

TRAINING OF SPECIALISTS FOR REMOTE SENSING OF LAND
RESOURCES AT MOSCOW INSTITUTE OF LAND USE PLANNING
ENGINEERS

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Abstract.

Remotely sensed data are widely used in Land use planning, soil and geobotanic studies, in Soviet Agriculture. Land registration and the studies of land resources are available on the base of reliable and timely information, providing the system of measures on efficient land uses.

A planner's specialization in the branch of remote sensing of land resources is being done in Moscow Institute of Land Use Planning Engineers (USSR).

The report on this training system includes: metode used in the process of studies of the disciplines on speciality, the system of students' laboratory and research work, field practice training, the use of computers in the studies, and so on.

The state policy in the field of the USSR land fund utilisation for the period until 1990 is aimed at implementing the Food Programme, of which ensuring high tempoes of agricultural production on the basis of highly effective land use constitutes one of the major orientations.

In terms of the total area of the land fund and agricultural land, the USSR ranks first in the world. However, in view of the unfavourable climatic and soil conditions, the area under cultivation as compared to other countries is not great; agricultural land in the USSR makes up approximately 27 per cent of the total area, in Great Britain - 80 per cent, in the United States - 68 per cent, in France - 66 per cent. The arable land in the USSR makes up only about 37 per cent of the entire area of agricultural land, which can be explained by country's specific natural-climatic conditions.

The condition of the USSR land fund makes it imperative that a leading place in the organisation of the system of rational nature management be given to questions of effective utilization of agricultural lands, improvement of their quality, and their protection.

The existing land use level is, mainly, a consequence of the immediate economic activities of man, and depends on how correctly they are carried out i.e. whether scientifically based land-use systems, the rational technology of agricultural crop production, and other measures are applied, with due consideration being given to the land cadastre data.

We would like to point out that the extent to which land cadastre may exercise its impact will be determined by the up-to-dateness and reliability of its data, i.e. each mistake it may contain leads to incorrect conclusions, and, thereby, to a non-rational land-use.

A comprehensive study of land resources is a task many specialists are solving, including land management engineers trainee in the Moscow Institute of Land Use Planning Engineers.

The Moscow Institute of Land Use Planning Engineers is the only specialized academic establishment in the field of land management in the USSR. In 1979 its jubilee - bicentenary of its founding - was solemnly marked by its work collective. At the present time the Institute trains land management engineers and geodetic engineers for management of land resources, and their protection using for the purpose space and aero-geodetic methods. Research personnel is trained widely at the post-graduate course.

Much importance is attached to training specialists in remote sensing of land resources. The Institute embarked on training small groups of specialists in 1977 on the basis of its Land Management Faculty. Their line of specialization is "The study of land resources". The term of training is 5 years.

The present report highlights the major questions involved in the professional training of land management engineers in this new line of specialisation, and the main characteristics of the curriculum and the teaching methodology. We would like to point out that the training of specialists in remote sensing of land resources within the "land management" specialisation has not been selected by chance. It was based on the nature of the subsequent work of graduates in the organisations of the Ministry of Agriculture, which is our constant customers of aerospace information, so that it could be utilised for an optimal organisation of agricultural objects. It was intended that engineers in remote sensing of land resources would participate in compiling land boundary, soil, geobotanic, and other agricultural maps and atlases, and will make observations of emerging shoots of agricultural crops, their development, weed infestation, the condition of natural fodder plants growth and dynamics of erosion processes, the incidence of diseases and pests of plants, etc.

The aero- and space surveying in agriculture can be used also for solving certain tasks involved, for example, in the quest for arable land, inventory of pastures for animal husbandry search of ground water for water supply for agricultural territories in arid regions, etc.

The foregoing has determined the major orientation in training specialists for the study of land resources with the aid of aero- and space methods in the Moscow Institute of Land Use Planning Engineers.

The curriculum and the syllabi for all disciplines constitute the main state documents for training land management engineers. Special emphasis in the curriculum is placed upon the sequence in which the disciplines should be studied, with due consideration being given to the structural-logical connection between them, and the forecast model of the specialist which is based on the agricultural imperatives for 5-8 years ahead. The formation in students of the dialectico-materialistic outlook, and professionally training them in their line of speciality on the basis of the general political education are in the focus of concern of the teaching staff.

In the curriculum there are the following groups of disciplines:

I. General educational disciplines - political economy, higher mathematics, physics, radioelectronics, computer technology, physical geography and landscape study, nature protection, etc; to which the total 1200 academic hours are devoted.

2. Agricultural disciplines - geomorphology, land reclamation, soil science and geobotanics, forestry science, agriculture and plant growing, land cadastre, land law, land management, etc., to which the total of 700 academic hours are devoted.

3. Geodetic disciplines - geodesy, higher geodesy, the theories and methods of information processing, cartography, etc., to which the total of 1000 academic hours are devoted.

4. Air surveying, photogrammetry, and deciphering of agricultural objects, aero space survey, photography, deciphering of photographs, etc., to which the total of 1300 academic hours are devoted.

In obtaining fundamental knowledge in political economy, mathematics, physics, and other disciplines in the sphere of general education, the students also receive a good grounding in computer technology, and computer programming. The Institute possesses a computer center which has modern computers and "Elektronika" microprocessors. In the computer halls in which the students are studying with the aid of display facilities, individual assignments are fulfilled by them - course theses on information processing in many academic disciplines in dialogue with ES computers-geodesy, higher geodesy, photogrammetry, cartography, etc. Since the interpretation of aero- and space surveys for the study of land resources is difficult without knowledge of agricultural disciplines of which we spoke above.

In studying agriculture, attention is drawn to the conditions of life of agricultural plants (air, heat, and water regimes of the soil), the agrotechnical measures in soil protection from water and wind erosion, etc. In the course in plant-growing the study is made of various agricultural crops (wheat, maize, millet, etc.), as also of the conditions of their cultivation, methods of soil cultivation, and the measures of control against plant pests, etc.

In the course in land management, land cadastre, the questions of rational organisation of agricultural territory are studied, with due consideration to the zonal systems of agriculture, the quantitative and qualitative assessment of lands, with the use of automated systems of land resources management, soil rating, etc.

The course in soil science familiarises students with soil types, methods of studying them, with a view to obtaining various characteristics necessary for compiling soil maps. To be able to correctly register and decipher lands to which reclamation measures are applied, students are offered a course in land reclamation which acquaints them with irrigation, drainage, anti-erosion, and other types of land ameliorations.

Disciplines, such as geodesy, air survey, and photogrammetry are also intended to provide students with the necessary professional knowledge.

Geodesy constitutes one of the central disciplines which is studied by students in their first two years in the Institute. Major emphasis in studying the course is placed upon modern technologies of topographic surveying with the aid of ground-based methods (techeometric, etc.) and classification survey of aero- and space images. The students study modern instruments used for measuring angles and elevations, and also distances

between the points of the terrain.

The assessment of the accuracy of measurement results is accentuated in the course. For example, in studying topographic plans, the tasks are solved for assessment of the accuracy of the area of land plots when it is determined on the basis of the integer model of its contour or on the basis of its plan with the aid of the integrating instrument, which is of importance for reliable quantitative determination of land resources, etc.

In the course in the higher geodesy, the main emphasis is placed on studying questions involved in organising aero- and space surveys, and, then, studying their results. In this way, students obtain knowledge of radiogeodetic aircraft systems used for closing photos, the astro-inertial orientation in photo made from space, application of autonomous definitions in bridging aero- and space photos to the main bases of geodetic datums. In the section of the course devoted to plane coordinates, the method is given of measuring curvilinear surfaces and the methodology of computing the areas of surfaces and that of quantifying the surfaces of sizable regions in connection with the assessment of land resources distribution. The course in cartography offers the mathematical basis and process of the thematic agricultural mapping. The students are offered lectures and are given individual laboratory assignments in computing cartographic projections with the aid of computers, and also lectures in the technology of agricultural mapping and atlas-making, automation of work in cartography and other questions.

The geometric and physical basis of aero-space surveying, (aero-space scanning photocameras, the equipment for small-frame aero-space television, radio location survey, etc.), the technology of surveying work, including the selection of the type and parameters of the survey systems, the development of the programme for planning space survey are given in the course in space aero-survey.

It is known that in creating agricultural maps, their deciphering takes up more than a quarter of the total volume of work involved in this effort. This share considerably increases when maps are revised. In using the results of space surveys, the extraction of sense information comes to occupy a predominant place. Therefore, one of the most important questions involved in training specialists in making land resources study is that of methods of image deciphering. The course in image deciphering offers data on optical characteristics of the landscape elements, and the technology of spectrometric research. Special attention is given to the methods of deciphering: visual, machine-visual and automated. An important place in this course is given to selecting the conditions of aero-survey for agricultural purposes, soil, geobotanic, hydrographic, and hydro-geological agricultural deciphering to the questions of use of aero- and space survey for studying and protecting the environment.

In the course in photogrammetry, consideration is given to the technology of topographic mapping with the of analogy stereophotogrammetric instruments and the collateral theoretical questions, including analysis of aerophotos, phototriangulation, fundamentals of stereoscopic observations, mutual orientation of pairs of photos, external orientation of the geometric model etc. The course also offers the methods of photo grammetric work in studying land resources and namely: photogrammetric methods in

establishing and restoring land-use boundaries, inventory of agricultural land, the study and determination of the quantitative indicators of soil erosion, maintenance of land cadastre, determination of soil salinity, etc.

The course syllabi offer the basis for implementation of the curriculum; the aim that is pursued in drawing up the syllabi consists in achieving a situation in which the organisation of training would be at the level of the advanced achievements of science and technology, so that the student would be able to grasp creative work habits, would acquire the capacity for advancing and implementing new progressive ideas, would deeply realise the essence of the agrarian transformations, would develop this economic thinking, would be able to raise and solve technical questions for aero-geodetic work for agriculture, would learn how to be exacting to himself and in relation to economizing and frugality, would master the methods of developing multi-variant solutions on the basis of economico-mathematical methods and computers.

Training engineers skilled in studying land resources is based on the advanced organisational forms and methods of teaching, which are called upon to create the conditions necessary for intensification of the training and educational process, the firm and creative grasp by the students of the growing volumes of professional knowledge. Students carry out their practical training in laboratories which are equipped with modern geodetic and aero-geodetic equipment, and also technical teaching aids: cinema, television, training systems with automatic feed-back, instruments for immediate control, etc. The theoretical training of students is connected indissolubly with their practical training, for which purpose the last two years in the Institute students are required to work during 22 week in production organisation in deciphering and studying land resources. The practical training provides the combination of theoretical knowledge with the ability to solve questions that may arise in the course of concrete work, and allows students to make their contribution to the implementation by respective institutions of their plans and programmes.

The teaching process in the Institute is supported by the availability of high-quality instructional literature. Among the textbooks we should mention "Geodesy", by Maslov A.V., Gordeev A.V., Batrakov Y.G., "Land-Management Designing" by a group of authors, edited by S.A. Udachina; "Pedology with the Foundations of Geobotanics" by A.F. Golubev, and many other. Besides, the faculty workers have written many manuals in support of laboratory and course theses which are written individually by each student under the guidance of the respective teacher.

The textbooks and manual thus published make it possible to organize the independent work by students in the laboratories of the Institute after the obligatory classes are over, with the participation of the respective teacher. The independent work by students is rather wide in scope, beginning from solving rather simple tasks during the two first years in the Institute and ending with the implementation by students of intricate course projects in the last years of their study at the Institute, during some semester. The topics of course projects are oriented towards solving production tasks of pressing importance in the field of organisation of land resources management; compilation of agricultural atlases and maps on the basis of aero- and space surveying, the computation of the parameters of the space images of agricul-

tural objects, etc. Students defend their individual course theses before the Chair Commission in which production workers also participate, and their work is assessed on the basis of the four-point system with regard to the level and quality of the theses written by the students during the above-mentioned semester.

Involvement of students in research activities is widely practiced. For this purpose a Student Scientific Society and also a Student Designing Bureau have been created in the Moscow Institute of Land Use Planning Engineers. Annually, student scientific conferences take place, at which the students promulgate the results of the research completed by them. Part of the research topics is carried out on contract with production organisations, for which the students receive a salary in addition to the state stipends. Involvement of students in scientific research carried out by chair experts has a positive impact upon the formation of the Institute's scientific school because the most talented youth is offered after completing the Institute to continue their studies in the post-graduate course or to work as teachers in the Institute. The most valuable results of scientific research by students are published in the scientific transactions and are also reported at All-Union conferences of students. The process of teaching ends in the Institute with defending by students of their diploma theses on topics selected by them. In writing the thesis, the student uses the materials collected by him in the period of pre-diploma practice term in the production field. In making technico-economic computations in the course of diploma writing use is widely made by students of computers for validating the decisions made by them, also the modern tools of respective statistics, and the theory of probabilities.

The most original works are recommended for introduction in the field of production.

The teachers of the Institute are improving their pedagogical skills on a systematic basis by studying at the advanced training faculties, in the country's leading academic institutions. At the Faculty of Land Management, there has been set up a permanent seminar on the pedagogics of the Higher School, and scientific research and methodological conferences are held.

In conclusion, we would like to note that the articles describes the experience in training personnel for remote sensing of land resources in the agricultural higher educational institution - the Moscow Institute of Land Use Planning Engineers. Having rich traditions in training students in land management and geodesy, the Institute is making first steps in training students in new and rapidly developing field of science and technology as is remote sensing of the Earth, its resources, and the state of natural environment.

The scientific methodological work that has been accomplished by the Institute's work collective of professors and teachers for the last 7-years demonstrates that the new direction in training specialists in remote sensing of land resources with a view to their effective use and protection is a promising one.