survey methods, using modern equipment. Satisfactory results, however, are obtained by applying photogrammetric methods for densification of geodetic network (aerial triangulation).

Taking into consideration the necessary accuracy of the coordinates of the new-determined points, the implementation of aerial triangulation for this purpose should be preceded by the solution of some specific problems, connected with the choice of the aerial survey camera, the aerial film, the parameters of the aerial photography and the way of targeting the points on the terrain before taking the aerial photographs.

5. CONCLUSION

The photogrammetry in Bulgaria is provided with reliable technical means and technologies including software. They are used successfully in technical activities for the restitution of ownership of agricultural lands which will be followed by the creation of a new cadastre and land registration in order to guarantee the individual property rights and also for the creation of land information system with the purpose of developing it further into a geographic information system.

It must be, however, underlined that the technical means and the technologies related to them, are out-of-date and Bulgaria needs updating of the photogrammetry equipment for which it relies on its own funds, as well as on foreign aid, especially from the European Community.

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- *GKZ= Geodezia, Kartografia, Zemeustroistvo (Geodesy, Cartography, Land Management Journal), Sofia.

AUTHORS' ADDRESSES

Dr Ivan Katzarsky
Ministry of Regional Development and Construction
Main Department of Cadastre and Geodesy
17-19, Kiril i Methodi Street
BG-1202 Sofia, Bulgaria
Tel: (+3592)876 260 and 813 785
Fax (+3592)872 517 and 874 888

Dr Lilia Koleva
TERRA-F Co.
4 Simeonov Vek Street
B1.266-A, Vh.D, Ap.79
BG-1111 Sofia, Bulgaria
Tel./Fax: (+3592) 709 135