

POLISH ACADEMY OF SCIENCES  
INSTITUTE OF GEOGRAPHY AND SPATIAL ORGANIZATION

---

GEOGRAPHICAL STUDIES No. 111

WOJCIECH JANKOWSKI

LAND USE MAPPING  
DEVELOPMENT AND METHODS

WROCLAW · WARSZAWA · KRAKÓW · GDAŃSK  
ZAKŁAD NARODOWY IMIENIA OSSOLIŃSKICH  
WYDAWNICTWO POLSKIEJ AKADEMII NAUK

70. Pulina M., *Zjawiska krasowe we wschodniej Syberii*, 1968, s. 94 + 34 ilustr. + 4 fot., z1 19,—
71. Szupryczyński J., *Niektóre zagadnienia czwartorzędu na obszarze Spitsbergenu*. 1968, s. 127 + 15 ilustr. + 35 fot. + 1 wkładka, z1 34,—
72. Kosiński L., *Migracje ludności w Polsce w latach 1950—1960*. 1968, s. 106 + 41 ilustr., z1 28,—
73. Korolec H., *Procesy brzegowe i zmiany linii brzegowej Jeziora Mikołajskiego*. 1968, s. 67 + 16 ilustr. + 6 fot. + 1 wkładka, z1 24,—
74. Praca zbiorowa. *Ostatnie zlodowacenie skandynawskie w Polsce*. 1968, s. 216 + 12 ilustr. + 11 fot., z1 67,—
75. Praca zbiorowa. *Procesy i formy wydmowe w Polsce*. Zbiór prac pod redakcją R. Galona. 1969, s. 386 + 69 ilustr. + 68 fot., z1 98,—
76. Iwanicka-Lyra E., *Delimitacja aglomeracji wielkomiejskich w Polsce*. 1969, s. 117 + 12 ilustr., z1 28,—
77. Praca zbiorowa. *Z zagadnień ludnościowych krajów gospodarczo słabo rozwiniętych*. 1969, s. 146 + 6 ilustr., z1 32,—
78. Korcelli P., *Rozwój struktury przestrzennej obszarów metropolitalnych Kalifornii*. 1969, s. 124 + 34 ilustr., z1 28,—
79. Koter M., *Geneza układu przestrzennego Łodzi przemysłowej*. 1969, s. 130 + 13 ilustr. + 2 wkładki, z1 34,—
80. Kaszowski L., Kołarba A., *Wpływ katastrofalnych wezbrań na przebieg procesów fluwialnych (na przykładzie potoku Kobylanka na Wyzynie Krakowskiej)*;  
Nowak W. A., *Rzeźba podczwartorzędowa i ewolucja układu sieci dolinnej w północnośrodkowej części Wyżyny Małopolskiej*. 1970, s. 124 + 71 ilustr. + 1 załącznik kol. + 12 lot., z1 30,—
81. Stola W., *Proba typologii rolnictwa Pomorza*. 1970, s. 146 + 23 ilustr. w tym 7 wkładek + 9 fot., z1 39,—
82. Praca zbiorowa. *Studia z geografii średnich miast w Polsce. Problematyka Tarnowa*. 1971, s. 274 + 45 ilustr., z1 71,—
83. Wiśniewski E., *Struktura i tekstura sandru ostródzkiego oraz teras doliny górnej Drwęcy*. 1971, s. 95 + 33 ilustr., z1 24,—
84. Skoczek J., *Wpływ podłoża atmosfery na przebieg dobowy bilansu cieplnego powierzchni czynnej*. 1970, s. 96 + 49 ilustr. + 10 fot., z1 21,—
85. Jewtuchowicz S., *Rozwój rzeźby okolic Łęczycy po zlodowaceniu środkowopolskim*. 1970, s. 78 + 26 ilustr. + 5 fot., z1 18,—
86. Olechnowicz-Bobrowska B., *Częstość dni z opadem w Polsce*. 1970, s. 75 + 26 ilustr., z1 18,—
87. Baza ekonomiczna i struktura funkcjonalna miast; Dziewoński K., *Studium rozwoju pojęć, metod i ich zastosowań*; Jerczyński M., *Metody pośrednie identyfikacji i pomiaru*. 1971, s. 182 + 2 ilustr., z1 44,—
88. Rościszewski M., *Kierunki ewolucji rolnictwa w krajach Maghrebu*. 1970, s. 127 + 8 ilustr., z1 30,—
89. Adrjanowska E., *Przestrzenne powiązania produkcyjne stoczni gdańskich*. 1971, s. 105 + 16 ilustr., z1 22,—
90. Różycka W., *Metody oceny warunków fizjograficznych dla potrzeb planowania przestrzennego miast*. 1971, s. 203 + 16 ilustr., z1 40,—
91. Ciołkosz A., Miszański J., *Wykorzystanie zdjęć lotniczych w geografii stosowanej*. 1972, s. 86 + 23 ilustr., z1 15,—
92. Czyż T., *Zastosowanie metody analizy czynnikowej do badania ekonomicz-*

POLISH ACADEMY OF SCIENCES

INSTITUTE OF GEOGRAPHY AND SPATIAL ORGANIZATION

\*

GEOGRAPHICAL STUDIES No. 111

PRACE GEOGRAFICZNE

Nr 111

WOJCIECH JANKOWSKI

KARTOWANIE UŻYTKOWANIA ZIEMI  
ROZWÓJ I METODY

\*

ГЕОГРАФИЧЕСКИЕ ТРУДЫ

№ 111

ВОЙТЕХ ЯНКОВСКИ

КАРТОГРАФИРОВАНИЕ ИСПОЛЬЗОВАНИЯ ЗЕМЛИ  
РАЗВИТИЕ И МЕТОДЫ

POLISH ACADEMY OF SCIENCES  
INSTITUTE OF GEOGRAPHY AND SPATIAL ORGANIZATION

---

GEOGRAPHICAL STUDIES No. 111

WOJCIECH JANKOWSKI

LAND USE MAPPING  
DEVELOPMENT AND METHODS

WROCLAW · WARSZAWA · KRAKÓW · GDAŃSK  
ZAKŁAD NARODOWY IMIENIA OSSOLIŃSKICH  
WYDAWNICTWO POLSKIEJ AKADEMII NAUK

1975

Editorial Committee

EDITOR-IN-CHIEF: M. KIELCZEWSKA-ZALESKA

DEPUTY EDITOR: K. DZIEWOŃSKI

MEMBERS: R. GALON, L. STARKEL

SECRETARY: I. STANCZAK

Editor of this Volume

JERZY KOSTROWICKI

Translated by

HALINA DZIERZANOWSKA

Redaktor Wydawnictwa Krystyna Nasuszny

*Printed in Poland*

Zakład Narodowy im. Ossolińskich — Wydawnictwo. Wrocław 1975.  
Nakład: 800 egz. Objętość: ark. wyd. 8.40, ark. druk. 7, ark. form.  
A1 9.30, Papier druk. sat. kl. III, 80 g. 70 × 100. Oddano do składania  
17 I 1975. Podpisano do druku 11 IV 1975. Druk ukończono w maju  
1975. Wrocławska Drukarnia Naukowa, Zam. 2041/75. Cena zł 35.—

## CONTENTS

Introduction . . . . .	7
I. The development of land use research (an historical outline) . . . . .	10
II. A review of land use surveys and maps . . . . .	16
Selected British surveys up to 1930 . . . . .	16
The first Land Utilization Survey of Britain directed by L. D. Stamp . . . . .	18
The Second Land Use Survey of Britain under A. Coleman . . . . .	20
Hong Kong . . . . .	24
Cyprus . . . . .	25
Land use studies in India . . . . .	27
Pakistani studies . . . . .	28
Iraq . . . . .	29
Studies in the Sudan by J. H. G. Lebon . . . . .	29
Land use studies in South Africa . . . . .	30
Attempts at land use mapping in Nigeria . . . . .	31
Canadian experiences in land use mapping . . . . .	32
Australian studies . . . . .	35
Other studies based upon methods recommended by the Commission . . . . .	35
The United State of America . . . . .	36
Italy . . . . .	39
Japan . . . . .	42
Works of the Directorate of Overseas Surveys in Africa . . . . .	45
Other studies . . . . .	46
Polish studies in the interwar period . . . . .	48
Polish postwar studies . . . . .	52
Cooperation between European socialist countries and result obtained . . . . .	63
Soviet studies . . . . .	67
Conclusions . . . . .	68
III. Cartographic methods applied in the construction of land use maps . . . . .	70
IV. Tendencies in the development of research methods and techniques . . . . .	78
Final remarks . . . . .	85
Bibliography . . . . .	87
Kartowanie użytkowania ziemi. Rozwój i metody (streszczenie) . . . . .	104
Картографирование использования земли. Развитие и методы (резюме). . . . .	108





## INTRODUCTION

It is now over a century which separates our generation from the period when the first thematic maps, based upon modern and detailed research work, were compiled. It seems therefore worth while to sum up achievements of the separate branches of thematic cartography. The present study is a description of the development of thematic cartography in the domain of land use maps. Thematic cartography is a type of research which has been developing widely since 1930, i.e. the year when the late Professor L. D. Stamp made the first land use survey of Britain. It seems therefore advisable to present a detailed description of efforts concerned with the preparation of land use maps and the elaboration of methods of their construction, especially as so far such a comprehensive survey or evaluation of these problems has not been published yet. The present study is therefore an attempt to make up for this deficiency.

The problem of land use is a broad one and can be approached from various angles. It seems therefore necessary to determine exactly the subject with which the present study is concerned. Its predominant interest is with land use maps, i.e. maps presenting the spatial distribution of the various forms of land cover; the utilization of the Earth by man (or non-utilization as well, as there still exist vast areas which have not yet been affected — or are only slightly affected — by man's activity aimed at transforming the natural environment) and the spatial relations between and mutual interdependence of the various forms of land cover are therefore its main subject. Out of the whole group of thematic maps only this narrow field has been selected and is covered by the present analysis. Thus, such related maps as those presenting vegetation, forests, agricultural production, economic or social aspects of agriculture, as well as maps included in atlases (made usually on a rather too small scale) have not been taken into consideration. Neither have numerous articles published in the world geographical literature been analysed, similarly as dissertations concerned with land use in certain specific areas, illustrated by simple text maps, which do not

add anything new to the mapping methodology or to which land use maps are not enclosed.

The topographic map, which also represents the area's surface, is a specific type of a land use map. Therefore, the differentiation between the thematic and topographic maps may seem hardly possible. For example, a road map or a land use map, although they contain some elements of topographic maps, should be classified as thematic maps. E. Imhof includes the topographic map in the category of not-specialized maps, which provide information on phenomena seen directly on the Earth's surface [125]. His definition seems, however, debatable as information on certain selected phenomena is also an expression of specialization. Moreover, a general division of maps into topographical and thematic may also not be unequivocal. The topography of the Earth's surface can be treated as a separate subject, and therefore topographic maps should be classified as thematic. These are however theoretical considerations, whereas the division established by practise is so obvious that it leaves no doubt.

Besides maps a number of textual publications dealing with the methods of the land survey and of the construction of maps as well as cartographic methods applied in the preparation of land use maps has been taken into account. Here, some definitions must be supplied. The land use survey denotes all activity leading to the elaboration of a map, like collecting relevant information regarding the investigated area, assembling statistical and cartographic data, as well as the registration of information on the spatial distribution of the various forms of land use, on such cartographic base material as cadastral plans, management plans, topographic maps, aerial photographs. The land use map is the final, graphic product of the survey.

An almost synonymous term, with however a slightly narrower range than the survey, is land use mapping, understood as field work carried out on cartographic basis and including the collection of information on the investigated area.

Certain authors have tried, even if sporadically, to introduce new terms or change their widely recognized, general meaning. Such a new term is, for example, *Land Cover*. T. M. Burley uses it to refer to the setting in which action (employment) takes place, i.e. the vegetation and artificial constructions covering the Land Surface. *Land Utilization* he uses for the action i.e. the employment of the Land Surface through the medium of the Land Cover [38]. Another term was proposed by J. W. Fox, who differentiates "land use" from "land utilization". "Land use" is — according to him — the actual and specific use to which the land surface is put, whereas "land utilization" denotes

the process of exploiting land use — that is, land use applied to a specific objective [100]. Some broader terminological deliberations on this subject are included in the works by T. M. Burley and L. Symons [37, 293]. In his final conclusions T. M. Burley suggests a different solution, namely that the term “land use” should denote a broader, superior notion, representing both the land cover and land utilization, according to the following formula:

$$\text{land cover} + \text{land utilization} = \text{land use.}$$

This discussion cannot actually change the fact that both terms, i.e. land use and land utilization have generally been treated as synonymous, and land cover has been adopted almost exclusively by some Australian authors only.

The present study was initially meant to deal only with land use mapping and cartographic methods applied in such a procedure. It has however come out that the severing of the map from the survey is hardly possible because of the influence exercised upon the content and character of the map by the method used in the elaboration of the survey (cf. the final part of the study).

The study consists of two main parts. First part contains a historical outline as well as a description and evaluation of differences in the contents of various land use surveys or maps. In second part cartographic methods applied in land use mapping are reviewed, analysed and evaluated, and the trends as well as directions of land use mapping following the development of research techniques are discussed.

The initially intended autopsic examination of every map has proved to be impossible. Therefore, some already published source materials, such as articles, reviews, reports, etc. in which various land use surveys or maps are assessed, have also been used. The textual material has not always been available and because of that the range of information as to certain surveys or maps is abundant and satisfactory, whereas in other cases it is too scarce and fragmentary.

It should also be emphasized that the problem could not be fully exhausted, as research was based upon materials available in Poland, mainly in the library of the Geographical Institutes of the Polish Academy of Sciences and of the University of Warsaw. The bulk of material came from Professor J. Kostrowicki's private collection. The author wishes therefore to express his deep gratitude to this scholar, who not only allowed him to utilize his own collection, but also helped to import other material from abroad.

## I. THE DEVELOPMENT OF LAND USE RESEARCH (AN HISTORICAL OUTLINE)

L. D. Stamp believed that the organization and utilization of the Earth's surface are influenced by man's needs, essential for his survival, such as: food, shelter, work, rest, communication, and safety [283]. A rational organization of space and its effective development are conditioned by a balanced proportion laid down for each of those needs, but especially for the first four. One of the main forms of obtaining information as to the current state of the organization of space is the land use map, which also enables the researcher to form his own views on the rationality of such an organization. The presentation of all the forms of land utilization together with their distribution and interrelations is the principal characteristic of the land use map and a feature which contributes to their practical meaning, especially for physical planning. This quality has been recognized universally, in developed as well as developing countries, in the states where food supplies are plentiful and in those where they are scarce.

The steadily growing density of population, inducing more and more rapid changes in space organization as well as more and more frequent conflicts between the various forms of land use, has greatly contributed to the increased interest in these problems in the last forty years, particularly after World War II, although they have taken place throughout the whole period of the utilization of the Earth's surface by mankind.

The determination of the period when land use research was started is not easy; it is moreover beyond the scope of the present study. Most of the early research projects was concerned with the preparation of cadastral plans, which are not the subject of our investigations. First, initially quite occasional, surveys corresponding to the current notion of a land use map were made mostly in Britain in the 19th century [207, 217, 218]. They usually covered small areas, and only in the 20th century have their number, scope, and form been developed to such an extent that this century should undoubtedly be recognized as the period of the actual expansion of land use research. These facts are outlined

in the present chapter, starting with some important events which happened before the establishment of the IGU Commission on World Land Use Survey. Certain additional details will be included also in the subsequent parts.

Within the discussed time range American geographers were the first to make in 1915 an attempt at a presentation of the spatial distribution of main land uses as a whole. Moreover, following a discussion on the detailed methods of field research they worked out a classification of land use forms, specially for the purpose of such investigations [151, 266].

The leading role was however played by Britain, where works on a big scale were undertaken. On L. D. Stamp's initiative and under his guidance the land use survey of England, Wales and Scotland was made in 1930—1945, wound up with the publication of a series of maps on the scale 1 : 63 360. The practical and scientific significance of the British survey has been tremendous and it has induced a regular flow of similar works all over the world.

The first postwar International Geographical Congress, held in Lisbon in 1949, called into being the Commission on World Land Use Survey (referred in this study as the Commission) as one of the seven IGU commissions. S. Van Valkenburg (US) was elected its chairman and L. D. Stamp (England), H. Boesch (Switzerland), P. Gourou (Belgium) and L. Waibel (Brazil) its regular members. Its principal task was to organize the world land use survey on the basis of premises laid down by the Commission. The scale 1 : 1 000 000 was adopted on its first meeting in Worcester, Mass. (5—16 December 1949) on the grounds that this was the scale on which the international World Map had been prepared and also following the opinion that such scale was large enough to present the general picture of the distribution of the main land uses in the world [253]. A preliminary classification of land use categories was also drawn. Subsequent research work revealed that the scale 1 : 1 000 000 was inadequate to present clearly the very complicated spatial pattern of land use and the initial plan of the World Map was abandoned. However, a recommendation was also adopted in Worcester that separate countries, following their local conditions, could or even should make their surveys and prepare the maps on larger scales up to 1 : 25 000 or even 1 : 10 000 inclusive. All individual solutions should, however, be in harmony with the classification and a master key, drawn by the Commission. The classification contained the following 9 main categories of land use [253, 254]:

1. Settlements and associated non-agricultural lands (dark and light red),
2. Horticulture (deep purple),

3. Tree and other perennial crops (light purple),
4. Cropland:
  - a. Continual and rotation cropping (dark brown),
  - b. Land rotation (light brown),
5. Improved permanent pasture (managed or enclosed) (light green),
6. Unimproved grazing land:
  - a. Used (orange),
  - b. Not used (yellow),
7. Woodlands:
  - a. Dense (dark green),
  - b. Open (medium green),
  - c. Scrub (olive green),
  - d. Swamp forests (blue green),
  - e. Cut over or burnt over forest areas (green stipple),
  - f. Forest with subsidiary cultivation (green with brown dots),
8. Swamps and marshes (fresh- and salt-water, non-forested) (blue),
9. Unproductive land (grey).

Because of its universal character particular categories covered a wide range of land use forms. For example, in the third category, together with orchards of the type found in Europe, subtropical and tropical crops were also included, such as citrus or olive groves, vineyards, plantations of cocoa, coffee, tea, pineapples, bananas, etc. Similarly, various types of woodland were differentiated by using certain shades of green; for example, mangrove woods, various shrub associations, garrigues, macchia, etc. The thus drawn classification, after some adaptations to local conditions has subsequently proved to be useful even in detailed survey and maps.

The Commission distributed a circular letter in English, French and German containing information on its current work and their project of the classification [314, 106, 26]. The letter was addressed to geographers, universities, academies of science, governmental institutions, scientific institutes, scientific periodicals. Replies from 16 countries contained reports on completed work in this field or information on planned work. The Commission's proposals, the classification of land use and collected materials were included in the report submitted to the XVIIth International Geographical Congress held in Washington in 1952 [253]. The membership of the Commission was then slightly changed; S. Van Valkenburg remained its chairman, H. Boesch (Switzerland), H. Gausson (France), P. Gourou (Belgium), P. James (US), L. D. Stamp (England) were elected regular members and N. Ahmad (Pakistan), S. P. Chatterjee (India), S. Faissol (Brazil), F. J. Ormeling (Holland), E. Otremba (GFR) and J. W. Watson (Canada) — corresponding members.

The second report prepared for the subsequent XVIIIth Congress in Rio de Janeiro included information on respective activities from almost 60 countries [254].

In Rio de Janeiro L. D. Stamp was elected chairman and H. Boesch, H. Gaussen, J. Kostrowicki and S. Van Valkenburg became the Commission's regular members [129]. The inclusion of the Polish representative was a sign of appreciation for Polish attempts in this field, presented during the Congress.

L. D. Stamp was also responsible for a series of publications. The World Land Use Survey was started by him in 1950 for the purpose of sponsoring land use research and publishing results obtained. Prior to 1960, i. e. the year when the XIXth International Geographical Congress was held in Stockholm, three monographs had appeared, namely on land use in Hong Kong in 1958, in Cyprus — 1959 and in Tobago — 1960, as well as the first volume of the series (entitled Occasional Papers) on land use in Transvaal [305, 49, 224, 68].

The Congress in Stockholm granted the Commission the status of a standing commission; L. D. Stamp remained chairman, and its regular members included: H. Boesch, Robert Ho (Malaya), J. Kostrowicki and S. Van Valkenburg. At that period this type of research was undertaken of expanded in many countries, and therefore the activity of the Commission was mainly directed toward giving help or advice, and safeguarding methodical uniformity and comparability of executed maps, which however, as will be seen in the subsequent part of the work, was not always attainable. The publishing series lacked also thematic uniformity and certain volumes of Occasional Papers dealt with subjects unrelated with land use.

Land use research, although not always carried out as a survey, followed by the preparation of a map, was quite well developed with the only exception of South America where progress in this field was very slow.

At the same time The Directorate of Overseas Surveys, organized by the British Government, undertook research based upon aerial photographs, mainly in African countries, and produced i. a. maps of Sierra Leone on the 1 : 40 000 scale and Gambia on the 1 : 25 000 scale.

The subsequent meeting of the Commission was held in Honolulu between 28 August and 2 September 1961, during the Xth Pacific Science Congress [168, 284]. Ten reports concerned with land use surveys were read at the Congress and Poland's representative J. Kostrowicki described objectives, methods and progress obtained in land use research in Poland and East Central Europe, gave information regarding the International Conference in Warsaw on methods and problems on land use

research (30 May — 8 June 1960), which had been participated by geographers from seven socialist countries, and on research, carried jointly in Bulgaria, during which the Polish methods were applied [190].

At the XXth International IGU Congress in London (10 July — 7 August 1964) a new member was elected, namely M. Glazovskaya from the Soviet Union. J. Kostrowicki made a report on the IInd conference of land use in East Europe, which had been held in Budapest from 6 to 10 May 1964 where a regional sub-commission for East Central Europe had been formed [170, 173]. Its activity will be discussed later on.

In the period between the Congresses in Stockholm and London work was rapidly developing [282, 284, 285, 286]. In 1960, for example, the second land use survey of Britain was started under chairmanship of A. Coleman. Moreover, 16 (out of the total of 26) sheets of land use in Italy, were published; progress was also obtained in the preparation of the Canadian and Japanese surveys. Mapping of land use in the Sudan and India was completed, and the last map was included in the Indian National Atlas.

The sudden death during the IGU Latino-American Regional Conference in 1966 of L. D. Stamp, the pioneer of land use research on the world scale and its unyielding propagator, affected the activity of the Commission. H. Boesch was elected to chairmanship.

At the XXIst International Geographical Congress in New Delhi a full set of 26 sheets of the Italian 1 : 200 000 map was presented. Other projects were also continued, whereas about 100 sheets of the British 1 : 25 000 map and over 300 sheets of the Japanese 1 : 50 000 map were published.

The membership of the Commission changed again to include the following members: E. Csati (Hungary), P. Flatres (France), R. C. Hodges (Canada), J. Kostrowicki (Poland), A. Watanabe (Japan), and H. Boesch continuing as chairman [130].

The conference and the exhibition of land use maps in Budapest (28 October — 5 November 1968) were a survey of achievements and methodical as well technical possibilities in the field of thematic cartography [132]. Abundant cartographic material induced the participants to make a very valuable proposal to compile the bibliography of land use maps and to organize their archives. The task was entrusted to S. Radó who started a *sui generis* central repository of land use maps at the Cartographic Section of the Agricultural Museum in Budapest [238].

The third Conference on Land Use in East Central Europe took place in Maribor (Yugoslavia) from 7 to 11 October 1969. The Regional Subcommission for East Central Europe changed then its name to The Subcommission on Land Use and Agricultural Typology [175, 176].



In the period from 1962 to 1971 ten volumes of Occasional Papers were published [208, 287, 319, 35, 275, 309, 303, 146, 220, 75]. Moreover, two new monographs were added to the former three: one — on the Sudan, and another on four islands, namely Madeira, Zanzibar and the two Azores islands — Santa Maria and Faial [199, 99]. All of them were edited by Mrs Audrey Clark, a long time collaborator and secretary to the late Professor L. D. Stamp.

In April 1970 modern methods of and possibilities for making land use surveys in developing countries were discussed on a special symposium organized in London by the IGU Commission on World Land Use Survey and SHELL International Petroleum Company Ltd. [29]. The symposium was a sign of a new era in the history of land use surveys because since then technological achievements have been widely applied in field work (aerial and satellite photographs) and in editorial work (use of computers and automatic methods in cartography). The material from the proceedings was published in volume No 9 of Occasional Papers [220]. However, this was only the beginning of a new road. Problems of mathematization and automation dominated also the proceedings of the XXIIInd International Congress, held in Canada in 1972 [133].

In 1972 the membership of the Commission was changed again. Two new members: Ch. T. N. Paludan (US) and M. Takasaki (Japan) were elected and together with H. Boesch as president and former members: E. Csati, P. Flatres and R. C. Hodges continued work [131]. R. C. Hodges has been replaced by P. B. Clibbon also Canada in 1974.

Early in 1974 the General Instruction for the Compilation of Land Use Map of Europe (EULUSMAP) on the scale 1 : 2 500 000 was issued. E. Csati, from the Geocartographic Research Department of the Hungarian Institute of Geodesy and Cartography was appointed the coordinator of the project of the map. The base manuscripts shall to be supplied by various European countries. The Commission on World Land Use Survey adapted it officially as one of its main projects [31, 188].

## II. A REVIEW OF LAND USE SURVEYS AND MAPS

Rich tradition, scope and significance of British efforts in this field make it appropriate to start the survey and analysis of the most important works with British achievements. The first British survey prepared by L. D. Stamp has generally been recognized as classical. The influence it exerted upon similar studies in many countries has made it possible to analyse all these undertakings jointly, directly after the analysis of British land use surveys and maps. Stamp's influence has been direct and also to a large extent indirect, as the Commission has based its activity largely upon this scholar's own experience. American, Italian, Japanese surveys, as well as some other of lesser importance and range, departing from the classical form, will be discussed subsequently. The Polish efforts in land use surveying and mapping will be described separately in greater detail. For a better explanation of methodological investigations, which have put Poland on a leading position among the socialist countries carrying out such research work, the planned framework of this chapter will often be overstepped.

### SELECTED BRITISH SURVEYS UP TO 1930

In the field of land use study Britain has played a leading role for quite a long time. L. D. Stamp in his historical outline of land use mapping in Britain went as far down as the Roman period and even the prehistorical era [281]. He mentioned the Domesday Survey, made during the reign of William the Conqueror in 1086, which had been analysed in great detail by H. C. Darby and many other efforts, which exceed the scope of the present study [80].

In the British Museum there is a unique set containing the six sheets of a land use map of London and its neighbourhood, prepared by Thomas Milne and published in 1800 [36, 219]. This is a map on the scale 1:31 680, showing in various colours the 12 land use categories; for example: arable land (brown), meadows and pastures (light green), woodland (dark green), market gardening (light blue), orchards (blue), etc.

This map, even if it oversteps the analysed period and covers a small area, should be mentioned because it was a kind of prototype of later land use maps. At the end of the 19th century some studies on human environment and man's influence upon its transformation were published [207]. H. R. Mill suggested therefore to make a complete survey of Britain based upon the Ordnance Survey maps [217]. The survey was planned to include i. a. the various categories of land uses, their distribution and area. Following the example of south-west Sussex the author showed how such a work should be made [218]. Besides several regional surveys of small areas, however, this kind of studies was rather little developed.

In the first quarter of the current century other studies were undertaken, the form of which tallied to a greater extent with the classical land use survey. Teachers and specially trained students registered the results of their field work on topographical maps. These maps were supplemented with sketches, notes, photographs and specimens of plants or rocks. The results were published in the *Geographical Teacher* and subsequently described and evaluated by W. S. Baker in 1926 [8].

The preliminary stage of experimentation and determination of a method of land use mapping was completed with the land use survey and map of Northamptonshire, which was the first stepping stone to the new period of rapid development in this field of research, not only in Britain but also all over the world. This project was undertaken by, E. E. Field, who recruited help of pupils from primary and secondary schools, run in the county [95]. He was greatly assisted by the Northampton Education Committee, headed by J. L. Holland. Moreover, this institution facilitated the publication of the map printed by the Ordnance Survey in Southampton. The scale used was 1 : 10 560 and various categories of land use and numerous territorial objects were shown. The areas of each village (totalling 305) were mapped very precisely, and field after field was presented. The material collected was worked out and generalized and subsequently published in three sheets on the scale 1 : 63 360. The following categories of land use were i. a. differentiated: arable land (brown), grassland (light green), woodland (dark green), waste land.

Subsequently L. D. Stamp prepared a pilot project of land use in Britain on the basis of the above survey. The degree of Stamp's interest in Field's work and method can best be illustrated by his following remarks: "It is not too much to say that the pioneer example of Northamptonshire has made possible the organization of the Land Utilisation Survey of Britain." [280]. Two organizers of the Northamptonshire survey, E. E. Field and J. L. Holland, were invited to the Advisory Committee of the Land Utilisation Survey of Britain.

C. Board differentiated three periods in the development of land use studies in Britain [24]. The first, covering the years from 1887 to 1908, was characterized by search for new methods and the publication of works by MacKinder, Mill and some others [207, 217, 218]. The second, which C. Board called "experimental" extended from 1908 to 1928. Some field research was then started, which was quite similar to present-day land use surveys. The survey of Northamptonshire marked the transition to the next stage, called a major effort lasting from 1928 to 1948. In 1928 the Geographical Association elected L. D. Stamp to chairmanship of the Regional Survey Committee. This was the beginning of striking development in this branch of geographical research.

THE FIRST LAND UTILISATION SURVEY OF BRITAIN  
DIRECTED BY L. D. STAMP

The initial stage of the preparation of the British land use survey fell on a very difficult period of the Great World Depression, which in Britain reached its peak exactly in 1930—1932. L. D. Stamp started work having at his disposal only 500 pounds donated by the Rockefeller Foundation, whereas the cost of a complete map on the scale 1:10 560 was 1 500 pounds [281].

The recommendations concerned with field work foresaw that each surveyor should possess two copies of basic maps — one for field work — and the other for his first draft to be submitted for further elaboration. These were the Ordnance Survey topographical maps, made on the scale 1:10 560. Land use categories were to be marked on field with letter symbols and subsequently their area was painted by means of crayons or water colours. The main six categories were then differentiated:

	Symbols	Colours
Forest and woodland	— F	— dark green
Meadowland and permanent grass	— M	— light green
Arable land	— A	— brown
Heath and moorland	— H	— yellow
Gardens	— G	— deep purple
Land agriculturally unproductive: buildings, yards, mines, cemeteries	— W	— red

The seventh group comprised ponds, lakes, reservoirs, ditches, dykes, streams and anything containing water — P — marked blue.

Woodland was divided into four groups: high forest (Fa), coppice (Fb), scrub (Fc), forest cut down and not replanted (Fd). Moreover, the following categories were also introduced: coniferous (Fa<sup>c</sup>), deciduous (Fa<sup>d</sup>), mixed (Fa<sup>m</sup>).

Special attention was paid to exclude from grassland grass areas forming part of the field-grass rotation system (leys) and classified as arable land. Market gardening was included in the category of arable land. The fifth group — gardens — comprised only home gardens, allotments, orchards and nursery-gardens. Parks, golf courses or sport grounds were to be classified as woodland, grassland or gardens according to their coverage. The first two sheets of the map on the scale 1 : 63 360 were ready on the New Year's Day (1933) and exhibited during the meeting of the Geographical Association; they contained the sheets: 114 — Windsor and South-West London and 142 — Isle of Wight. They awoke wide interest and won appreciation of the authorities. The United States showed their interest in the British Survey by inviting L. D. Stamp to participate in the works on the Tennessee Valley Authority project, described in the later part of the study. Usefulness of land use maps for physical planning was then established and thus opinions expressed by E. C. Willats in 1930 confirmed [322].

By the end of 1933 the next six sheets were completed and in 1934 additional four. From 1935 till 1947 the yearly publication of some dozen maps became a regular procedure.

The war years were again a difficult period in the history of the survey. The blockade of the British Isles by German submarines stimulated, however, the efforts to continue the survey. At a time when every strip of land had to be rationally utilized, a land use map was of greatest significance for getting a thorough knowledge of land reserves. Therefore, irrespective of many difficulties arising from the state of war, work was not interrupted. In 1941, ten sheets, already printed, were destroyed during a German raid.

Year	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947
Number of published sheets	8	4	18	16	17	14	12	11	—	12	8	8	12	18	8

The printing of the last eight sheets, out of the total of 166, was completed in 1947; the maps covered all England and Wales, as well as some parts of southern and northern Scotland. Fourteen sheets concerned with the remaining part of southern Scotland and some fragments of the eastern coast were left in their original plot [281]. The full coverage was planned to include 235 sheets, of which 146 for England and Wales, and 89 for Scotland. Excluded from the survey were mainly the Scottish Highlands unsuitable for agricultural use.

In 1941, a decision was taken to prepare a series of maps for the sake of national planning. The selected scale was 1 : 625 000. The first map presented land use categories and was printed in two sheets in

1943. The land utilization was shown as the generalization of maps made on the 1:63 360 scale. It was printed in eight colours by the Ordnance Survey. Arable land was marked in brown, meadowland and permanent grassland in light green, heath- and moorland in yellow, forest and woodland in dark green, orchards and nurseries in purple, built up area in red. Moreover, blue and black, i. e. the colours of the base Ordnance Survey map, remained unchanged.

In addition fifteen sheets on the scale 1:253 440 showing certain parts of England and Wales were printed during the war time. They covered the following three blocks of land: the Lake District with the adjacent northern part of the Pennines; northern and central Wales; and a large part of Cornwall. Their publication was undertaken in order to obtain quickly the cartographic picture of these areas on a relatively large scale. The maps, however, in the same way as many others, were destroyed during a raid in May 1941. They were subsequently reproduced from the salvaged negatives.

Together with this quite extensive cartographic production 92 reports were also made, in which the characteristics of land use in every county of England, Wales and Scotland were given and the surveying process, geological structure, relief, soils and climatic conditions were described; the reports included at the same time the statistical data, maps and diagrams. The reports were compiled by many authors and published consecutively in the period from 1936 to 1946. In the end they were collected in nine volumes under the title *The Land of Britain*, each volume referring to a particular part of the country, e. g. Wales, East Anglia, etc. A study prepared by L. D. Stamp on the use and misuse of land in Britain, which subsequently, was reprinted two times (third edition in 1962), culminated this already classical survey [281].

#### THE SECOND LAND USE SURVEY OF BRITAIN UNDER A. COLEMAN

Numerous reasons accounted for the decision to begin a new survey. Much material collected during Stamp's survey was destroyed during the hostilities; many important changes occurred in British agriculture in the meantime. To reprint the maps made during the previous survey, an already historical document after so many years, was of no avail. Prestige motives played also a certain role. By 1960 up-to-date land use maps had already been completed or started in numerous countries. In Britain, many, often vast, areas had also been mapped by certain schools or colleges. This research was however uncoordinated, of very unequal value, and its results were not published. A great merit of A. Coleman is that she made use of local initiatives and coordinated

their effects in such a way as to lay foundations for a new survey on a national scale.

Coleman started the organization of the Second Land Use Survey of Britain on the 1 : 25 000 scale in 1960. This had been preceded (1959) by mapping the Isle of Thanet, lying in the eastern part of Kent, which occupies an area of 500 sq.m. This project was undertaken by members of the local branch of the Geographical Association. The method used in the new survey of England and Wales was based upon experiences gained during mapping the isle and upon the first survey. The instruction for field surveyors was published in the beginning of 1960 [73]. To eliminate excessive travelling or the organization of special expeditions it was decided that each surveyor would be responsible for the coverage of the area in the vicinity of his place of residence or work. The greatest advantage of such a solution was that the surveyor would work in an area, well known to him. Owing to energetic and well-organized recruiting among the members of the Royal Geographical Society, the Geographical Association, the Institute of British Geographers as well as in schools, local geographical societies, universities, branches of the National Farmers' Union, etc. surveyors were found for 85 per cent of the area foreseen for mapping. The survey of the remaining area was undertaken by a number of geographers who sacrificed their holidays to carry out the project [69].

Similarly as in the first survey the Ordnance Survey topographic map on the scale 1 : 10 560, commonly referred to as the six-inch map, was used as a base map. These maps, for which all data had been collected during the field survey, were to be used as the basis for a fair draft of the sheet to be published on the scale 1 : 25 000. Out of the planned total of 849 sheets about a hundred for various parts of the country were printed by the end of 1969.

For printing the land use maps the topographic maps were used. The Ordnance Survey supplied transparencies and all notations made by the surveyors were introduced by both sides. The utilization of a four-coloured (black, grey, orange, blue) topographic base maps cause a certain departure from the colouring adopted by the Commission on World Land Use Survey. Colours used for settlement were grey and black, as in the topographical base, whereas unvegetated land was left white instead of grey.

In general, thirteen categories of main land uses were differentiated on the map, namely: settlement, industry, transport, derelict land, open spaces, grass land, arable land, market gardening, orchards, woodland, heath and rough land, water and marsh, as well as unvegetated land.

1. Settlement (grey and black) areas included residential and com-

mercial ones. Public buildings were marked in black, drawn vertically on to a horizontal surface, or by using symbols with the following description of the building, e.g. school, hospital, infirmary.

2. Industry (red) was subdivided into four categories:

- a) manufacturing industry,
- b) extractive industry (mines, gravel pits, quarries),
- c) active and abandoned tips and other derelict land,
- d) public utilities (gas, electricity, water works, etc.).

For the first of these subdivisions the index number of the main 14 manufacturing categories listed in the 1951 census was used and the respective numbers from 3 to 16 were printed on the map.

3. Transport (orange) included railways, airports, ports, bus termini and car parks, as well as main roads.

4. Derelict land (black stipple).

5. Open spaces (lime green) included parks, recreational grounds, golf courses, cemeteries.

6. Grassland (light green) included all forms of agricultural grass, while the field mapping symbol L was added to indicate young leys where identifiable. This differentiation did not appear on the printed map.

7. Arable land was classed in six subdivisions: ley legumes (light brown and green hachure lines), cereals (light brown), and the remaining four groups: root crops, green fodder, industrial crops and fallow were marked by various types of light brown hachure lines.

8. Market gardening (purple) — ordinary market gardening was printed in a flat wash of purple, the remaining five groups (nurseries with glass houses, allotment gardens, flowers, soft fruit and hops) were crosshatched in purple.

9. Orchards. The instruction contained only symbols to mark orchards, grassed or mown for hay, as well as sown with crops, namely the purple diagonal stripes interlaced with stripes denoting co-appearing cultivation, e. g. green or brown.

10. Woodland (dark green). Subdivisions were shown by means of conventional signals overprinted in black and included: deciduous, coniferous, mixed, coppice, coppice with standards and scrub woodland.

11. Heathland, moorland and rough land (yellow).

12. Water and marsh (blue).

13. Unvegetated land (white), such as rocky cliffs, sea beaches, etc.

However, not all the sheets were made according to the above listed instructions. Certain changes were introduced during printing, which is a debatable procedure, especially during the publication of a series of



that type. Moreover, the changes do not seem necessary, and certain amount of doubt was felt in this respect [140].

The basic principle of marking each category of use by one colour and its subdivision with some tones of the main colour was retained. Initially, ten colour plates were used, whereas the two additional colours resulted from certain combinations, i. e. for open spaces light green overprinted on yellow, and for woodland — blue overprinted on yellow. The thirteenth colour was white. This colouring did not satisfy the authors and in three cases certain changes were introduced [70, 71]. Orange, selected for transport areas, was found too intensive and strikingly differing from the remaining, more pastel shades, especially when it covered large portions of the map. Therefore railway stations, airport and ports were marked by a chequer-board pattern of orange and white to make the colour less intense. The procedure could have been accepted, if simultaneously the very bright red shade, which was used to denote industrial area and which came out even more striking than the orange, had been made lighter.

Similarly green, adopted to mark woodland, was found too intensive and dark. Some attempts were made to use a lighter shade of blue; the effect was — in the author's opinion — correct, but the same blue used for waters looked too pale. Consequently, dark green was adopted in addition and thus the number of colours increased to eleven.

The next change affected the orchards. Because of difficulties in obtaining an ideal matching of colours many other variants were tried, but failed to win the approval of the authors. Finally, three various patterns of purple stripes were introduced.

Many doubts have also arisen as to the introduction of a dynamic presentation of the above mentioned category. Certain areas, marked with grey stipples, not included in the explanation of colour conventions, appear on the maps. These symbols, leftovers of the topographical map which was chosen as the base sheet, mark former orchards. Together with the coloured distribution of uses, they provide information on changes (liquidation or new placing) or on lack of changes in the distribution of orchards. Even the assumption that the map was made entirely to be used by the British, does not permit the authors to leave out an explanation. Changes, marked in such a way, are fragmentary and casual, as the authors themselves admitted [70]. However, even if the procedure of not explaining the symbols used in the topographical map was consciously accepted, it was rather inconsequently applied. For example, the category "water and marsh" was included in the explanation, whereas areas affected by sea tides were not differentiated, though they occupy

vast spaces, especially at the river mouths. The same is true of the marking of rocks in the mountainous areas, and certain other symbols.

The orange colour used for contour lines on the topographical maps and for transport areas and roads on the land use maps is a subsequent inconsequence in the colour system, as railway lines are marked in black.

The complete list comprises 64 symbols. In comparison with the first survey their number was increased. However, the scale of the new map is almost three times greater than in the old map. In such a situation the capacity and readability of the map was not utilized in full to present the new content. Moreover, the number of the details and proportions between the differentiated groups, seems to be increased in an irregular way. Market gardens are, for example, subdivided into seven categories, whereas arable land only into six. Grass lands were treated as one category, without any subdivision, although they occupy almost half of Britain's agricultural land and are highly differentiated. The classification of leys as permanent grassland seems incorrect, especially as in the former Stamp's survey they were included in the group of arable land. Thus, comparability between those two main uses represented in the first and second surveys was also completely lost.

A very valuable feature of the maps made during both surveys is the presentation of the relief by using relief contours drawn at every 25 m. This is a perfect additional information to the agricultural content and makes it possible to understand more fully and appreciate many problems connected with the distribution of the separate uses.

The material collected by the Second Land Use Survey of Britain was also used for the preparation of the *Wildscape Atlas of England and Wales*, to be issued in two parts. The atlas will comprise 161 sheets on the 1 : 100 000 scale as well as 50 pages of explanations and notes concerned with the interpretation of presented scenery. Part I was to appear in 1971 and Part II in 1972 [72].

#### HONG KONG

The first monograph in the series published in 1958 by the World Land Use Survey dealt with Hong Kong. The small territory (1,026 sq. km) of the colony and a considerable density of population (over 3,000 inhabitants per sq. km) require a highly rational utilization of its land resources. The preparation of the land use map was therefore of primary significance for planning purposes.

The author of the map, T. R. Tregear, began to collect material in 1952. A full set of air photographs was made and cadastral surveys

were checked and brought up to date by field research. All these data served as a basis for the preparation of a coloured map, published in 1955 on the scale 1:80 000 and supplemented by a short commentary [304]. Subsequently, on L. D. Stamp's suggestion, the author expanded his commentary and prepared an extensive study on problems concerned with land use in Hong Kong. Having obtained support of the director of the Colonial Department of Agriculture, Fisheries and Forestry, Treager collected rich material, which he published — after a thorough analysis — in 1958 [305].

The title *Hong Kong and the New Territories* does not indicate that this is actually a land use map. This was caused by the utilization of the thus entitled base map. The separate categories of land use were printed in colour over the map and the explanations of the colours were added at its foot part, below the frame. The map is not very satisfactory from the esthetic point of view. The uses are not separated one from another by a line and their ranges are shown by coloured patches only; moreover, the colours are rather mucky and very intensive. The following eight shades were used to represent the main categories, i.e. following the order used in the explanatory notes: woodland (green), scrub (orange), rough grassland and scrub under 12 inches (yellow), badlands heavily eroded (dark red), arable (blue), swamp (orange and blue grid), houses with gardens (purple), build-up area agriculturally unproductive (scarlet). Moreover, there are almost 20 symbols used on the base map, such as the road and railway networks, hydrography, etc. A rather striking example is the presentation of arable land in blue; however, when we recollect that these are in 90 percent rice fields covered by water, such a decision seems to be more logical and even well-grounded.

#### CYPRUS

The second monograph was devoted to land use problems in Cyprus. It was prepared by one author while the enclosed map was made by another.

In the initial stage mapping was made in various scales on base cartographic maps of unequal value. The scales of the maps were: 1:63 360, 1:50 000, 1:31 680 and of the cadastral plans 1:5000 and 1:2500. Research was carried out irregularly on small areas [50].

Work was intensified in 1952—1953. The collected material was plotted on a 1:50 000 map and the Commission's classification was applied. Air photographs taken in 1949 by RAF on the approximate scale 1:10 000 were used to verify the findings.

The following eight main categories of uses were differentiated:

1. Settlements and associated non-agricultural lands,
2. Horticulture,
3. Tree and other perennial crops,
4. Crop land:
  - a. Irrigated crop land,
  - b. Unirrigated crop land,
5. Unimproved grazing land,
6. Woodland:
  - a. Dense woodland,
  - b. Open woodland,
  - c. Scrub,
7. Swamps and marshes,
8. Unproductive land.

Numbers used in the Commission's classification were retained in the explanatory notes with the only exception of improvements in permanent pastures, which do not appear on the island [49]. Moreover, arable land was subdivided into irrigated and unirrigated (4a and 4b), woodland into dense, open and scrub (6a, 6b, 6c) and intercultivated categories of uses were shown by overimposing the symbols representing respective crops.

The map was prepared by a team of workers from the Department of Geography of the London School of Economics, under R. R. Rawson and K. R. Sealy. The map was reduced to a smaller scale and after generalization printed in 1956 on the scale 1 : 250 000 [248]. Although only two colours were used, the map is clear and legible. This was obtained by a consequent use of brown for arable land only, a solid for irrigated land and a grid for unirrigated. The remaining uses, with the exception of settlement, were signified by black hachure. All inscriptions, the outline draught and the frame were also made in black.

In principle it is a map showing the distribution of land uses only, deprived of any additional topographic information, like roads, contour lines or even altitude points, with the only exception of roads. The quality of drawing is not high, as it lacks precision and esthetic values. Both the map of Cyprus, as well as that of Hong Kong described above, depart from the colouring principles adopted by the Commission, although they were published in its series. Financial reasons and the need for economy are responsible for the deficiencies in the map of Cyprus, whereas colouristic changes in the second are incomprehensible.

## LAND USE STUDIES IN INDIA

A great interest in land use research, which can be observed in Asiatic countries, is closely connected with the efforts to raise productivity of their backward agricultures and to alleviate suffering caused by the famine harassing the population of numerous overcrowded areas of that continent and, paradoxically enough, predominantly agricultural regions. Therefore, as early as 1956 i.e. in the second report of the Commission's activity, Van Valkenburg could include a list of 17 Asiatic countries which had already developed land use studies and mapping [314].

However, not all projects have been continued completed, as, for example, that undertaken in India. Although the problem of land use has been analysed extensively and the number of publication is astonishingly high, no national land use survey, nor a large-scale map have been made there, irrespective of continuous efforts of Indian geographers. In most publications they have emphasized the significance and merits of a land use map for improving the standard of Indian agriculture.

Land use studies were initiated in the late 1940 by the Departments of Geography in the universities of Aligarh and Calcutta. Their greatest popularizers and promoters are S. P. Chatterjee and M. Shafi. Shafi has often pointed out that agricultural production, so important in the country where a great portion of its population is near starvation, can be intensified i.a. with help of geographers and in particular through the preparation of the land use map enabling the discovery of all irrationalities in the utilization of the production potential of the Indian soil [269, 271]. Similarly H. S. Singh emphasized the need for the land use survey of India, as it may contribute to the adoption of the proper course towards a rapid expansion of Indian agriculture [279]. M. Shafi worked out principles and methods of the survey and drafted the classification of categories. He also reviewed and evaluated methods applied in other countries [269, 273]. His proposals been utilized during field work, organized for the geographical students of the University in Aligarh, during which they are taught the techniques of mapping and research work on land utilization [193, 194, 255, 270].

Both centres carried out numerous field studies on small areas in certain districts, their parts or separate villages. M. Shafi, for example, prepared a study of 12 villages in the East Uttar Pradesh, illustrated with land use maps for two seasons, rabi and kharif, i.e. winter and summer [272]. B. N. Ganguli's study refers also to the same province [102]. K. Z. Amani studied land use in the district of Aligarh. S. P.

Chatterjee's scientific output in this field can be best exemplified by his two studies, one on Bengal, dating from the initial stage of research work and another, more recent, on Rajasthan [3, 45, 46]. B. K. Roy's contributions, describing many villages, are also worth mentioning [259, 260, 261].

The applicability of the Commission's classification for India has been analysed by some foreign geographers; to mention only R. Ellefsen (US), who in 1959 mapped the Delhi state on the basis of a 1:21 120 topographic map [87].

#### PAKISTANI STUDIES

Similarly as in India the classification worked out by the Commission was utilized in the preparation of land use maps of selected areas in East Pakistan (now Bangla Desh), which were based upon field studies. Some of them were included in the monographs of the mapped areas [1, 156].

In West Pakistan the classification was enlarged and adapted to the needs of a survey on the 1:250 000 scale. The map not being available in Poland, only the classification, which was published in the second report of the Commission [254], can be discussed in the present study.

1. Settlement,
3. Plantations,
4. Cropland:
  - a. Perennial irrigation,
  - b. Seasonal irrigation,
  - c. Sailaba cultivation,
  - d. Barani cultivation,
6. Unimproved land used for grazing:
  - a. Range land,
  - b. Scrub land,
7. Woodland:
  - a. Reserved forest,
  - b. Unreserved woodland,
  - c. Swamp forest,
8. Marsh,
9. Unused land:
  - a. Desert land,
  - b. Rocky mountainous land,
  - c. Other unused land.

Permanent improved pasture was not included, as this category of land use does not occur in Pakistan.

## IRAQ

A provisional land use map of Iraq was prepared by D. H. Davies on the basis of a great number of base cartographic material of various origin and value. The map was printed in Baghdad in 1954. Following the Commission's preliminary recommendations the 1:1 000 000 scale was used, whereas the classification was adapted to local conditions. The categories of improved pastures and woodland, with the exception of scrub oak woodland, were omitted as not occurring in Iraq. Separate presentation of gardens and perennial crops was impossible because of the small scale. A combination of parallel stripes was used to mark the co-appearance of these categories. Moreover, the highland unimproved pastures of transhumance in Kurdistan and the unimproved lowland pastures of nomadic and pastoral economies were also recorded by means of other colours than those selected for the categories of used and unused unimproved grazing land [81, 254].

## STUDIES IN THE SUDAN BY J. H. G. LEBON

The idea to survey the Sudan was born in 1955 during a meeting of L. D. Stamp with J. H. G. Lebon on a symposium held in Kampala [197]. Following Stamp's suggestions Lebon investigated the chances of the preparation of a land use map; they were not very satisfactory. The main obstacle was lack of a detailed map, which could be utilized as a base for mapping or at least for the identification of the main categories of land use. Another difficulty was the size of the country, exceeding 2,500 thousand sq. km with certain parts hardly attainable. The resulting study, therefore, based on the compilation of the available cartographic material, i.e. *The Sudan, Vegetation Map* in 1:4 000 000, published in Khartoum in 1955 and a topographic map on the scale 1:250 000, published between 1929 and 1955, which, of course, was not up-to-date.

The first pilot map on the scale 1:3 000 000, i.e. the largest scale enabling to present the country on one sheet, was presented at the Congress in Rio de Janeiro (1956). Later, the author got hold of air photographs stored in the state Survey Department in Khartoum. These were, however, old photographs of the area lying north of the 8°N, which had been taken by the American Air Force in 1942—1943. It was only in the late 1950s that the part lying south of the 8°N was photographed. In 1957 the total number of the photographs was 113,000. On their basis a sheet, El Fasher ND 35, was made on the scale 1:1 000 000; the recommendations and classification prepared by the Commission were utilized. The new photographs were also used for the

rectification of the former map on the scale 1 : 3 000 000, which was reprinted as a *Revised Provisional Land Use Map of the Sudan* on the scale 1 : 4 000 000. In Lebon's publications the scale of this second map was given inconsistently, once as 1 : 3 000 000 and subsequently as 1 : 4 000 000 [197, 199]. With the original unavailable in Poland the correct scale cannot be established. The remaining sheets on the scale 1 : 1 000 000 were made subsequently and thus the full coverage of the country was obtained [198].

The main ten categories of land use, distinguished according to the Commission's classification, adapted to Sudanese conditions, are as follows:

1. Settlements and associated non-agricultural lands,
2. Horticulture,
3. Tree and other perennial cropland,
- 4a. Perennial irrigated cropland,
- 4a—6a. Intermittently cultivated flush-irrigated cropland, combined with grazing,
- 4b—6a. Land rotation and grazing in Savanna,
6. Unimproved grazing (used and unused),
7. Woodlands,
8. Marshes,
9. Unproductive (desert).

The largely reduced map reproduced in the Monograph shows the distribution of the main five uses out of the nine recommended by the Commission. Some uses could not be reproduced on such a small-scale map, e.g. settlement, horticulture, or do not appear in the Sudan. On the other hand the Commission's classification was expanded to include certain additional categories characteristic of that country: 4b cropland — land rotation (10 subcategories) and 6a unimproved grazing land — used (6 subcategories).

#### LAND USE STUDIES IN SOUTH AFRICA

Problems of land use in South Africa were mainly dealt with by M. Cole and C. Board. In 1949 M. Cole investigated the area of Transvaal and published her findings in the first volume of the Occasional Papers in 1956 [68]. With the exception of the analysis of the land use in this area her study does not contain any original methodical or cartographic solutions. The monographic description is illustrated by 13 black and white maps, showing the pattern of land use of certain selected small areas. A similar work was made by her for Cape Province [66].

C. Board produced a coloured map of land use in 12 sheets, on the



scale 1 : 125 000 basing upon air photographs and topographic maps in various scales. He applied — with insignificant changes — the Commission's classification and symbols, while discussing broadly its applicability in conditions of South Africa [19, 20, 22].

Land use classification modified for Border Regional Survey:

- |  |              |
|--|--------------|
| 1a. Built-up areas, mainly residential   | red,         |
| 1b. Built-up areas, mainly industrial and commercial   |              |
| 1c. Associated non-agricultural land, mainly recreational                                    |              |
| 1d. Associated non-agricultural land, mainly industrial and commercial                       | orange,      |
| 2. Horticulture, including nurseries   | deep purple, |
| 3. Perennial crops, including orchards and banana gardens                                    | magenta,     |
| 4. Arable land, with fallow, including pineapples and lucerne, which are not truly perennial | brown,       |
| 5. Improved permanent pastures, often irrigated  | light green, |
| 6a. Veld (unimproved pasture) used for grazing   | buff,        |
| 6b. Veld, not used for grazing, i.e. from which domestic animals are excluded                | yellow,      |
| 7a. Dense forest and plantations of exotic trees of all ages                                 | dark green,  |
| 7b. Cut-over forest  |              |
| 8. Marshes, not used for grazing   | blue,        |
| 9. Unproductive land, sand-dunes and bare rock   | grey.        |

#### ATTEMPTS AT LAND USE MAPPING IN NIGERIA

Similarly as in many other developing countries no uniform cartographic base material is available in Nigeria and therefore the preparation of a comprehensive survey is a very difficult or even unattainable task. R. M. Prothero informed that until recently the greatest scale used in mapping Nigeria as a whole had been 1 : 500 000 range. All maps produced on a large scale covered only some small areas. A similar situation existed in air photography. Nigeria had at her disposal only British photographs taken by the RAF on the scale 1 : 30 000 and American ones made by the USAAF on the scale 1 : 60 000. Moreover, only a certain part of Nigeria was thus photographed.

In such conditions an attempt was made to survey land use in traverses along the roads in the region of the town of Ilesha [234]. In this experiment carried out in 1951, in which air photographs were also made use of, the following classification was applied:

1. Land under cultivation,
2. Land being cleared for cultivation at the time of the survey,
3. Bush fallow,
4. Bush with secondary forest,
5. Cocoa,
6. Plantain.

In 1952 the same author investigated the region of the village of Soba, lying in the northern province of Zaria. On the basis of air photographs and field research a map was prepared on which cultivated land, one-two year and three-five year fallows as well as shrubs were differentiated [235]. New air photographs were utilized for mapping land use in Ibadan division [228].

#### CANADIAN EXPERIENCES IN USE MAPPING

First studies of land use were initially scattered and of unequal value. This situation was caused not only by the size of the country, but also by the federal form of government. The division into 10 provinces and 2 autonomous, self-governed territories made it difficult to centralize research efforts. The two territories, which occupy the northern and north-western area of Canada, situated in the sub-arctic region, are scarcely populated. Agriculture on the area, where the annual mean temperature does not exceed  $10^{\circ}$ , is of course not practised and therefore detailed mapping would be useless. In such conditions even the largest scale on which topographic base maps are made is 1 : 250 000 whereas the southern agricultural provinces of Canada are mapped on 1 : 50 000 and 1 : 25 000 scales. The central state collection contains almost 3,5 millions of air photographs, made on the scales from 1 : 15 840 to 1 : 67 200 [222, 223].

A state agency, the Agricultural Rehabilitation and Development Act (ARDA), was organized in 1961 to direct and coordinate agricultural research. Prior to the foundation of ARDA land use studies in Canada had been carried out by various scientific institutions, which used different methods and examined small areas in certain provinces only. The task of unification was entrusted to the Geographical Branch of the Federal Department of Mines and Technical Surveys, which obtained considerable results but only at the stage of the publication of maps. The described studies were undertaken i.a. in certain places on the territory of British Columbia [44, 93, 94, 222], Nova Scotia [76, 221], Newfoundland [251], Prince Edward Island [249] and Ontario [250, 252].

In Nova Scotia a group of geographers organized field research, measured field after field and plotted their findings on air photographs

on the scales 1 : 38 880 and 1 : 31 680 [221]. Other pilot projects of some selected parts of Nova Scotia, measuring from 90 to 260 sq. km, were based upon air photographs on the scale 1 : 15 840. In the remaining area mapping was done by a fast method, when observed features of the land use were plotted from the road on the 1 : 63 360 or 1 : 50 000 maps [76].

The mapping of Terrace District in British Columbia was started in order to investigate the soil capability for agricultural cultivation. On the basis of air photographs certain areas were eliminated as barren, whereas areas potentially adaptable for agricultural purposes and agricultural land were investigated in detail. As a result a coloured map was published on the scale 1 : 63 360 [93]. Other investigations were started in the Avalon Peninsula of Newfoundland. Mapping, which began in 1950, was based on the recommendations of the Commission; air photographs were utilized. The first draft was made on the scale 1 : 39 600, the next version was reduced to the scale 1 : 1 000 000. The map shows the distribution of the five main categories of land use. Subsequently, another method was applied, which was a combination of the physical classification of the area with the current form of land utilization. Field maps were drawn from air photographs taken on three different scales: 1 : 39 600, 1 : 9 600 and 1 : 2 400; the first scale was used for the extensively used territories and the third for settlements and separate categories. Symbols and numbers were used to mark land type on the base map. The fractional code method, devised earlier in the United States, was also applied. Main uses were indicated in the numerator by means of letters and numbers, physical data were given in the denominator. A detailed description of both method is included in Chapter 3.

A map made by M. J. Troughton and F. W. Graves of the University of Western Ontario *Land Utilization in Yarmouth Township* is also worth mentioning. It is based upon data collected during field research in 1966—1968. The separate categories of land use are presented by means of various hachures, overlaid on the background of three colours (out of five used in printing), showing the areas with cash crop, fodder crop/livestock and mixed (cash/fodder/livestock) orientations.

The Canada Land Inventory, one of the branches of ARDA, carried out research, among others in the following fields: soil capability for agriculture, land capability for forestry, land suitability for recreation, land capability for wildlife, capability for sport fish, present land use and agroclimatic classification. Almost one hundred governmental institutions, universities and colleges, private firms and various organizations cooperated in the realization of the programme. Computers were

used to proceed masses of collected data and for the production of maps on the scale 1 : 250 000, with the exception of the map of British Columbia, drawn to the scale 1 : 126 720 [203, 226].

The classification of land use categories was largely based upon experiences gained during previous research, mentioned above, as well studies carried out in the provinces: New Brunswick, Alberta, Saskatchewan and other. In certain cases the existing subdivisions were left as they were, and therefore many sheets, in the form of original plot or even after printing could have been utilized with insignificant changes. This procedure was, for example, adopted for the preparation of the four sheets covering the region of Victoria in British Columbia. The maps were made during field research (carried out in 1960 and 1961), based upon air photographs, and published on the scale 1 : 50 000 [98]. The preliminary classification was tested in two experimental areas, in eastern counties of Ontario and in the Gaspé region in Quebec, in July 1963; it was worked out anew in the winter of 1963/64 and the revised project was presented for comment to all interested in the problem of land use in the spring. At the end of 1964 the following final version of the classification was proposed for distribution [203]:

1. Urban:
  - a. Built-up area,
  - b. Mines, quarries, sand and gravel pits,
  - c. Outdoor recreation,
2. Horticulture,
3. Orchards and vineyards,
4. Cropland,
5. Improved pasture and forage crops,
6. Unimproved pasture and range land.
7. Woodland:
  - a. Productive woodland,
  - b. Non-productive woodland,
8. Swamp, marsh or bog,
9. Unproductive land:
  - a. Sand flats, dunes and beaches,
  - b. Rock and other unvegetated surfaces.

The maps are drawn on the sheets of the topographic map on the scale 1 : 50 000. Air photographs, forest management plans, maps prepared as university diploma theses and many other sources of information are utilized. One of the first projects was completed in Alberta by a team under the direction of A. H. Laycock [120]. As the current data are not available in Poland, the present state of the realization of the whole project is not known.

## AUSTRALIAN STUDIES

Land use research in Australia was carried out rather spontaneously by various federal or state agencies, by universities, and even private people, mainly in connection with the preparation of plans of economic development of certain areas.

The Department of National Development of the Commonwealth Scientific and Industrial Research Organization in Canberra undertook a number of studies in the northern part of Australia. One of the greatest achievements was the survey of the Barkley Region, carried out in 1947—1948, which covered an area of appr. 120 000 sq. miles; 38 land systems and 11 land use groups were differentiated, the groups being formed by the amalgamation of similar systems. Land use groups were presented in colours on a 1 : 1 000 000 map [254].

The survey of land use in the Hunter Valley, carried out under the direction of T. M. Burley and organized by the Hunter Valley Research Foundation, is worth describing in greater detail. The survey covered about 22 thousand sq. km of agricultural as well as industrial and built up areas, and was made in stages. From the first stage, during which the surveyed area was preliminarily investigated, through the preparation and testing of the land use classification and the elaboration of the first version of the map on the basis of air photographs, verified in some doubtful cases when the photograph did not provide a reliable information, to the final stage when the ready, edited map was printed.

The adopted classification is very interesting. It is adapted to the limited legibility of air photographs and includes the seven principal forms: forestland (F), grassland (G), sown land (S), urban areas (U), barrenland (B), water areas (W), waterlogged areas (L). Letter symbols used to present those forms indicate their origin: capital letters signifying a natural form, and small letters — artificial forms, created by man's interference.

The cartographic output included three types of the maps: a detailed map on the scale 1 : 63 360, a generalized map on the same scale, and a general map, based upon the latter, *The Land Cover of the Hunter Valley* on the scale 1 : 253 440 [187, 39].

The problems of land use in the investigated area was also dealt with in some monographs which appeared in the series published by the Foundation [38—42].

### OTHER STUDIES BASED UPON METHODS RECOMMENDED BY THE COMMISSION

The series of the monographs published by the Commission includes also the work of D. L. Niddrie, devoted i.a. to land use in Tobago [224].

The enclosed one-colour map on the scale 1 : 63 360 shows the following categories: rain forest (virgin and secondary stands), mature secondary and bush, littoral woodlands, swamps, beach, cocoa, coconut, limes, bananas in pure stands, bananas growing in coconut groves, towns, villages and settlements (including recreation grounds and airstrip), land under bush fallow system of cultivation in past five years (including land under grass), bush fallow cultivated lands reverting to forest ("lastro").

Besides those already described, some other studies made in Asia, should also be listed. In 1949 the map of Ceylon, 1 : 253 440, was published by the local Survey Department in four sheets [189]. Colouring was used to denote coconut plantations, rice fields, tea plantations, rubber plantations, other crops, woodland protected; moreover, symbols were used to mark agricultural stations, experimental stations, citrus trees, etc. Using Ceylon as a case study R. Wikkramatileke discussed problems and difficulties with which a surveyor mapping land use in a tropical zone is confronted [321].

The map, *Malaya land utilizations map 1 : 760 320* appeared in 1953 [210]. Similarly as in the map of Ceylon colours were used to show rubber trees, rice fields, coconuts, oil palms, pineapples, miscellaneous cultivation, mining land, forest reserve; symbols gave topographical information. This map covers only the southern part of Malayan Peninsula. Equatorial forests were not specially marked, but left as white spots; this procedure was, however, not explained in the accompanying notes.

The colour map of land use (1 : 50 000) of north-eastern Thailand is included in volume 8 of "Occasional Papers".

A 1 : 500 000 map of Ghana was also made on the basis of the Commission's classification, adapted to local needs.

The review of surveys and maps prepared under the influence of L. D. Stamp or the recommendations of the Commission can be closed with the mention of a detailed map of Singapore, made on the scale 1 : 6 360 under the direction of Robert Ho.

#### THE UNITED STATES OF AMERICA

A great majority of American studies are not typical land use maps. They comprise certain original solutions, which -- even if no wider application has been made of them -- seem to be interesting.

The first study of land use in the United States was made at the end of the 19th century, under the leadership of J. W. Powell, director of the Geological Survey. Its object was to present areas requiring irrigation, dry-farming areas and also areas suitable for pasturage or afforestation [66, 161].

In the current century geographical field research, including also land use studies, was initiated by a group of Chicago geographers. They suggested that the methods of mapping and classification should be worked out and tested on small areas [151, 266]. C. O. Sauer's proposal foresaw a division into five main categories:

1. Barrens,
2. Woodlands (with the presentation of the type of forest growth and of the condition of the forest, including its composition and age),
3. Permanent pastures and meadows,
4. Cultivated lands,
5. Town sites.

On the basis of preliminary investigations certain categories were grouped according to their type or crop. It was discovered then that the most typical combination on the investigated area included: hay-oats-corn-pasture. All forms with a similar structure of uses were classified together and denoted by the same symbol [266].

Field research developed greatly in the next period because of growing requirements of the rational and efficient land use planning. At that stage three surveys sponsored by the Government were completed: 1. Michigan Land Economic Survey, 2. Tennessee Valley Authority (TVA), 3. Rural Land Classification Program of Puerto Rico [4, 117, 161, 209].

During the Michigan Land Economic Survey, begun in 1922, extensive material was collected which included information on land resources, types of soil and the character of the natural environment, vegetation, etc. [9, 268].

The second survey, completed within the development of the programme of the Tennessee Valley was undertaken in order to evaluate the potential possibilities of the natural environment. Preliminary experiments were made on some small areas and were followed by mapping based upon air photographs for the registration of field observations [118]. The fractional code method was used and areas homogeneous in their natural conditions and utilization were plotted on the base map by means of letter and number symbols. The notation was in the form of a fraction, with the main forms of land use in the numerator and information on the natural conditions in the denominator, e.g. slope, drainage, erosion, stoniness of soil, rock exposure, soil texture and soil fertility [4,96]. A detailed description of this method is included in Chapter 3.

A similar classification was adopted when the adaptability of land in Puerto Rico to agricultural purposes was investigated. Work was carried out by Northwestern University with the cooperation of the Puerto Rico Planning Board; it was directed by C. F. Jones. The island, divided

into 18 units, was mapped in 1949—1951 on the basis of air photographs on the scale 1 : 10 000 and topographical maps. The total area mapped then amounted to 8,881 sq. km [254]. The main object of these and other similar, though on a lesser scale undertaken studies was the evaluation of the natural conditions and their adaptability to agricultural purposes.

In 1950 the US Department of Agriculture, Agricultural Research Service, published the land use map (reprinted in 1958) prepared by F. J. Marschner on the scale 1 : 5 000 000, subsequently included in the National Atlas of the United States [213]. It covered the whole continental part of the country, islands and Alaska were excluded. The use of eight colours presented clearly the distribution of the main twelve principal uses and the areas of big metropolitan cities. Cropland was marked with red dots, each 1 mm in diameter and representing 10 000 acres (4,047 ha). Statistical data were taken from the 1945 Census. Cropland included fallow and idle lands as well as cropland used for pasture. In the order of the legend of the map the following categories were identified:

1. Cropland and pasture land (red dots overprinted on yellow),
2. Cropland, woodland and grazing land (red dots on light green),
3. Irrigated land,
4. Forest and woodland grazed,
5. Forest and woodland mostly ungrazed,
6. Subhumid grassland and semiarid grazing land,
7. Open woodland (pinon, juniper, aspen groves, chaparral and brush),
8. Desert shrubland grazed,
9. Desert mostly ungrazed,
10. Alpine meadows and mountain peaks above timber line,
11. Swamp,
12. Marshland,
13. Metropolitan cities.

The use of dark blue to denote the irrigated areas seems debatable, especially as no information was provided to explain their utilization.

In the later period the Department of Agriculture completed a broad survey, entitled the National Inventory of Soil and Water Conservation Needs, which included also information on land use. Areas, measuring approximately 2 per cent of the whole county, were selected for a sample study. They were plotted first on the road maps on the scale 1 : 63 360 and subsequently on air photographs on the scale 1 : 15 840. These maps were used for the detailed land use maps executed during field studies. In the final stage data were compiled and processed by



means of a computer, and thus relations between land use and its natural, economic and other conditions were determined [5].

As the most recent cartographic material and respective studies published in the US are not available in Poland, the current state of land use research cannot be described. It seems, however, that this type of research is not carried out on any larger scale at the present time.

#### ITALY

Italy is one of the first countries which responded to the initiative of the Commission to start land use surveying. However, the Commission's recommendations have not been followed. In 1950 the concept of the Italian map was prepared by a Committee, under Carmelo Colamónico. Its members were recruited from the Consiglio Nazionale delle Ricerche and the Centro Studi di Geografia Economica in Naples. As it was decided to utilize cadastral plans as the starting point, the Direction of the Cadaster took upon itself the task of preparing the plans for the purposes of mapping on the scale 1 : 200 000. The map was divided into 26 sheets covering the whole of Italy together with Sicily and Sardinia. Printing was entrusted to the Touring Club Italiano [43].

The first preliminary sheet with an extensive commentary, explaining the whole project of the map and the technique of its construction and providing a historical outline of some earlier Italian agricultural and woodland maps, was presented at the Geographical Congress in Washington [55]. Differences between the preliminary sheet and the subsequent ones lie more in the colouring than in the actual classification of land use; however, there was a discordance between the numbering in the preliminary sheet and the numbers given in the index.

The next sheets were printed successively, as a rule at the occasion of the consecutive international geographical congresses or international conferences of land use; they were exhibited on such events. Moreover, C. Colamónico used to present reports and information on the current stage of mapping [56—64]. The first two sheets of the final series (19 and 20) were prepared for the 18th Congress in Rio de Janeiro in 1956, whereas the last three (24, 25, 26) covering Sardinia, were published in 1968; the whole series was presented at the Congress in New Delhi in 1956. After 1956 the publication of maps was followed by a series of monographs entitled *Memoria illustrativa della carta della utilizzazione del suolo d'Italia*, characterizing the physical conditions and land use of each region. By 1972 fourteen monographs had been published.

Out of the 21 categories presented by the map 15 refer to agricultural uses, 4 to woodland, 1 to settlement and other forms of land use, and 1 to unproductive land.

1. Arable land,
2. Arable land with fruit trees,
3. Arable land irrigated,
4. Arable land irrigated with fruit trees,
5. Rice fields,
6. Gardens,
7. Vineyards,
8. Olive groves,
9. Vineyards with olive trees,
10. Citrus,
11. Orchards (mellow fruits),
12. Orchards (dry fruits — almond, nuts),
13. Deciduous woodland,
14. Coniferous woodland,
15. Mixed woodland,
16. Chestnut forests,
17. Dry meadows,
18. Irrigated meadows,
19. Pastures,
20. Unproductive land,
21. Settlement.

The occurrence of sugar beet and tobacco is indicated by letters “b” and “t” overprinted on arable land. The classification and method of denoting arable land do not point out to the differences existing between the intensive agriculture of Northern Italy and the extensive two-field rotation system with fallow, practised in the Southern part; moreover, the co-appearance of certain categories, like pastures combined with fruit trees, or pastures overgrown by dry shrubs, so typical of Mediterranean agriculture, was neither indicated.

The method of denoting grassland in dark blue and of pastures in light blue seems debatable. It is not only inconsistent with the recommendations of the Commission, but also it is misleading because almost the same shade was used in the grid to indicate waters (lakes and sea) [141].

Different colouring was also used for settlements; in the preliminary sheet red was used, whereas in the final version — grey and black.

The decision to take the road map as a base caused that all its elements, like rivers, roads, railways, points of altitude, the coastline and the contours of settlement were drawn in black. These elements form a, so to say, second plan of the map, on which the coloured picture of the distribution of land use was overprinted. The colours used to denote the categories were also imposed upon the roads, drawn

with a double line widely spaced. This feature is not of the utmost significance but in such cases where the road is at the same time a boundary between different land use forms, certain doubts can be raised; moreover, the colouring should not be imposed upon any road, drawn in such a way. The procedure resulted from certain preliminary recommendations, worked out by the Committee which, however, seem debatable as for the printing offices of the Touring Club Italiano a correct placing of colours would not present any difficulty. The map, printed in 10 basic colours, deserves special attention as the quality of its print is very high and the effect is very elegant and highly esthetic.

Besides the above described map another version was published in 1961. This map of land use in Italy, worked out by A. Antonietti and C. Vanzetti, was made on the scale 1 : 750 000 and contains 11 sheets [7].

This map, modest in appearance and less well done from the point of view of cartography, follows more closely the recommendations of the Commission, as it includes the following categories:

1. Arable land,
2. Intercultivated arable land,  
and perennial crops with preponderance of vineyards.
3. Intercultivated arable land and perennial crops with preponderance of olive trees,
4. Vineyards,
5. Olive groves,
6. Gardens,
7. Meadows and pastures,
8. Woodland,
9. Fallows,
10. Non-agricultural land,
11. Waters,
12. Settlement.

It served also as a basis for the preparation of a derivative map, on the scale 1 : 2 500 000 and became a point of departure for the World Atlas of Agriculture [324]. Though atlases are not the subject of this analysis, the map should, however, be described, even if shortly, as it comprises almost exclusively land use maps on either 1 : 2 500 000 (for separate regions of Europe, US, Japan and New Zealand) or 1 : 5 000 000 (for the remaining parts) scales. The following 16 categories of land use are shown:

1. Arable land,
2. Rice field,
3. Meadows and permanent grassland,

4. Coffee plantations,
5. Tea plantations,
6. Agave plantations,
7. Spice plantations,
8. Fruit trees, vineyards, bushes and orchard land,
9. Sugar-cane plantations,
10. Market gardens, gardens and nursery gardens,
11. Rubber plantations,
12. Woods and forests,
13. Virgin forest and jungles.
14. Rough grazing land,
15. Reindeer grazing,
16. Non-agricultural land.

Moreover a number of mixed categories was also included, like arable land with rough grazing, woods and forest with arable and rough grazing land, etc. The maps show the topographical distribution of uses with areas not less than 2 sq. mm on the map scale. Smaller areas (mainly of non-agricultural land) are added together on the basis of statistical data and shown as circles symbolizing a certain value, e.g. 1 000 ha, 3 000 ha, 10 000 ha. Their multiple gives an information as to the size of dispersed uses within a given administrative unit. This great and valuable cartographic opus, though published under the auspices of the International Association of Agricultural Economists and prepared by an international Committee for the World Atlas of Agriculture can be included among Italian works as it was initiated by the Italians, C. Vanzetti as the committee's secretary, and G. Medici as its chairman. Moreover, the atlas was printed by the well known works of the Istituto Geografico de Agostini in Novara.

#### JAPAN

Land use maps and their usefulness for planning are highly appreciated by Japanese authorities. In a country where only 16 per cent of the area is agricultural land and where the density exceeds 260 people per sq. km every piece of land should be utilized in the most rational way. In this situation the government, expressing its interest in a search for land reserves, appointed a Council of Land Resources, subordinated directly to the prime minister. In 1949 dispositions were given to carry out a detailed survey of land use, as the basis for future planning. The Land Survey Law was completed in February 1951 and work began [254]. Akira Watanabe explains in his short report that work is mainly performed by the Geographical Survey Institute. Other

institutions, engaged in this activity, have however adopted the same methods of work [320]. Maps are considered as classified and all relevant information is published only in Japanese. Under such circumstances only the map and its contents can be analysed.

The basic map was published on the scale 1:50 000 and does not comprise Hokkaido island, covered by another map on the scale 1:200 000 in 12 sheets. On the basis of material available it is hardly possible to find any information as to the current state of the survey and the degree of the country's coverage by the 1:50 000 scale map. L. D. Stamp, who had been invited by the Council of Land Resources to visit Japan in 1955, was informed that a quarter of all sheets had already been published [254]. Watanabe, however, disclosed in 1969 that 312 sheets had already appeared. This signifies that almost one-third of Japan, with the exception of Hokkaido island, was mapped [320]. The original Japan index of thematic maps (March 1974) informed that only about 70 sheets had been printed. Taking into consideration that 14 years elapsed (if the date is correct) such a result does not seem very imposing. The map departs largely from the recommendation of the Commission and is an original work, uninfluenced by any previous models or productions. Arable land, subdivided into paddy fields and upland fields, is represented by the various shades of yellow and orange or green hachure lines. In the first subdivision fields with a single crop, two-three or more crops and fields with perennial crop were distinguished. The second subdivision besides those mentioned above contains some additional categories, like fields cropping three times during two years or land with alternate fields and woods. Small brown symbols, overlaid on the background, denote the separate groups of crops, e.g. industrial crops, fodders, vegetables, flowers, etc. Orange and purple are used to show perennial crops with purple denoting mulberry groves. Brown symbols on the orange background denote the various kinds of fruit trees: apple, cherry, citrus, etc. The eight shades of light blue and green, obtained by means of overprinting yellow on blue and brown symbols provide extensive information on woodland, i.e. its age, type 1) natural thin (sparse) wood, 2) cut-over area, 3) young tree, 4) shrubbery, 5) coniferous tree, 6) mixture of coniferous tree and broad-leaf tree, 7) broad-leaf tree, 8) bamboo. Moreover, Latin letters in brown indicate the kind of the tree, i.e. M — pine, H — Japanese cypress, Ab — Chinese black pine, etc.

Grassland (yellow with delicate blue hachure lines) is divided into four categories, marked with brown symbols: meadows or pastures, bamboo grass, grasses, water plants.

The group „others” comprises the following: pastures or pastures

used only periodically, national forests and parks, salt fields on the coast, bare land, waters.

In the category „settlement” eight subdivisions were introduced, indicated by brown hachure i.e. residential districts, transport areas, public utility areas, villages, commercial districts, heavy industry, light industry and fish industry.

Main roads are marked in purple, which is the colouring of the mulberry plantations, whereas for railways, tramway lines, other roads, railway stations and stops brown is used.

Various lines in brown are also used to show e.g. the range of terraced fields and drained fields; special symbols denote dams and dikes, differentiated in their utilizations (for power or agriculture), water reservoirs and moreover: harbours, piers, meteorological stations, mines, power stations, etc. Peat bogs and marshes are also represented.

The map approached from the traditional angle, i.e. based upon a hypsometric scale of colouring, makes an impression that river valleys with paddy fields, coloured yellow and orange, look very much like banks or hills overlooking forests marked i.a. in blue. As the latter grow in Japan mainly on the highlands or mountain slopes, lying a hundred or even several hundred metres over the valley bottom, the impression is misleading. Another feature of the map, which deserves some criticism, but can be discovered only when you analyse it in great detail, is the fact that the authors retained all topographical contents (thick contour lines at every 20 m, altitude points, settlement, road system etc.) printed in ochre, over which other colouring was imposed. This makes the picture very confusing and reduces the readability of the map. Moreover, the standard of printing is not always very high. For example, purple is often badly matched with the main roads or railway lines of the topographical base. This was caused i.a. by the fact that the maps were made by various institutions in the separate provinces and were printed at various times by different printing works. Such a procedure resulted in some deviations in the shades of colours and uncomplete coverage, with the substance limited to the area of the province in which they were prepared. The explanatory notes are only in Japanese, and not, as Stamp informed, in Japanese and English [254].

Besides the 1:50 000 map the separate provinces prepared maps on the scale 1:25 000 of certain selected areas on the basis of the same recommendations. Their contents and explanatory notes, again only in Japanese, are identical with the map, described above. Two languages were used only on the 1:200 000 map.

Finally, the *National Atlas of Japan*, published in 1972, comprises a land use map on the scale 1:2 500 000, which presents the distribu-

tion of nine land use forms (built-up area, paddy field, cultivated area, orchard, mulberry field, tea field, forest, scrubland and grassland, barren land) in a very legible way taking into consideration the smallness of the used scale.

#### WORKS OF THE DIRECTORATE OF OVERSEAS SURVEYS IN AFRICA

The Section of Land Use Surveys, specially appointed for this purpose within the Directorate of Overseas Surveys, started the mapping of land use on the basis of air photographs in the countries where no such maps had been produced. A. R. Stobbs described an agro-ecological project of a survey in Malawi, including also a land use map to be subsequently plotted on the sheets of a 1 : 50 000 map [291]. It was planned to utilize air photographs and computers for processing statistical data [148].

The Directorate completed also land use maps on the scale 1 : 25 000 for Gambia and on the scale 1 : 40 000 for Sierra Leone. The map of Gambia comprises 35 sheets and was printed in six colours. The following 15 categories of land use were differentiated:

1. Woodland,
2. Fallow bush,
3. Grass,
4. Ground nuts,
5. Ground nuts, sorghums and millets,
6. High mangrove,
7. Low mangrove,
8. Grass marsh,
9. Barren marsh,
10. Reeds,
11. Standing water in marshes,
- 12—15. Rice.

The map of Sierra Leone, printed in four colours (blue, yellow, grey and black) in 1960, comprises 10 main categories of land use and built-up areas: woodland, farm bush, (including cultivation), three types of mangrove swamp, swamp forest, riverine and aquatic grassland, swamp areas under water, swamp rice.

The recommendations of the Commission, both in relation to colouring and to the content, were here disregarded; moreover, they greatly differ between themselves in their underlying premises. Different colours were used for the same or similar crops. This points to lack of a uniform concept of land use mapping.

## OTHER STUDIES

There exist other many studies, on a smaller range and of lesser significance, sometimes departing in their contents from the criteria adopted in the present study.

The reports of the Commission often mention west-german studies; however, these are mostly in the form of annexes to monographs. A special mention should be made of a sheet of the land use map from the vicinity of Cologne and Bonn; compiled in 1957—1959 by V. Herzog, who used a topographical map as its base, the map was published on the scale 1 : 100 000 in 1968 [113]. The presentation of the category of woodland is however startling; he did not give any information as to the stand of timber, or at least on the condition of the forest but indicated the forms of ownership by using various colours on the space covered by the woodland. Yellow was used to denote arable land and brown hachure lines, of various intensification indicating the percentage share, to mark the main groups of crops: cereals, roots and fodders. Areas under vegetable cultivation, orchards, vineyards, meadows, pastures, etc. are shown separately; industrial areas are also treated as a separate category of land use. In most of west-german studies some kinds of rural landscape maps were produced. But although each of them included some elements of land use, they differed from the standard type. The most typical examples can be found in the *Atlas of Rural Landscape (Atlas der Deutschen Agrarlandschaft)*, edited by Erich Otremba.

Out of studies made in the western hemisphere, besides the Canadian and American efforts already discussed here, attention should be paid to the study by E. Coelho de Souza Keller, executed in the State of Sao Paulo, Brazil [154, 155]. The field survey of this area, spreading over almost 5 000 sq. km was made on the basis of air photographs. The following classification used in the resulting 1 : 50 000 map corresponds with the recommendations of the Commission with some minor modifications necessary because of local conditions.

Non-agricultural uses — inhabited areas, state enterprises, transport facilities, experimental stations.

Horticulture — small gardens.

Perennial crops — coffee, oranges, bananas with intercropping.

Annual crops — a) continuous cultivation of the same crop on the same field (sugar cane, rice), b) cultivation with regular or irregular rotations (irregular rotations of rice, maize, cotton, manioc), rotation: cotton—maize; rotation of cereals: rice, maize and cultivated pastures — utilized in 3—4 years, c) crop rotation.



Natural and artificial grazing land.

Woodland — natural and with subsidiary cultivation, afforestation.

Uncultivated land.

Irrigated land, waters (lagoons, ditches).

Unproductive land (rocks, sands).

The category of arable land was expanded, whereas natural and artificial grazing land was presented together, as their differentiation is hardly possible.

The Democratic Republic of Viet Nam produced an original map on the scale 1 : 500 000, in which 15 categories of land use were differentiated.

French studies are also worth mentioning. A. Perpillou compiled maps of the various parts of the country, which he himself defined as the land use maps; they present the current forms of land use in relation to the terroir type [103, 231, 232].

Attempts at land use mapping in the Nord department of France were presented by P. Flatres [97]. He was concerned with the following three types of maps: the 1 : 50 000 map of main or permanent types of land use, the 1 : 10 000 map showing the detailed distribution of crops and livestock and the 1 : 10 000 map of crop rotation. Presented methodological problems are — according to the author — debatable.

A specific method of preparing a land use map on the basis of slides or photographs made from an aeroplane was applied by C. H. MacFadden from the University of California in Los Angeles. Directly after the end of hostilities in World War II he made an attempt to utilize a 35 mm camera and an aeroplane for surveying the area [204, 205]. He carried on his experiments in Southern California for four years. Flying a light craft at low altitudes he photographed, using various types of black-and-white films, negatives, coloured diapositive films, from which he later on produced slides. Thus, he collected documentary material for the investigated area. Photographs were oblique, taken at an angle from 20° to 40° and clearly showed all forms of land use and their coverage.

MacFadden's method was also applied in 1957 when the land use map of Nepal was prepared. This, almost schematic, map on the scale 1 : 2 534 400 differentiates:

1. Arable land (yellow),
2. Woodland and highland pastures (green),
3. Unproductive land (white) [152, 153].

In Nepal, land use was also surveyed by R. Schmid on the basis of air photographs during the realization of some other studies commis-

sioned by the Service for Technical Cooperation with Developing Countries of the Swiss Government [267].

Quite interesting, though lacking cartographic aspects, is a survey made by M. and R. Light of the various form of African agriculture and rural settlement from the southern end of the continent to Cairo, based upon photographs taken by the authors from an airplane [202].

#### POLISH STUDIES IN THE INTERWAR PERIOD

Irrespective of the principle adopted in this study to exclude atlas maps, the chronological survey of Polish land use maps should begin with a map included in the *Geographic-statistical Atlas of Poland* by E. Romer, published in 1916. In the same way as the atlas, which opened a new period in the history of Polish economic cartography, the map marked also the birth of a new type of agricultural maps, i.e. the land use map. Moreover, it seems that even the term "land use" included in its title was then used for the first time. As most maps in the atlas, the land use map was made by means of isopleth methods and presented the area of agricultural land in relation to the country's area. Moreover, richly and poorly afforested areas were also denoted by means of symbols.

The first attempt at a synthetic presentation of the problem on the basis of proportions between arable land and grassland was a map of land use in the Eastern Carpathians made by W. Kubijowicz [183]. In modern terms this map would be referred to as presenting land use orientations. His classification included:

1. Unproductive land,
2. Woodland,
3. Grassland,
4. Areas with a predominance of meadows over arable land,
5. Areas with a predominance of arable land over meadows and meadows and pastures jointly over arable land,
6. Areas with a predominance of arable land over meadows and pastures,
7. Areas with arable land exceeding 50 per cent of the total area.

The first three categories, i.e. unproductive land, woodland and grassland were differentiated on the basis of topographical maps, the remaining are the effect of the interpretation of statistical data for each commune and were drawn by means of the isopleth method. The map, originally made on the scale 1 : 200 000, was greatly diminished in the process of publishing to an undefined scale.

Certain elements of the land use map can be also found in some

landscape maps or plans. A not very successful specimen of this type is the landscape map of Nowy Sącz, published in 1927 on the scale 1 : 12 500 by W. Kubijowicz [184]. A much better effort is a *Landscape plan of Tarnów*. This very interesting contribution, endowed with rich content, was annexed to a monograph of Tarnów and its environments, published in 1930 by Z. Simche [278]. The plan, compiled in 1927, was printed in seven colours and contained i.a. such information, typical of a land use map, as arable land, meadows, vegetable gardens, lawns, parks, a broadly developed detailed classification of built-up areas, road and railway systems, hydrography and hypsometry with contour lines at every 5 m. The same author in his article *On the types of landscape plans of towns*, published in 1928, made an attempt to survey all Polish and foreign literature on the subject [277].

For the Second Congress of Slavonic Geographers and Ethnographers, held in 1927, Z. Hołub-Pacewiczowa prepared a map presenting the settlement and economic problems of pastoral activity in the Tatras. Its scale was 1 : 75 000 and the following seven forms of land use were differentiated as economic areas:

1. Arable land,
2. Arable land and forest meadows,
3. Forest meadows,
4. Pastures,
5. Pastures dispersed among unproductive land,
6. Woodland (utilized in the pastoral activity up to the boundaries indicated in the explanatory note),
7. Unproductive land (rocks and major complexes of dwarf mountain pine) [114].

This multi-coloured map is specially interesting because of the high quality of printing and graphic presentation. Although the material plotted on the intensive, hachured drawing of the mountainous relief was abundant and all the details of the situational drawing were retained, the map is highly readable. Excellent drawing, clever combination of colours and a very precise way of printing by the works of the Military Institute of Geography undoubtedly make it the most brilliant specimen of all interwar maps discussed in this study, even though land use is only a background feature.

In her other study Z. Hołub-Pacewiczowa inserted a map showing the distribution of crops on land owned in 1787 by the town of Twardoszyn, based upon the cadastral plan [115]. Errors in the description make it impossible to determine the scale of the reproduced map. The explanatory notes mention 14 main categories:

1. Arable land,
2. Meadows,
3. Reconstructed meadows,
4. Meadows on clearings,
5. Privately owned plots with no further identification,
6. Reconstructed valley pastures,
7. Valley pastures,
8. Alpine meadows,
9. Clearings,
10. Forest on swamps,
11. Swamps,
12. Forest,
13. Buildings,
14. Roads.

The map showing the utilization of land in Western Polesye was published in 1930 [264]. Its author, E. Rühle, based his work upon topographic maps on the scales 1:100 000 and 1:200 000, statistical data and field surveys. After determination separate uses were plotted on the topographic map and confronted with statistical data for each commune. Its final scale was 1:200 000.

Methods of land use mapping were discussed shortly by W. Ormicki [227]. This author also described the structure of agricultural land use in Cracow and its direct vicinity [159].

S. Leszczycki prepared two maps, as illustrations to his publications [200, 201]. The first map covered the Beskid Wyspowy Mountains and was entitled *A landscape plan (distribution of cultures)*. It was based upon cadastral plans, the contents of which were plotted on a 1:25 000 map and subsequently tested in field research. S. Leszczycki differentiated the following six categories:

1. Woodland,
2. Meadows,
3. Pastures,
4. Arable land,
5. Stone fields — unproductive land,
6. Roads.

Rich material was utilized by the same author for the preparation of his map, *The distribution of agricultural land*, published in the book *The Region of Podhale*. An original survey on the scale 1:25 000 was made for the western part of the examined area. The survey of the Tatra Mountains was based upon the economic-settlement map of Z. Hołub-Pacewiczowa, discussed above, whereas a map made by S. Jarosz was utilized for the Gorce Range. The eastern part was mapped on the

basis of the cadastral plans, 1 : 25 000 maps made then by the Office of the Regional Plan for Podhale and topographic maps 1 : 100 000. The map, printed on the approximate scale of 1 : 500 000, presented seven categories of land use:

1. Arable land,
2. Woodland,
3. Meadows,
4. Pastures,
5. Damp grounds,
6. Unproductive land,
7. Peat bogs.

The above mentioned maps by S. Jarosz contained two maps on the scale 1 : 50 000, prepared by field research in 1932. The first one, *The geographic-sylvan map of the Gorce Range*, with an erroneously given scale, was printed on tracing paper and had to be placed over a second chart, *The map of the distribution of the species of forest trees and property relations in the Gorce Range*, printed on map paper [147].

In the first map the author differentiated the following categories of woodland:

1. Primaeval forest,
2. Primary forest,
3. Semi-primary forest,
4. Artificial forest,
5. Parent forest,
6. Older deforested areas,
7. Deforested areas originating from the last fifty years,
8. Deforested areas renovated by sowing,
9. Deforested areas renovated by self-seeding.

In the second map he showed the species of trees and property relations using the following 12 categories: 1) spruce, 2) fir, 3) beech, 4) larch, 5) sycamore maple, 6) pine, 7) property of big landlords, 8) commune property, 9) common property, 10) peasant private property, 11) glades, 12) forest range. Topographic maps on the scales 1 : 25 000 and cadastral plans were used as base material.

The *Map of cultures in the basin of the proper Czeremosz* by W. Przepiorski on the scale 1 : 128 400 presents the distribution of main land uses in that area [237]. Prepared on the basis of cadastral plans and field observations it covers an area of 113 sq. km. The following categories are presented: arable land, meadows and pastures, woodland, unproductive land, boundaries of the communes, mountain ranges and rivers.

To close the review of pre-war Polish studies that of A. Malicki should be mentioned. This study is illustrated by land use maps of numerous localities (Belz, Busk, Uhrynów, Kulików, Sokal, etc.) and their direct neighbourhood [211]. Using 1:25 000 topographic maps as base material the author differentiated arable land, gardens, pastures, buildings, waters, peat bogs.

A common feature for a majority of described land use maps is a certain casuality in their production; they covered small areas and served as illustrations of articles not always concerned with the problems of land use [143].

#### POLISH POSTWAR STUDIES

1946—1952. Plans for the reconstruction of Poland's agriculture devastated during the hostilities were an incentive to start the preparation of a land use map. Whereas the interwar research and other work connected with land use were some individual, spontaneous efforts undertaken on the occasion of another kind of studies, the postwar period was characterized by continued work towards the elaboration of a method for surveying the whole country, and almost all field studies, even if confined to some small areas, served this purpose.

The whole project was initiated by K. Dziewoński, the then Director of the Research Section of the Central Office for Physical Planning (C.O.P.P.). During his war-time stay in England he had carefully studied the British survey and found it a very useful enterprise. Encouraged by the English succes he had made it his goal to carry out a similar survey in Poland.

Preliminary premises and the survey method were prepared by A. Jahn, specially invited by the C.O.P.P. His project, including a draft of the instruction, was discussed on a specially organized conference [139]. Jahn suggested that material collected during field surveys should be plotted on topographic maps on the scale 1:25 000 and subsequently the maps should be reduced to the scale 1:100 000. Following the assumption that the topographic 1:100 000 map would serve as base material for the preparation of the final version its colours (four shades: brown, blue, green and black) were to be retained. The project differed from the recommendations of the Commission only slightly, and foresaw the following categories:

	Symbols	Colours
Arable and fallow land	R	orange
Orchards and gardens	O	brown
Meadows and pastures	L and P	light green

Woodland	L	dark green
Non-agricultural uses (built-up areas)	Z	red
Unproductive land	N	pink

During the elaboration of this instruction A. Jahn utilized experiences gained in field research carried out under his supervision in the Vistula Valley (between Solec and Dęblin) in 1946. Maps made during these first postwar field studies of land use were not published.

In 1949—1950 on the basis of the instruction, slightly modified and adapted to specific local conditions of an urban area, K. Bromek prepared land use maps on the scale 1 : 25 000 and 1 : 5 000 for Cracow and its direct neighbourhood [33]. The 1 : 25 000 map was commissioned by the Regional Directorate of Physical Planning in Cracow, because the local authorities needed it for the preparation of a plan of economic development of Cracow and its suburban zone. Seven categories of land use were differentiated on the 1 : 25 000 map in the following way:

1. Arable land (orange),
2. Meadows (light green),
3. Pastures (yellow),
4. Woodland (dark green),
5. Orchards and gardens (brown),
6. Built-up area, factories, mining, storage, roads, railways (red),
7. Unproductive land (pinkish purple).

The 1 : 5 000 map, covering the city in its administrative boundaries, was commissioned by the Presidium of the City Council. The classification was expanded to 12 principal, 11 special and 9 mixed and temporary uses.

These maps were never published with the only exception of two segments in black, enclosed to an article written by K. Bromek [33].

The subsequent survey was undertaken in 1952 under L. Ratajski and covered the areas of Dwikozy, Czachów, Solec and Janowiec [244]. Unpublished 1 : 10 000 maps were drawn on tracing paper; the classification and colouring differed from A. Jahn's instruction. The explanatory notes included the following denotations: physical unproductive land A (yellow hachures), economic unproductive land B (black), orchards and gardens (blue), woodland (green), cereals (yellow), meadows (orange), pastures (red). Lack of other crops but cereals is a striking feature. Possibly, cereals should be interpreted as synonymous with total crop land.

These three surveys exhaust in principle the list of first attempts to work out the method of a detailed survey. In this initial period,

covering the years 1946—1952, it became clear on the basis of experience gained that the detailed survey of the whole country was an enterprise greatly exceeding current organizational, technical and financial means. The same conclusion was also reached at a meeting of the Section of Scientific Affairs of the Polish Geographical Society, held in Poznań in May 1948 [310]. Thus, the conception of full coverage was abandoned for an unspecified period, whereas efforts to work out the method of such a survey were continued.

Poland's General Land Utilization Map in 1 : 1 000 000 scale. Convinced that work on a small scale could precipitate the mapping of land use in the whole country, F. Uhorczak put forward a proposal that topographic maps on the scale 1 : 100 000 should be used as base material for the preparation of a land use map on the scale 1 : 500 000. He corroborated his suggestion by a thus made map for Cracow and its vicinity. His technique implied the drawing and making of the transparencies of the separate uses, and a subsequent reduction by means of photographs to the scale 1 : 500 000.

The task to elaborate the method was entrusted to the Commission of the Polish Geographical Society, under F. Uhorczak, composed of R. Galon, A. Jahn and M. Kielczewska-Zaleska. Following its recommendations the scale 1 : 300 000 was accepted as a basic scale for the elaboration of maps on a smaller scale. Experimental maps made in the Lublin centre, under the supervision of F. Uhorczak, revealed that the spatial location of meadows-pastures and settlement was incorrect and therefore the conception of the 1 : 300 000 scale was abandoned.

The subsequent Commission, which included F. Uhorczak (chairman) and K. Bromek, M. Kielczewska-Zaleska and J. Wąsowicz, was appointed in October 1950. They proposed to produce a 1 : 300 000 map (i.e. on the scale used for soil and geological maps) as the final version, with 1 : 100 000 as a working scale. The Commission was entrusted with the preparation of the instruction.

The Lublin centre undertook the task to prepare such a map for the area of the Lublin voivodship. Their project of a coloured map on the scale 1 : 300 000, showing four categories of uses (hydrography, meadows and pastures, woodland, settlement), printed separately in six various combinations and finally on one sheet, presenting all forms of land use together, was presented in Lublin in 1952. Final conclusions were drawn during a discussion from experiences of all geographical centres cooperating in the preparation of the map. The Lublin centre (personally F. Uhorczak) was entrusted with the organization and co-ordination of the whole scheme. Work was carried out in the centres mentioned below on 1 : 100 000 maps in the following way. The Lublin



centre, besides the organization and consolidation of all maps of voivodships into one map covering Poland as a whole, prepared the plates of waters and settlement for all voivodships; moreover, this centre compiled the maps of the greatest number (seven) of the voivodships. The Cracow centre prepared the map of the Cracow voivodship; the Łódź centre — those of the Łódź and Kielce voivodships; the Poznań centre — of their own voivodship: the Toruń centre — of the Bydgoszcz and Gdańsk voivodships; the Warsaw centre — of the Warsaw and Olsztyn voivodships; and the Wrocław centre — of the Wrocław and Opole voivodships.

In 1953 the Polish Academy of Sciences called into being the Institute of Geography, which in turn organized a Laboratory of Land Utilization Maps in Lublin. Under the directorship of F. Uhorzczak the laboratory continued work on the map.

The first two maps of Poland on the scale 1 : 300 000, one showing waters and the other meadows and pastures, were completed in 1954. Following the discussions held during the Congress of the Polish Geographical Society in Lublin and a session of the Institute of Geography in 1955 the scale was changed to 1 : 1 000 000 leaving the preliminary working scale 1 : 100 000 unaltered. Five maps of the main uses (waters, meadows and pastures, woodland, arable land, settlement) were published. Although the reduction of the area was hundred-fold and of the two assemblies one was on the scale 1 : 300 000 and the other to the 1 : 1 000 000 scale, the maps were comprehensive. Initial ten maps combining two elements were changed into two maps combining three elements, two maps with four elements and the final single map presenting all five categories. The negative of the arable land map was subsequently utilized for printing the four remaining uses in brown, whereas the area of arable land was left blank in the hope that certain other problems, like the cropland area, soils, etc. could be plotted later on. Altogether the following 22 maps, including also that of the administrative division, printed on tracing paper were published: 1) waters, 2) meadows and pastures, 3) woodland, 4) arable land, 5) settlement, 6) waters combined with meadows and pastures, 7) meadows and pastures combined with woodland, 8) meadows and pastures combined with arable land, 9) arable land and settlement, 10) waters and woodland, 11) waters and arable land, 12) waters and settlement, 13) meadows and pastures combined with settlement, 14) woodland and arable land, 15) woodland and settlement, 16) waters and forests combined with meadows and pastures, 17) waters, forests and arable land, 18) waters, meadows and pastures, woodland combined with settlement, 19) waters, meadows and pastures, arable land, and settlement, 20) waters, meadows

and pastures, woodland, arable land combined with settlement, 21) arable land (a negative), 22) administrative division (on tracing paper).

Printing was completed in 1957 and a commentary describing the history and methods used was published by F. Uhorczak in 1969 [310].

*Poland's General Land Utilization Map* has many undebatable merits, mainly owing to the method adopted for its preparation. It was for the first time that such a detailed picture of the river system, grassland, woodland, arable land and settlement network, showing its regional differences and not distorted by generalization, was made on such a scale for Poland as a whole. All elements were plotted in their true proportions with the exception of settlement. Fearing a possible distortion of the character of settlement during the process of mechanical reduction the authors adopted an equidistance of 50 m from every building marked on the 1 : 100 000 map. Thus, the detailed content of the 1 : 100 000 map was preserved on a much smaller scale. The minutest detail was 1 ha, presented as a square with an arm of 0,1 mm, which made it possible to see it with a naked eye. The five maps of the separate uses were exhibited during the XVIIIth International Geographical Congress in Rio de Janeiro. They were generally thought a true achievement of the Polish geography.

1953--1956. The second stage in the preparation of the method of the detailed land use survey began in 1953--1954, again on the initiative of K. Dziewoński. A detailed land use survey was then made in the neighbourhood of Sandomierz on the scale 1 : 25 000 and the following six main uses: agricultural (arable) land, grassland, unproductive land, build-up areas, orchards and gardens, woodland were presented. On the basis of subsequently collected experiences the powiat of Mrągowo was mapped in 1955/56 under the supervision of K. Dziewoński with the cooperation of J. Kostrowicki and the powiat of Bielsk Podlaski under the supervision of J. Kostrowicki. The methods of field work and cartographic presentation of the survey material were described in an instruction [86]. It was for the first time that the scope of investigations was not limited to the identification of the principal uses, which had been the accepted procedure in the previous research of this type, and the substance of the map was largely enriched. As far as the arable land was concerned, separate colouring was used to denote various groups of crops, classified as cereal, root, fodder, industrial and gardening crop rotations; black symbols were chosen to mark the length of rotation cycles (1, 2, 3, ... years). Meadows and pastures were divided into: dry (grond), flooded and boggy with improvements marked. Six types of woodland comprised coniferous forests (bors), mixed forests (lasobors), grond forests, lęg forests, highland forests and

monocultures with a great number of subtypes; forest age was also marked. Settlement and unproductive land categories were also subdivided. The most important feature of this method was that fields were not differentiated as separate units, as was the case before, but arable land was approached as an entity within an accepted unit (village, state farm, collective farm), for which the relative preponderance of separate groups of crops was determined on the basis of statistical data.

Simultaneously with the 1956 instruction the first version of the *Detailed Land Use Map (samples)* was printed in 18 colours; it covered the area of three sections of the Mrągowo powiat; the explanatory notes were in English. The map was presented by K. Dziewoński at a plenary session of the Institute of Geography of the Polish Academy of Sciences. Subsequently, the map was also demonstrated by this scholar on the International Geographical Seminar at Aligarh (India), and by J. Kostrowicki on the XVIIIth International Congress in Rio de Janeiro [84, 85]. The method was again assessed along with the general map as an achievement attained by the Polish geographers. The high opinion found its expression in the appointment of Poland's representative J. Kostrowicki as a regular member of the Commission on World Land Use Survey of the International Geographical Union.

The activity of the Section of Agricultural Geography in the Institute of Geography of the Polish Academy of Sciences from 1956 to 1959. The Section was called into being in 1956 and J. Kostrowicki was appointed its head. This new unit continued research oriented towards the elaboration of methods to be used in the preparation of a land use survey. Investigations concerned with land use in urban areas were carried out by the Section of Population and Settlement Geography of the same Institute [107, 241—243]. Later on, the Section of Agricultural Geography of the Geographical Institute in Warsaw University started investigations of land use in industrial areas [298—301].

The methods employed in field surveys as well as of collecting and processing the data were gradually improved and developed on the basis of new experiences and results obtained during an increased number of field works carried out in various natural conditions and undertaken on which various types of agriculture were practised. The Section cooperated also with some departments of Economic Geography, predominantly of the Jagiellonian University, Higher Pedagogical School in Gdańsk, Copernicus University in Toruń and University of Łódź [163]. The Cracow Centre, under K. Bromek and subsequently by C. Guzik continued intensive research into land use and worked out a large number of 1 : 25 000 maps covering all (or parts of) the powiats

of Limanowa, Olkusz, Chrzanów, Oświęcim and Nowy Sącz [34, 108, 109]. The Gdańsk centre also carried out its own research work of the land use in the Gdańsk voivodship [105, 214, 265].

Two consecutive instructions for 1957 and 1958 show the range of the methodical changes which occurred in that period [307, 308]. The first comprehensive instruction for the detailed land use survey was published in 1959 [126]. In the instruction, entitled *The Polish Land Utilization Survey*, J. Kostrowicki reported that up to the end of 1958 research had been carried out in 17 points on an area of 7,580 sq. km [162]. The content of the maps became richer thanks to new experiences gained then and a complex survey of land use presented such information as: property relations, agrarian structures, agrotechnics, arable land use orientation, livestock breeding, gardens, perennial crops, permanent grassland, woodland, waters, settlement, mining areas, industrial-agricultural, industrial, commercial areas, transport and communication areas, public activity areas, recreation areas, as well as unproductive land and special areas. The main categories, listed above, were furthermore divided into subtypes and subcategories. The content of the new map was undoubtedly greatly enriched [164, 166, 174].

The next, revised edition of the instruction did not bring about any greater changes [127]. It was published in 1960 together with an abridged version in English, requested by foreign specialists in this field [165].

The method, together with a specially prepared map of Nieborów on the scale 1:25 000, printed in 16 colours, were presented at the Anglo-Polish Seminar held at this village between 15 and 18 September 1959 [14, 167].

Work on the detailed land use survey undertaken by the Department of Agricultural Geography in 1960—1970. The year 1960 opened a new period. The Section, raised to the rank of a Department, started to apply their method also in land use surveys undertaken in certain other European socialist countries [12, 16, 178]. This experiment permitted the Polish geographers to test its applicability in different conditions, and contributed also to its further improvement.

The determination of arable land use orientations was then re-examined and certain new categories, unknown in Poland, were included. The Polish method became more universal and could therefore be applied also in conditions other than those existing in Poland.

The third, and so far the last version of the instruction appeared in 1962 [128]. The method was formally not changed, and only some new symbols were added to the master key. The instruction was utilized for the preparation of the sheet Chroberz, made on the scale 1:25 000 in

a Polish and English version [82, 294]. This model sheet of the Polish survey was printed in 16 colours and a legend, based upon a complete 24-coloured key and containing almost 300 items, was inserted in the English version of the instruction [169]. The same key was also utilized in the preparation of a series of maps, published in the volume *Land Utilization in East-central Europe, Case Studies* [191]. This collection, edited by J. Kostrowicki, contained studies presenting common efforts of geographers from the socialist countries; it included 13 land use maps on the scales 1 : 25 000 and 1 : 50 000 of some selected areas, of which 6 from Poland, 5 — from Yugoslavia, 2 — from Bulgaria and 3 — from Hungary. The latter three maps were printed in black-and-white and prepared with a different method. All these maps and the sheet Chroberz were exhibited during the XXth International Geographical Congress in London, arousing much interest. Both the maps and the method were commented in foreign geographical literature [23, 51, 186, 256, 269, 274, 286, 293]. The Polish method of land survey and of its cartographic presentation was also applied in Czechoslovakia, Hungary and Yugoslavia. The same method was used by W. Biegajło when he prepared a 1 : 25 000 land use map of the commune of Banon in Provence, France, printed in black-and-white as an enclosure to his articles [10, 11]. This subject will be discussed in more detail in the subsequent part of this study. An American geographer, P. B. Alexander, used also the Polish method when he surveyed the Karst territory of Yugoslavia [2].

\*

The content of the Polish detailed land use map, in its final coloured full version adopted in all recent publications, is much richer than any other map of this type produced so far. At the same time it is fully comparable with other maps, as it conforms to the recommendations of the Commission, as far as the main categories of land use and the colouring are concerned. The reproduction of the explanatory note in full would take too much space and therefore only its main entries will be listed here [15, 165, 169, 295].

- |   |                                       |
|---|---------------------------------------|
| 1. Agricultural land:                               |                                       |
| a. Arable lands                                     | various shades of brown,              |
| b. Perennial crops                                  | carminé.                              |
| c. Permanent grassland                              | various shadows of yellow and orange, |
| 2. Woodland   | various shades of green,              |
| 3. Waters   | various shades of blue,               |
| 4. Settlement and associated non-agricultural land: |                                       |

a. Residential	vermillon,	
b. Industrial	}	
c. Mining		
d. Agricultural-industrial		various shades of purple,
e. Commercial		
f. Communication		
g. Public utilities		green,
h. Recreational	vermillon and yellow,	
i. Other built-up areas	vermillon,	
5. Unproductive land	grey,	
6. Special territories	grey.	

The various categories of land use are plotted on a 1 : 25 000 map during field research. Aerial photographs, cadastral plans, management plans are also used as additional material. As explained before the subdivision of arable land is carried out for each basic unit, i.e. village, state farm, collective farm; data obtained from the Survey Departments of the local administration served to plot the boundaries of such units.

Neither separate fields nor individual crops cultivated during the survey are presented, but the total area of arable land is treated as a whole for every basic unit, for which dominance or co-dominance of individual groups of crop combinations are established on the basis of statistical data and marked on the map. The share of separate groups of crops in the total cropland area and the domination of certain crops within each group are indicated by the stripe cartogram, which is a variety of the structural cartogram. Separate fields were not differentiated on the grounds that because of crop rotation such a map would be out of date by next year. Practical experience gained during many years of research carried out by the Department of Agricultural Geography has proved that changes in crop combinations, which are presented in the cartogram, are much slower. Additional information plotted on the area of arable land includes: size of holdings, fragmentation of arable land, crop rotation systems and intensity of livestock breeding.

Predominant kinds of trees or shrubs as well as the age (young and fully productive) of the trees in the orchards are indicated on the areas under perennial crops. The types of grassland, identified on the basis of their classification, are marked in various shades of yellow and orange, whereas symbols present their utilization and the current management system.

Dominant species and age of forest trees are given as well as information as to the system of forest management for all the area of woodland.

Waters are subdivided according to their utilization and fishing type of waters.

The character of settlement, the height of elevations, the type of industrial areas, as well as the character and origin of unproductive land are also indicated.

Alongside with mapping a wide range of information are collected during land utilization surveys, enabling the user a subsequent detailed analysis of the investigated area [172].

The Polish land utilization survey being conformant with the recommendations of the Commission as far as the classification of land uses and adopted colours are concerned, at the same time greatly expands that classification to show ways, orientations and intensity of land utilization. Irrespective of the wealth of information contained the readability of the map is not impaired. The only departure from the recommendations of the Commission is the presentation of grassland without a subdivision into improved and unimproved, as in Poland, similarly as in many other countries, the boundary between them is hardly recognizable. Moreover, vegetable gardens are included in the category of arable land because the scale of the map hardly permits for such a differentiation.

As Professor L. D. Stamp put it once the content of the Polish detailed map of land utilization consisted of two layers. The first one, seen at a distance, presents a picture of the distribution of the main forms of land utilization, the second one, only seen at a small distance, differentiates various forms of utilization, as to the ways and orientations of their use.

\*

In subsequent years the technique of the elaboration of the survey material established in the instruction was formally not changed. However, in due course, several changes gradually took place. First of all, a new method of the determination of arable land use orientations (crop combinations) was adopted. Formerly, this procedure had been based upon the percentage share of the crops and their groups, whereas the new method consisted in assessing the role played by respective groups of crops in the basic unit by means of successive quotients technique. Orientations thus defined are presented on the map by means of a method similar to the structural cartogram, as six quotients are usually applied. The main stripe represents the whole, i.e.  $\frac{6}{6}$  of arable land, whereas the actual share of each group of crops is shown in the denominator, e.g. extractive =  $\frac{6}{2}$ ; intensifying =  $\frac{3}{2}$ ; structure-forming =  $\frac{1}{6}$  [145, 180].

Altogether during post-war studies, up to 1970, almost 17 000 sq. km were mapped during consecutive detailed surveys.

Experimentation on new general map. Having worked out the method of a detailed survey, which was a time-consuming and costly procedure the Department of Agricultural Geography responding to some practical requirements, set out to devise a method of preparing a new, more general and simplified map. The working scale was accepted as 1:100 000, whereas 1:200 000 or 1:300 000 were foreseen for the reproduction stage. The second variant seems to be a better solution because it makes possible to correlate the land use map with soil and geological maps, made on those scales. Its most important principle is to use as much as possible the indoor work based on topographic maps and air photographs and to limit field work to a minimum.

The new map, while it bases upon the principles of the detailed survey as far as the classification of land uses and grouping of crops are concerned, must, of course, be quantitatively and qualitatively generalized. The gromada (the smallest administrative unit), state farm or collective farm with an area exceeding 200 ha have been selected as the basic research units [112, 145, 180]. Arable land use orientations are determined by means of the method of successive quotients, mentioned in the previous paragraph. Orientations are plotted on the map in the same way as in the detailed survey for its basic units. In the category of woodland forests are shown not by their management sections — as on the detailed map — but as special complexes for which predominant species of trees are determined. Up to 1970 sample maps were made for the area of approximately 60 000 sq. km, including the entire Białystok voivodship and large parts of the Warsaw, Gdańsk, Bydgoszcz, Kielce and Rzeszów voivodships. Such maps were devised as basic material for planners at the voivodship level. To reduce the cost of printing two versions were prepared, one in six colours, representing the main land uses and the other black-and-white [236].

Moreover, premises were also determined by the Department of Agricultural Geography for another map, which gives a general picture of land use in the country as a whole on the working scale of 1:500 000.

\*

To conclude the survey of Polish land use studies it seems important to observe that irrespective of the fact that Poland worked out an original method, tested it, and won approval abroad, no land use map of Poland as a whole, or even of certain larger areas, has yet been published. Meanwhile, numerous publications presenting results obtained by means



of the Polish method appeared in Czechoslovakia. The Polish scientific circles which devised the method have apparently too little authority and too meagre means to make such a survey possible. Neither one department nor one research institute are able to undertake such a task by themselves. However, with efficient organization and sufficient means, it would be feasible to survey land use simultaneously in the whole country, on condition that local administration promised to help. It could be done by specially appointed staffs, trained and supervised by research workers from the Geographical Institutes of the Universities and of the Polish Academy of Sciences, and following uniform directives in their work. A special committee could coordinate the whole enterprise at the national level as well as collect and process data obtained in field research. It seems that with a united effort, a detailed survey could be made for each powiat without additional help. Similarly, the publication of maps could be financed by local sources.

The task would be, of course, easier if a special organ is appointed, or the whole project is carried out by one of the already existing units, like the Pedological Service.

It is to be hoped that in the present time when the utilization of scientific findings for practical purposes has grown in significance, this project will also be implemented.

#### COOPERATION BETWEEN EUROPEAN SOCIALIST COUNTRIES AND RESULTS OBTAINED

As mentioned before the final version of the Polish method was prepared and its universal character acquired on the basis of research carried out also in some other socialist countries.

On the initiative of the Department of Agricultural Geography the Geographical Institute of the Polish Academy of Sciences held the first International Conference on Land Use in Warsaw from 30 May to 8 June 1960. The conference was participated by geographers from seven countries of East-central Europe, i.e. Bulgaria, Czechoslovakia, Yugoslavia, the German Democratic Republic, Poland, Hungary and the Soviet Union, as well as by one observer from the United States [185, 190]. The conference initiated cooperation between represented European countries, through the exchange of research teams. The Polish group went first to Bulgaria in September 1960 and, assisted by local geographers, carried out field studies in three points [179, 181, 191]. Subsequently, similar research was continued on some selected areas of Yugoslavia, Bulgaria, Czechoslovakia, Rumania and Hungary [12, 16, 178].

The next stage was the II<sup>nd</sup> Conference on Land Use held in Buda-

pest from 6 to 10 June 1964, during which the regional subcommission for East-central European countries was appointed within the Commission on World Land Use to coordinate the cooperation [170, 173]. J. Kostrowicki was elected chairman, whereas T. Jordanov and V. Velev (Bulgaria), K. Ivanička and Z. Hoffmann (Czechoslovakia), V. Roubitschek (GDR), G. Enyedi, T. Bernat (Hungary), W. Biegajło (Poland), I. Velcea, V. Tufescu, H. Grumazescu, N. Barbu (Rumania) and V. Klemenčič and I. Crkvenčič (Yugoslavia) became its members.

The collection of papers read on the Budapest conference, which were subsequently published in Hungary, together with a master key printed in Poland and coloured maps of land use printed in Czechoslovakia, is a document showing close relations between the geographers of the said countries [192].

Subsequently, results obtained by Polish teams abroad were published in a Polish periodical, called *Dokumentacja Geograficzna* [311—313]. Land use maps, enclosed to the papers, were produced in black-and-white only. This is, of course, a handicap in comparison with coloured maps but was dictated by financial grounds. The bibliography and characteristics of papers completed up to 1967, by Polish authors and representatives of the other countries of East-central Europe were worked out by J. Kostrowicki and W. Tyszkiewicz [182].

The third Conference, held in Maribor, Yugoslavia, on 7—11 October 1969, was a mark of continued cooperation. Besides the members of the subcommission geographers from the Federal Republic of Germany, Italy and Norway participated as observers [175, 176]. The usefulness of the land use survey for typological studies, which had also been included in the activity of the subcommission, was recognized. The name of the subcommission was changed to the subcommission on Land Use and Agricultural Typology. The proceedings of that meeting have however not been published.

\*

Yugoslavia was the first among the countries participating in the above subcommission to show interest in land use research. Already before 1960 Yugoslav geographers closely cooperated with Polish scholars in the preparation of a common method for surveying East-central Europe. The centres in Ljubljana and Zagreb were particularly active. S. Ilešič was the first to start research after the end of hostilities, as a continuation of his work carried out before World War II [121]. He produced three studies, in which he presented the aims and methods of land use research [122—124]. More recent studies were oriented towards finding new solutions. French and West-German morphological methods

and particularly those developed by the München centre of social geographers, were investigated and tested simultaneously with the Polish method [77, 158].

The black-and-white maps of two Slovenian villages and one from Hercegovina were published in 1962 [149, 150, 157]. These maps were subsequently worked out in colours following the Polish master key and a commentary compiled by the authors in English was moreover included in the book *Land utilization in East-central Europe. Case Studies* together with the map of the village of Ritopek [191]. They were also published in the GDR [78]. Some year later the map of the village of Železnik (1 : 25 000), made during the first Polish studies in Yugoslavia, was also published [144, 192]. This type of research was continued by B. Jacimovic in the vicinity of Belgrade [137, 138]. Published in 1962 the agrarian-geographical map of Serbia is also a kind of a land use map [233].

In C z e c h o s l o v a k i a the Polish method was used to produce the land use map of the region of Kosice (1 691 sq. km) on the scale 1 : 50 000, prepared under the supervision of K. Ivanička. Printed in 14 colours it was annexed, similarly as the map of the village of Krasna made by J. Paulov, to the monography of this region [134, 230]. The black-and-white map of the Kosice region, largely reduced (to about 1 : 180 000) was also enclosed to K. Ivanicka's paper *The land utilization map of the Kosice Region*. The 1 : 25 000 map of the Kačice commune, by W. Biegajlo and N. Hanzlikova, was included in the same publication [192]. In 1972, another map was prepared by the same method as that used for the Kosice region, covering a large area around Bratislava, again on the scale 1 : 50 000 [135].

Certain villages, or large farms, were mapped in Hungary and their maps were included in various publications. Three maps (Bekescaba, Csepreg, Nyiradony) were reproduced in *Land utilization in East-central Europe. Case Studies* [191]. The colour map of the Badacsony commune, prepared by the Polish group, was published in the collection of materials from the Budapest conference [192]. G. Enyedi used the Polish method for the preparation of the maps of the villages of Kerecsend and Maklar [92]. Moreover, he also devoted much space in his publications to problems connected with land use in Hungary [83—91]. E. Csati of the Hungarian Institute of Geodesy and Cartography was entrusted with the task of coordinating work on the Land Use Map of Europe (EULUSMAP), prepared on the scale 1 : 2 500 000 [188].

This valuable example of international cartographic cooperation can be included among Hungarian works, as it was initiated, edited and printed in Hungary.

The EULUSMAP is for the time being the only — in particular — inter-European, and — in general — international cooperation to prepare land use map of any continent or greater region. It will be a wall map of bureau type with the size of  $190 \times 126$  cm.

It is based on the 12 assembled sheets of the 1 : 2 500 000 World Map produced in the late sixties by six socialist countries.

Initiated by the coordinator yet in 1969 after a detailed study of the existing European national land use maps and after several consultations with topic experts, a legend consisting of 32 categories all with areal (surface) signs was developed by the end of 1973.

Arable land (Temporary crops) — light orange colour of various shades — are subdivided into cereals, fodder crops, tuber root crops, industrial crops, mixed crops and fallow subcategories.

Perennial crops — eight types — are the second main group. Orchards with red dark orange purple colour variations are subdivided into stone fruits, soft fruits, berries, nuts) chestnuts, citrus fruits and mixed orchards subcategories. Vineyards and olives separately are also included here.

Any kind of grasslands (pastures, meadows etc.) are in light green shade variations partly bluish-green and partly yellowish-green, comprises the third main group. Dry grasslands (with less than 500 mm precipitation annually), wet grasslands (over 500 mm), cold grasslands (where permanent snow-cover is over 5 months annually) practically only in Fenno-Scandinavia, and alpine grasslands are distinguished. The mentioned four big grassland types are all subdivided into unimproved and in case of any regular human intervention (melioration, irrigation, seeding etc.) improved subtypes.

Forest and woodlands in medium green shades are divided into conifers, deciduous and mixed types. All are further subgroups of productive and unproductive categories. The latter includes all forest reserves, natural and national parks, game reserves and all those wooden areas of extreme low productional figures per hectare above the permanent tree-line.

Waste land category consists of the barren (exposed) rocks, glaciers (in white) and badlands, quicksands and sandy beaches in light yellow. Built-in lands/settlements only with contourlines in black and inland-waters in cyan-blue.

To the richest of the land use categories are attached over 20 symbols for dominant crop types (barley, wheat, etc.) and about 12 symbols for dominant tree types (poplar, pine, cork-oat etc.).

Qualitative information typical for land use maps. Quantitative information steps into the EULUSMAP through the cartographic presentation method.

If arable land over 50% of the total area of the first grade administrative unit of any country, then it is presented by successive percentage of the four main arable land subtypes as a cartogram. Within the first grade division the second grade division comes as a statistical base to show the concentration of any dominant crop type through symbols of 3 sizes.

Actual form of the symbols differ from each other, key is always added of course.

If arable land is below 50% then it is shown as other surface element in a slightly different orange colour, in the "mixed crop" arable land subdivision.

Colour scheme is developed to try to use so called "cold colours" for northern-European regions and "warm colours" for the south. It is intended to express the utilization intensity with the density of colours.

There is a promising aspect as well to introduce for updating and shape-controlling the true-coloured combination of a satellite picture of ERTS-1 MSS images in 3 wave-lengths.

The land use map of R u m a n i a as a whole was made in 1949—1951 in 39 sheets. However, it has not been published [306]. Another land use map on the scale 1 : 250 000, compiled under the supervision of the Ministry of Agriculture, was published in 1960. It presents the distribution of arable land, pastures, meadows, orchards, vineyards and woodland. Some detailed research was made for planning purposes of the Danube Delta [315, 516]. A black-and-white map of land use in Rumania was also published with a commentary by L. Velcea and I. Jordan in 1963 [317, 318].

Land use maps for B u l g a r i a are limited to those made in cooperation with Polish geographers and published with comments in Poland [101, 191, 313]. L. Lakov described premises underlying the construction of the land use map, and compared them with those devised for other existing methods [186].

Problems of land use surveys are rarely dealt with in the G e r m a n Democratic Republic; studies leading to the preparation of a detailed survey are practically non-existent [258].

#### SOVIET STUDIES

As agriculture in the USSR bases upon large farm units, Soviet scholars, similarly as those in the United States, are mostly preoccupied with the evaluation of the natural quality of land. The main object of research is not so much a form or orientation in land use but the natural value of land and changes induced by agrotechnics and improvements applied. However, such maps are beyond the scope of this study. Only

A. N. Rakitnikov mentioned in his publications that some investigations, based upon a modified version of the classification prepared by the Commission, had been started and were continued also in the Soviet Union [234, 240]. Their range and development have not yet been disclosed. The classification used in the Soviet Union takes into account some elements of the natural environment such as its susceptibility to erosion; the level of ground waters, stoniness, etc. According to A. N. Rakitnikov studies in which the classification is used serve two aims: 1) determination of the uses as well as of the kinds of crops or stock-breeding, 2) establishment of methods to be applied to associate agriculture with natural environment, i.e. what crops should be cultivated in a given area from the viewpoint of potential possibilities of the environment. Much attention is paid to the general aspects of land use, theoretical deliberations and methodical assumptions [104, 196, 216, 276].

### CONCLUSIONS

One of the main intentions of the Commission was to secure a uniform character for all land use maps, irrespective of the conditions prevailing in the surveyed country and thus to contribute to their full comparability, as is the case with geological maps. Each category of land use should be immediately recognizable without consulting the explanatory notes and irrespective of the scale and the situation of the area which the map portrays. The presented survey indicates however that those intentions were realized only partially. In a majority of cases individualistic solutions led to new classifications and symbols, differing from those recommended by the Commission, even in studies carried out and published under the auspices of the Commission. Such a procedure is hardly comprehensible and the motives of its application were not disclosed.

A large majority of maps are not comparable, as various classifications, colours, or both, were used in the process of their production. Such a procedure was, for example, applied in British studies published by the Directoriat of Overseas Surveys. Not only the colours were inconsistent with the recommendations of the Commission but also different colouring was used in every map. Similarly the classification of land uses was worked out independently for each map. Although various forms of land use exist, yet, the classification drafted by the Commission is so elastic and universal that it can be applied in all conditions.

In certain maps, drawn in full accordance with the classification of the Commission, or with minor changes to adapt them to the local

needs — for the sake of economy — different colours were used for their publication, or even one or two colours only, like i.a. the map of Cyprus, or that of Sudan, reproduced in the monographs.

Some other deviations were caused by the utilization of available topographical base maps on which land use categories were plotted. A typical example of such a procedure is the map of the Second Land Use Survey of Britain.

The Polish classification, as already indicated, proved to be a successful solution. The method applied in the survey and the cartographic presentation put Poland among the leading countries in this field of research, although, as far as the total number of published maps is concerned, she is far down the list. Poland has become the main centre of methodological studies, not only in relation to detailed survey but also in relation to more general mapping, adapted to conditions prevailing in European socialist countries.

### III. CARTOGRAPHIC METHODS APPLIED IN THE CONSTRUCTION OF LAND USE MAPS

Confusion in terminology as far as methods applied in economic cartography are concerned had been quite great in Poland until last few years when it was accurately established and standardized [244, 246, 247, 296]. The terminology used in this survey of cartographic methods was based upon criteria and terms proposed by L. Ratajski [244, 246, 247].

The most common and also correct method for the topographic presentation of the distribution of uses is the **areal method**. It is usually used for the preparation of almost all analytic maps, in which only such principal land uses, as arable land, grassland, woodland, etc. are presented, as well as in synthetic maps with more elaborated contents, including also, as far as arable land is concerned, the distribution of crops or species of trees — in orchards and forests. All differentiated areas, marked in colours or hachures, are adjacent and exclude each other, forming thus a clear picture of the various forms of land use. This is one of the simplest methods as well, where no calculations are required for the processing of material collected in field research, or for the interpretation of aerial photographs. The differentiated areas and the administrative divisions are not correlated.

**Cartograms**, understood as the processed relative statistical value referred to a surface unit, predominantly administrative, are seldom used in land use maps. On the basis of material analysed by the author it appears that the cartogram was used only in the Polish land use map, and even then not in its classic version. The **structural pseudo-cartogram** (named the **stripe cartogram**) drawn on the area of arable land was referred to such units as the village or gromada. As such it does not present the structure of land utilization but its orientation, established by means of one of the methods used to determine the leading elements of the structure. These methods, applied also in agricultural spatial studies, were reviewed by K. Bielecka [17].

The fundamental principle underlying the construction of a struc-



tural cartogram is that its components added together make a total of 100 per cent. In the case of the Polish map the main stripe did not represent 100 per cent, but the cartogram consisted of several stripes of various widths, denoting the accepted class interval, for example 1 mm = 0—20, 2 mm = 20—30, 4 mm = 30—40 and 6 mm = 40—60 per cent. The percentage values, arranged in class intervals and expressed by the width of the stripe, denoted the share of the separate group of crops in the total sown area, whereas the colour of the respective stripe marked the predominant crop in the given group.

In recent studies, undertaken by the Department of Agricultural Geography, the orientations in arable land utilization have been determined by the method of successive quotients, which implies that the value of separate elements should successively be divided by 1, 2 and 3, for example:

Group of crops	1 quotient	2 quotient	3 quotient
intensifying	210 ha	105	70
extractive (extracting)	120 ha	60	40
structure-forming	90 ha	45	30

and subsequently the highest values arranged in the decreasing order are accepted. In the above example by using six successive quotients the group of intensifying plants will occupy  $\frac{1}{6}$  of the main stripe, the width of which is always the same and which represents  $\frac{1}{6}$ ; extractive plants =  $\frac{2}{6}$  and structure-forming =  $\frac{3}{6}$ . The width of the stripe on coloured maps can be 6 mm but on one-colour hachured maps — if possible — a 12 mm width is preferable, as more legible [180].

Limited financial means and the high cost of printing multi-coloured maps has made it necessary to seek a one-colour solution. Such studies were undertaken not only in Poland [79]. The presentation of arable land orientations seems to be very difficult. A cartogram, which may be called checker (or US checker), proved to be a failure, though its construction was quite simple [311—313]. Every group of crops was represented by a different position of the stripe, the width of which corresponded with its share in the sown area of the respective administrative unit. The width of the stripes and class intervals were the same as in the former type of cartograms. The group of the intensifying plants was indicated by the horizontal position, that of the extractive plants — by the vertical and of the structure-forming — by the diagonal position.

The described cartogram made it possible to read out orientations in every unit, village or gromada. When this method was applied for a general map, including a great number of units, the orientations were

clear enough, but spatial differentiation of the units concerned disappeared. Looking at the cartogram one can first of all see blank spaces between the stripes as white squares of equal dimensions scattered on the whole surface. The square form made the picture look identical irrespective of the unequal width of the stripes and their internal differences.

The latest experiment, when a stripe cartogram was used on a one-colour map, seems to yield better results but still requires some improvement [236].

The same preliminary sheet of a simplified land use map was reprinted in six colours, denoting principal uses: brown — arable land, yellow — grassland, green — woodland, red — settlement, blue — waters and black used for descriptions and a situational drawing. This attempt also requires further experimentation as the quality of drawing and the technology of lithography should be improved.

The methods of symbols is used quite frequently. Predominantly, undimensional, qualitative symbols are used jointly with the areal method. On the surface, showing the area under a given use, symbols denote certain particular features, e.g. on the areas under orchards or forests the main species of the trees and their age. Symbols can be letters, geometrical figures, points, hachures or arbitrary signs.

A specific group of methods is that called the code methods. Its one variant, the fractional method applied by certain American authors and tested in Canada, cannot be classified into any group of generally known methods [118, 136, 251]. It consists in plotting the units on aerial photographs, as base material, by means of the method of scope. The obtained effect is very much like that when the areal method is used with the only difference that the differentiated areas are marked by a numeral code instead of a colour or hachures. The code number can therefore be interpreted as a specific kind of numerical symbols.

The thus presented material, which has been collected in field research, contains data relating to the type of economy, quality of land, productivity, physical properties of the area, etc. whereas code symbols can be used to mark various phenomena. Figures in the numerator denote the five general land classes and in the denominator eight factors were included.

The fractional code method of land classification

Land classes (general) expressed by the numerator:

0 — barren lands,

- 1 — forest land,
- 2 — agricultural land,
- 3 — land occupied by villages,
- 4 — urban land.

Barren land — 0 numerator: in detail

- 0r — barren — rocky,                      0c — barren cut over,
- 0o — barren — burnt over,              0b — barren bog.

Forest land — 1 numerator: in detail

- 10 — burnt over woodland,              On photos 800' equal 1", 200'
- 11 — best growth — commercial,      equal 1" Add.
- 12 — smaller dense growth,              110 — scattered 11,
- 13 — stunted — scrub,                    120 — scattered 12,
- 1c — cut over,                              130 — scattered 13,
- 14 — alder, etc.                            140 — sparse 14.

Agricultural lands — 2 numerator: in detail

On 3,300' equal 1" (unit of mapping equal 200 ac. approx.):

- major land use — pasture              — 0,
- hay                      — 1,
- hoe crops              — 2,
- mixed crops          — 3.

On photos 800' equal 1", 200' equal 1" unit of mapping field by field:

- newly cleared land                      — 0,
- cropland — hay, timothy, clover, etc. — 1,
- oats for fodder                            — 2,
- potatoes                                    — 3,
- vegetables (turnip, cabbage, lettuce) — 4,
- small garden plot                        — 5,
- pasture — very rough — non-arable land — 6,
- never ploughed but arable              — 7,
- pasture in rotation                      — 8,
- waste land and idle land                — 9.

Type of farming

- Full-time livestock and dairy — L,
- full-time mixed farming — M,
- full-time hoe crops — H,
- subsistence agriculture — S,
- part-time agriculture — P.

Size of farm:		Quality of buildings:	
less than 5 acres	— 0,	poor	— 1,
5—25 acres	— 1,	fair	— 2,
more than 25 acres	— 2.	good	— 3.

Physical conditions of the land: expressed by the denominator

1) Slope	2) Drainage	3) Erosion
0— 2 <sup>0</sup> / <sub>0</sub> — 1,	excessive — 1,	0 — no evidence of erosion.
2— 5 <sup>0</sup> / <sub>0</sub> — 2,	good — 2,	1 — mild sheet wash,
5—15 <sup>0</sup> / <sub>0</sub> — 3,	moderate — 3,	2 — severe sheet erosion.
15—30 <sup>0</sup> / <sub>0</sub> — 4,	imperfect — 4,	
> 30 <sup>0</sup> / <sub>0</sub> — 5.	poor — 5,	
	bog (glei) — 6.	
4) Stoniness of soil	5) Rock exposure	6) Depth of drift
0 — few stones,	0 — no evidence,	12" — 0
1 — moderately stony,	1 — 0—25 <sup>0</sup> / <sub>0</sub> ,	1-5' — 1
2 — very stony.	2 — 25—50 <sup>0</sup> / <sub>0</sub> ,	5' — 2
	3 — > 50 <sup>0</sup> / <sub>0</sub> .	
7) Soil texture	8) Soil fertility	
0 — glei,	0 — very low,	
1 — clay,	1 — low,	
2 — silty clay,	2 — fair,	
3 — clay loam,	3 — good.	
4 — silty clay loam,		
5 — silt loam,		
6 — loam,		
7 — sandy loam,		
8 — sand,		
9 — gravel.		

This is an example of notation:

2 1L 23  
 23100231

The US National Resources Planning Board developed a unit area land classification. In this method the complete symbol for each land unit is in three parts. The main is the third long fraction. In this part the numerator represents data as follows: major land use (1—10 types), agricultural emphasis (A—F), field size (1—4), amount of the idle land (1—4), quality of farmsteads and equipment. In the denominator seven digits and their subsequent orders relate to: slope (1—5),

drainage (1—5), erosion (1—5), stoniness (1—4), rock exposure (1—5), soil depth (1—4), soil fertility (1—5). This is an example of notation and its explanation

1 G 1 2 3  
 222 1123

1 — general farming, G — grain, 1 — large (field size), 2 — limited (amount of the idle land), 3 — medium (quality of farmstead). In the denominator: 2 — relative level to undulating, 2 — adequate (drainage), 2 — little denudation, 1 — moderately stony, 1 — little or no rock exposure, 2 — moderately deep of soil (3—6 ft.), 3 — moderately fertile [136, 274].

A similar attempt to use the fractional code method was locally made in Canada and published as land type — land use method. This is also a combination of various letter and numerical signs, symbolizing natural properties and the actual land use type.

Here is an example of notation taken from the map [222, 251]:

**T Silm X<sub>4</sub> D<sub>3</sub> W<sub>1</sub>**

The land type—land use classification is as follows:

*Soil*

- |  |   |
|--|---|
| <p>a) Origin of parent materials:</p> <p><b>T</b> — till,<br/> <b>K</b> — kame,<br/> <b>L</b> — lacustrine,<br/> <b>OW</b> — outwash,<br/> <b>NL</b> — bottom lands,<br/> <b>a</b> — if shallow.</p> | <p>b) Texture:</p> <p><b>G</b> — gravel,<br/> <b>S</b> — sand,<br/> <b>Lm</b> — loam,<br/> <b>Silm</b> — silt loam,<br/> <b>Clm</b> — clay loam,<br/> <b>Sicl</b> — silty clay,<br/> <b>Cl</b> — clay.</p>  |
| <p>c) Stoniness of surface soil:</p> <p><b>n</b> — few stones,<br/> <b>n'</b> — moderately stony,<br/> <b>n''</b> — very stony.</p>  | <p>d) Slope:</p> <p><b>X<sub>1</sub></b> — 0 — 2<sup>0</sup>/<sub>0</sub>,<br/> <b>X<sub>2</sub></b> — 2 — 5<sup>0</sup>/<sub>0</sub>,<br/> <b>X<sub>3</sub></b> — 5 — 15<sup>0</sup>/<sub>0</sub>,<br/> <b>X<sub>4</sub></b> — 15 — 30<sup>0</sup>/<sub>0</sub>,<br/> <b>X<sub>5</sub></b> — &gt; 30<sup>0</sup>/<sub>0</sub>.</p> |
|  | <p>e) Drainage:</p> <p><b>D<sub>1</sub></b> — excessive,<br/> <b>D<sub>2</sub></b> — good,<br/> <b>D<sub>3</sub></b> — moderate,<br/> <b>D<sub>4</sub></b> — imperfect,<br/> <b>D<sub>5</sub></b> — poor.</p>   |

*Present land use*

- a) Woodland:
- Wo** — burnt over,  
**Wc** — cut over recently,  
**W1** — commercial growth,

- W2 — smaller dense growth,
- W3 — scrubby or stunted small growth,
- W4 — alder,
- W10 — large trees but scattered,
- W20 — scattered smaller trees,
- W30 — open W3,
- W40 — scattered W4.

b) Barren lands:

- Bt — barren 12 inch till,
- Bta — barren shallow till,
- Br — barren rocky site,
- Bb — barren bog (depth of peat estimated),
- Bo — burnt over rocky land,
- Bow — barren outwash,
- Bowa — barren shallow outwash,
- Bk — barren kame,
- g — being grazed.

c) Agricultural lands:

- Co — newly cleared land,
- C — cropland — Ch — hay,
  - Coa — oats for fodder,
  - Cpo — potatoes,
  - Cv — vegetables,
  - Cg — small garden,
- P — pasture — Pn — natural pasture, never ploughed but arable
  - Pr — very rough pasture — non arable,
  - Pc — pasture in rotation.

d) Urban land — U — includes fishing villages, airports, etc.

One of the requirements put before the cartographer is that this form of transmitting information should be clear and legible. In both of the above described cases this requirement was not complied with. A notation composed of sets of numbers and letters does not present — and cannot do so — a clear picture of differentiation of the territory. Moreover, to present any differentiation of units based upon some dozen properties is a very hard task and when one wants to make use of such a notation, it should be transcribed to obtain a graphic picture which will facilitate a visual grasp of the regionalization of phenomena.

The applicability of another method, devised by J. Hult, seems also limited from the cartographic point of view [119]. The author determines each predominant form of land use (i.e. settlement, arable land, wood-

land, peatbogs, bog and other meadows) for every square kilometre in a kilometre grid on a topographical 1 : 20 000 map or aerial photograph on the scale 1 : 10 000. Predominant uses are marked in each square by an undimensional qualitative symbol. Symbols of a given use, appearing in groups on a majority of squares, present the spatial distribution of predominant uses. It does not seem worth while to substitute a topographic picture, showing a real distribution of uses, by an interpreted picture, not very readable and to a certain extent deformed.

Finally, the **isarithmic method** should also be mentioned, although it is in principle used mainly for the preparation of maps which are beyond the scope of the present study.

The isarithmic map of agricultural land by Romer, irrespective of the fact that the term land use was contained in its title, cannot be classified as such. Agricultural land was there presented in percentages of the country's area, whereas territories rich in woodland (over 40 per cent of the total), or poor in woodland (under 10 per cent), were marked with arbitrary signs.

It might seem striking that the number of methods which have been used for the preparation of such a highly specialized group of land use maps is so small. This is probably caused by one, or even both, of the following two factors. First of all, the very concept of the map implies that phenomena should be presented in a simple way by means of the topographical approach to the problem. The second factor is connected with the method of collecting data, i.e. with the mapping technique. No comment is necessary as far as the first factor is concerned, because the content of the map and its presentation is, after all, dictated by the concept of the map, irrespective of the mapping techniques. The map of the Second British Survey may serve as an example. Rich material collected during detailed field surveys was not reproduced in full on the map. The second factor will be discussed in detail in the next chapter, as it seems to be an excellent starting point for discussing techniques.

#### IV. TENDENCIES IN THE DEVELOPMENT OF RESEARCH METHODS AND TECHNIQUES

Out of the many ways of classifying maps the simplest procedure is to group them according to their scales. This method, so obvious that it does not need any further comment, is also connected with their division into detailed and general maps. Territorial ranges can also serve as a classification criterion, for example, maps (or rather plans) of farms, maps of villages and communes, up to maps of larger units, such as states, continents or the whole globe. Moreover, large scale maps of land use in towns can also be separately grouped.

There have also been attempts to group maps according to their contents, i.e. analytic, synthetic and complex maps [142]. On analytic maps facts are registered without any generalization, and such a map presents, for example, the spatial distribution of land uses. Synthetic maps give an interpreted picture of phenomena, while complex maps show connections between phenomena. However, not all maps can be classified univocally into one of the above listed groups.

It seems that no special classification is required for maps contained within this narrow section of thematic cartography. Perhaps it will suffice to divide them into two main categories: maps based upon field surveys and maps worked out indoor on the basis of the analysis of topographic maps or following the interpretation of aerial photographs.

The progress obtained in the technique of taking and interpreting aerial photographs has greatly contributed to changing the ways of mapping land use pattern. Its negative effect is perhaps a current tendency among geographers to abandon totally field surveys and to work out indoor [160]. R. N. Colwell will have it that multiband cameras with special films or magnetic tapes, new techniques of air photography, etc. make it possible to determine all resources on the Earth's surface and that all information can be transmitted to a computerized data system and submitted to quantitative analysis and pattern recognition procedures [74].



The author of this study is far from negating the new achievements of technique in geography. He believes, however, that the question of research separately from the terrain and its indirect study could be a starting point for discussion of advantages and disadvantages of both field surveys and of modern research techniques. At present, two tendencies can be observed as far as land use investigations are concerned: one, which implies a thorough examination of the area even at the cost of higher time inputs, leads to collection of a maximal amount of information on the terrain concerned and thus enriches the map content [21]; the second consists in a quick survey of larger areas at the cost of its content. Two examples from Great Britain may serve to illustrate both tendencies. By interpreting aerial photographs on the scale 1 : 10 000 the land use map of North-West Cardiganshire was executed on the scale 1 : 25 000 [116]. Without even entering into a detailed discussion of the key to the aerial photographs, through its indoor interpretation and a field survey, only seven categories were differentiated on that map, namely: F — woodland, M — meadowland and permanent grass, A — arable or tilled land, fallow, rotation grass, including leys under three years, H — heathland, moorland and rough hill pasture, W — yards, mines, cemeteries, spoil mounds and all agriculturally unproductive land, P — ponds, lakes, reservoirs, etc., G — gardens, allotments, nurseries.

The map of the Second British Survey, made on the same scale but drawn on the basis of field surveys, presented 13 main categories, often subdivided. For example, arable land and woodland were each subdivided into six sub-categories, market gardens into seven. Altogether, it contained 64 various categories [69, 73, 140]. Moreover, it should be pointed out that neither the material collected in field research, nor the capacity of the map were fully exhausted. It seems, therefore, necessary to investigate the problem in a broader way and approach it more profoundly, which the mere analysis of the map content cannot produce. A quantitative comparison between the two maps is not the most essential procedure of evaluation, it would be more appropriate to compare the degree of knowledge of the terrain covered by both maps. Neither specific features, nor the character, methods, orientations and the intensity of land use within each category of land uses can be learnt from an aerial photograph.

Objections raised against the classical land use survey, which often negate its purposefulness, are often directed against the static character of resulting maps, against a rapid loss of their topicality, as well as against the high cost of their elaboration and printing [257]. The last of the above listed objections can be immediately refuted on the grounds

that printing costs do not depend on the character of the survey, but on the author's concept, editorial make-up, the technology of preparatory work, etc. The comparison between the cost of the various types of surveys could make an interesting subject for a separate analysis, yet, it would not solve the problem of their usefulness. Time-devouring and costly character of the detailed field survey is often confronted with much cheaper and rapid mapping based on aerial photographs. To take aerial photographs as a basis will surely precipitate the whole work and may decrease their cost. These advantages are, however, neither general nor univocal. Firstly, shorter time spent on the collection of data will undoubtedly make the contents and the knowledge of the area poorer. The second advantage will be achieved only when standard photographs are taken (the cost of which is not counted) and no special flights, directed to the purpose of the research, is required. One of the most important conditions facilitating correct interpretation of the aerial photograph, especially as far as agricultural properties are concerned, is, however, the selection of time for taking pictures. When this condition is not fulfilled, which is often the case with standard photographs, the chances of correct interpretation are greatly diminished. The fact that the content of a map, worked out by interpreting aerial photographs, is limited to principal forms of land use, is i.a. caused by a difficulty encountered when attempting to identify the distribution of crops. Even panchromatic, colour or infra-red photographs used nowadays do not allow for completely correct readings. The shade and tint, two elements on which the interpretation should be based, depend on a number of factors, such as the part of the day when the photograph was taken, the current phase of plant growth, soil humidity, light, photographic material, etc. All these factors may bear an influence upon the actual appearance of the crop and consequently upon the interpretation. Cereals can be distinguished from — for example — grasses only if the photograph was taken in the late phase of the vegetation period [229, 323]. The scale of the aerial photograph decides also over its adequacy for the various purposes of research. K. H. Stone distinguished the three following groups of air photographs in panchromatic photographs, according to their scale: under 1 : 30 000, from 1 : 30 000 to 1 : 10 000, over 1 : 10 000 and noted that only the third group had made it possible to recognize separate crops [212, 292]. Thus, as correct readings depend on so many factors, it can hardly be assumed that the interpretation is always reliable.

Attempts to obtain a greater precision in interpreting cropland structures from aerial photographs were already made i.a. by D. Steiner, K. Ruppert and P. Meienberg [215, 262, 263, 288—290]. In Poland,

A. Ciolkosz, from the Photointerpretation Laboratory of the Warsaw University Geographical Institute, was working on the microphotometric method of reading the cropland structure [52, 53]. His method, painstaking, expensive and not reliable as yet, is based upon an analysis of the intensity of blackening in the negative. In optimal conditions the precision of readings can be evaluated as approximately 80 per cent; however, when fields are strongly fragmented this percentage is largely reduced.

At the present stage of its development, air photography can be — and has been in many cases — the only means for making the elaboration of land use or other maps possible, especially in the areas which are not easily approached, or in developing countries, which do not possess sufficient cartographic documentation. Air photography contributed greatly to the preparation of the land use maps of Gambia, Sierra Leone, etc. described in Chapter II. Efforts to perfection the technique of photography have been continued. The problem is of particular significance for the developing countries which have started to organize their economies on new principles and have to get a deeper knowledge of the land resources and reserves. These subjects were discussed on the already mentioned International Symposium organized by the Commission of the World Land Use Survey in cooperation with Shell Company, in London in 1970 [220]. Similar problems were raised in many papers, read during the 22nd International Geographical Congress held in Montreal, Canada, in 1972.

Static character and rapid loss of topicality are features which characterize not only land use maps but all types of maps with the exception of those presenting properties of natural environment, which changes rather slowly. It should, moreover, be remembered that aerial photographs also lose their topicality, similarly as the map based upon them.

It seems therefore correct to infer that of all procedures known so far the Polish method is most successful in maintaining the topicality of the land use maps for a longest time. Instead of presenting separate fields under rotated crops, which is the most changeable category, the use of arable land is described by orientations in its utilization (i.e. crop combinations), which are a much more stable feature. Long experience has proved that any greater changes in this respect, which could impair the topicality of the map, can be observed in 10—15 years, depending on the area [13].

The static character is a feature characteristic of all maps presenting any given phenomenon at a specific time, i.e. predominantly of all economic maps. A map presenting dynamically changes or develop-

ment trends cannot be described as a land use map in the strict sense of the term. Therefore, there is no other way to make a survey more dynamic than to repeat it from time to time and thus register changes which have taken place in the meantime, or to foresee their future course. In practice, such a procedure would make it easier to reach correct locational decisions and thus to contribute to a more rational land use, consistent with its specific properties, to a better spatial development of rural areas.

Besides those generally applied in land use research certain other techniques, better directed towards analysing and interpreting land use patterns on some selected small areas, were also used [32].

C. Board reviewed those methods in his paper read on the III Anglo-Polish Geographical Seminar in 1967 [25]. One of the early examples is a study carried out in Nova Scotia (Canada). The used sample area reconnaissance method consisted in the detailed mapping of every field. The thus investigated areas covered from 93 to 259 sq. km. Selection was based upon many factors connected mainly with such properties of the natural environment, as geological structure, type of soil, land-form, accessibility, etc. The results of territorial observations were recorded on the aerial photographs on the scale 1:15 840. The areas between the samples were surveyed in reconnaissance fashion by rapid traverses during which land use as seen from the roads was recorded directly to topographical maps in the scale 1:63 360 or 1:50 000 [76, 222]. Another example of such representative studies is mapping carried out in the United States by the National Inventory of Soil and Water Conservation Needs, referred to in Chapter II [5].

Certain attempts were also made to solve the problem by means of a line traverse sampling design. P. Haggett, who carried out such investigations in Brazil, came to the conclusion that this method was better than either the point or area sampling [110, 111]. Another representative of the same trend J. P. Latham introduced a system of traverses along six directions when he analysed the cropland pattern of the state of Pennsylvania, and thus increased the amount of information gathered. He presented results in terms of the frequency of intercepts (uninterrupted distances) of different length classes, i.e. the number of fragments under a given land use category per one specified territorial unit and their respective sizes [195].

In Poland this type of research was carried out by J. Rakowicz-Grocholska for the city of Warsaw. She based her investigation on land use by means of a random sample method with sample areas, each covering one square kilometre [107, 243].

Sampling methods in their various forms can be useful in the investigation of processes shaping the land use patterns, as their application makes it possible to obtain the characteristics of the uses. However, they are not a substitute for a land use map, which procures a full — and not a partial — picture of the distribution of land uses.

Satellite photographs, this most recent invention, were intensively tested by the Soviet Union and by the United States in the hope that any improvement in their techniques would widen the range of their application. At the present time their applicability is mainly limited to research of a very general character, carried out on small scales.

The land use classification system, if combined with the application of remote sensor data, can best exemplify these procedures. It bases upon four levels of classification. At the first level, for which satellite imagery is the source of information and very little supplemental information is available, it is possible to distinguish only nine main categories: urban and built-up area, agricultural land, rangeland, forest land, water, unforested wetland, barren land, tundra, as well as permanent snow and icefields. At the second level numerous subcategories can be differentiated in greater detail, on condition that along with satellite and high-altitude imagery topographic maps are also used. At the fourth, the most informative level, the source of information is described as "low-altitude imagery with most of the information derived from supplemental sources" [6]. A tendency to introduce automation to cartographic work can also be observed, i.e. in connection with great popularity of mathematical methods in geographical research [54, 74, 133, 225, 302].

As put by L. Ratajski, it is necessary "to elaborate as soon as possible such methods of cartographic presentation of phenomena which could be read by automatic readers and automatically processed. This is of particular significance for the type of maps which — because of their content — have to be quickly made available and duplicated" [245]. The statement concerns also land use maps.

Efforts to improve the instruments which could be used in cartographic notations and to make maps more effective were made in the Soviet Union and elsewhere [297]. Lately, the production of plotters, i.e. an automatic device for plotting connected to and directly steered by a computer, has been developed. Until 1969 forty-four numerical system had been worked out, applicable also in cartographic processes [47]. However, as MacKay maintains, only small scale maps can thus be produced; not meant for publication they are as a rule left as original plot to be used by researchers [206].

The analysis presented above justifies the conclusion that modern technological achievements were usually applied more for the registration of observations and information relating to the investigated area than for the processing of data and for making a cartographical picture. This situation is, however, not entirely satisfactory.

## FINAL REMARKS

Leaving aside a detailed analysis of the usefulness of land use maps for research, which seems to be obvious, the author wishes to point out that — irrespective of certain deficiencies — they are highly useful for practical purposes, physical planning in particular, as a starting point to the preparation of long term plans [18, 171]. This conclusion is corroborated by the pioneer survey of land utilization in Great Britain, directed by L. D. Stamp in the difficult time of World War II, when the discovery of each unused, or incorrectly used, piece of land and the following improvement of its utilization were of greatest importance for the British and made it possible for them to survive the German blockade [281].

The initiator of land use research in Poland K. Dziewoński wrote: "Land use research is a very significant part of regional studies. Its significance is closely connected with further utilization of its result, i.e. the land use map, for the preparation of a respective regional plan. One of the most important elements in such a plan is the zonal plan, which is nothing else but a long term plan, i.e. the land use map" [83].

M. Shafi pointing out to the tragic malnutrition of Indian people emphasizes that: "India's food problem is not a temporary disequilibrium between supply and demand. It is a manifestation of the misuse of the land and primitive and backward agriculture made to supply a livelihood for an increasingly large and growing population". One of the most important features, largely responsible for such a situation, is — according to Shafi — lack of a land use map. He appeals: "So the great need of the moment is to carry out a LAND UTILIZATION SURVEY to ascertain the present use and misuse of land, ... Without such a survey it is not possible to indicate the exact extent of land that can be reclaimed and the extra production that can be obtained by planning our land on a scientific basis" [269]. In other overpopulated country, i.e. Japan, the growing recognition of the significance of a land use map for the improvement of agriculture brought about the preparation of extensive detailed surveys [320]. European attempts to utilize land

use research in planning can be exemplified by the survey of land around Liége (Belgium) [48].

On the basis of the above examples it would not seem correct to negate land use maps in general, irrespective of whether they are in their more developed form, as a result of a detailed field survey, or whether their content is reduced because they have been based upon the interpretation of aerial photographs.

The role played by land use surveys and maps in planning is important, especially at the present time when the current common trend is to increase agricultural production, when taking over of agricultural land by other categories of land uses is of vital importance. A map presenting the spatial pattern of all land uses, together with the assessment of their natural value and the current state of development, will allow the planners to select residential, industrial or communications areas, etc. in a proper way.

The fullest use which can be made of a land use map is to confront it with another map of the same territory which may provide some supplementary information, like the map of natural conditions, or the complex map of the natural environment. In Poland, the comparison between the arable land orientations, shown on a land use map, with soil complexes differentiated on a soil-agricultural map, can lead to the conclusion that certain good soils, for which the land use map shows the orientation: rye-potatoes but which are specially suitable, for example, for wheat or sugar beet cultivation, are improperly utilized.

Moreover, the land use map may also become a basis for the preparation of many special maps, such as zoological, or that of protected areas. A very important current problem is the protection of natural environment, which requires that the area should be surveyed, an inventory of its resources drawn up and areas of special value differentiated for protection. The land use map is a great aid in such activities, because it shows also devastated areas, non-productive land as well as areas of high capability and value for agricultural production, the areas of intensive agriculture, valuable woodland, water reservoirs or clear water runs.

The present study provides an irrevocable positive answer to the question whether or not land use research should be developed. The continuation of such studies should however be accompanied by simultaneous attempts to improve the technique of field surveys and above all to devise a method of a much quicker procession of data and their subsequent cartographic presentation.



## BIBLIOGRAPHY

1. Ahmad N., Khan F. K., *Land use in Fayadabad Area*, East Pakistan Geographical Society, Monograph No 2, 1964, 54 p.
2. Alexander P. B., *Land utilization in the Karst Region of Zgornja Pivka, Yugoslavia*, Studia Slovenica, New York 1967, 132 p.
3. Amani K. Z., *Land utilization in Aligarh District*, Geografia 5, 1966, pp. 27—35.
4. *American Geography. Inventory and prospect*, P. E. James, C. F. Jones (ed.), Association of American Geographers, Syracuse University Press, 1954, 590 p.
5. Anderson J. R., *Toward more effective methods of obtaining land use data in geographic research*, The Professional Geographer 13, 1961, pp. 15—18.
6. Anderson J. R., Hardy E. E., Roach J. T., *A land use classification system for use with remote sensor data*, Geological Survey Circular 671, US Department of the Interior Geological Survey, Washington 1972, 16 p.
7. Antonietti A., Vanzetti C., *Carta della utilizzazione del suolo d'Italia*, Milano 1961, 86 p.
8. Baker W. S., *Some notes on a regional survey*, Geographical Teacher 13, 1926, 6, pp. 451—453.
9. Barnes C. P., *Land resource inventory in Michigan*, Economic Geography 5, 1929, pp. 22—35.
10. Biegajło W., *Z badań nad użytkowaniem ziemi w Prowansji. Gmina Banon. (From the study on land utilization in Provence, France. The case of the commune of Banon)*, Przegląd Geograficzny 37, 1965, 1, pp. 109—141.
11. Biegajło W., *Recherches sur l'utilisation du sol dans la region de Forcalquier commune de Banon (Basses Alpes)*, Cahiers du Centre d'Etudes des Sociétés Méditerranéennes, 1966, 1, pp. 131—171.
12. Biegajło W., *Polish land utilization survey in the years 1960—64*, Studies in Geography No 4, Budapest 1967, pp. 28—34.
13. Biegajło W., Jankowski W., *Land use mapping in Poland*, Geographia Polonica 22, 1972, pp. 105—112.
14. Biegajło W., Kowalczyk D., Piskorz H., *Land utilization in Nieborów*, Geographical Studies 25, Warszawa 1961, pp. 56—68.
15. Biegajło W., Szczęsny R., *Zdjęcia użytkowania ziemi. Historia, problematyka, metody. (Land use surveys. History, problems, methods)*, Podstawowe Problemy Współczesnej Techniki, PAN, 1971, pp. 109—126.
16. Biegajło W., Tyszkiewicz W., *Badania użytkowania ziemi w Rumunii. (Investigations of land utilization in Rumania)*, Przegląd Geograficzny 30, 1967, 3, pp. 635—639.

17. Bielecka K., *Metody określania elementów wiodących w strukturze. Modyfikacje metody J. D. Weavera. (Methods applied for the definition of the structure leading elements. Further modifications of J. C. Weaver's method)*, Przegląd Geograficzny 42, 1970, 3, pp. 487—504.
18. Birch J. W., *Rural land use: a central theme in Geography*, Land use and resources, Studies in applied geography, London 1968, pp. 13—28.
19. Board C., *The world land use system and South Africa*, South African Geographical Journal 43, 1960, pp. 19—27.
20. Board C., *The Border Region: natural environment and land use in the Eastern Cape*, Cape Town 1962, 238 p.
21. Board C., *Field work in geography with particular emphasis on the role of land use surveys*, Frontiers in Geographical Teaching, London 1965, pp. 186—214.
22. Board C., *Use of air photographs in land use studies in South Africa and adjacent territories*, Photogrammetria 20, 1965, pp. 163—170.
23. Board C., *Land use surveys: principles and practice*, Land use and resources, Studies in applied geography, London 1968, pp. 29—41.
24. Board C., *The importance of the land utilization survey of Britain: towards an assessment twenty years after*, International Conference on Land Use Maps, Budapest 1968, Radó S. (ed.), Budapest 1970, pp. 165—173.
25. Board C., *The quantitative analysis of land use patterns with special reference to land use maps: shape analysis with an application*, Geografia Polonica 18, 1970, pp. 121—138.
26. Boesch H., *Landnutzungskarten*, Geographia Helvetica 5, 1950, 3 pp. 180—190.
27. Boesch H., *Commission on World Land Use Survey*, The IGU Newsletter 19, 1968, 2, pp. 30—32.
28. Boesch H., *World Land Use Survey*, IGU Bulletin 21, 1970, 1, p. 47.
29. Boesch H., *Commission on World Land Use Survey*, IGU Bulletin 21, 1970, 2, p. 7.
30. Boesch H., *Commission on the World Land Use Survey*, IGU Bulletin 32, 1972, 1, pp. 10—12.
31. Boesch H., *World Land Use Survey Commission*, IGU Bulletin 23, 1972, 2, pp. 44—45.
32. Brassel K., *Land use surveys by sampling methods*. The World Land Use Survey, Occasional Papers No 10, London 1971, 16 p.
33. Bromek K., *Opracowanie szczegółowej mapy użytkowania ziemi dla Krakowa. (The preparation of a detailed land utilization map for the city of Cracow)*, Przegląd Geograficzny 27, 1955, 3—4, pp. 589—604.
34. Bromek K., *Użytkowanie ziemi w Krakowie i przyległych częściach powiatu krakowskiego około 1960 roku. (Land use in Cracow and the adjacent parts of Cracow powiat about 1960)*, Zeszyty Naukowe UJ, Prace Geograficzne, vol. 14, Kraków 1966, 107 p.
35. Brouwer L. E. J., *The North Sea*, The World Land Use Survey, Occasional Papers No 5, 1964, 34 p.
36. Bull G. B. G., *Thomas Milne's land utilization map of the London Area in 1800*, The Geographical Journal 122, 1956, 1, pp. 25—30.
37. Burley T. M., *Land use or land utilization?* The Professional Geographer 13, 1961, 6, pp. 18—20.
38. Burley T. M., *Land use in the Hunter Valley. The land cover survey*, The Hunter Valley Research Foundation, Monograph No 6, 1961, 28 + 16 p.

39. Burley T. M., *Land use research in the Hunter Valley. The land cover pattern*, The Hunter Valley Research Foundation, Monograph No 9, 1961, 28 p.
40. Burley T. M., *Land use research in the Hunter Valley. The Land Utilisation Survey*, The Hunter Valley Research Foundation, Monograph No 12, 1962, 30 + VII p.
41. Burley T. M., *Land use research in the Hunter Valley. The Land Utilisation Pattern*, The Hunter Valley Research Foundation, Monograph No 15, 1963, 79 p.
42. Burley T. M., *Agricultural land use in the Hunter Valley. The present situation and future prospects*, The Hunter Valley Research Foundation, Monograph No 16, 1963, 33 p.
43. *Carta della utilizzazione del suolo d'Italia. 1:200 000*, Consiglio Nazionale delle Ricerche, Centro Studi di Geografia Economica. Touring Club Italiano Milano (26 sheets).
44. Chapman J. D., Gilmore J. S., *Peace River-South. Land utilization survey 1948—51*, British Columbia, Dept. of Lands and Forests, Div. of Land Utilization Research and Survey, Victoria B. C. 1952, 49 p.
45. Chatterjee S. P., *Land utilization in the district of 24-Parganas. Bengal*, Calcutta Geographical Society Publications No 6, Calcutta 1946, 66 p.
46. Chatterjee S. P., Mukherji A. B., *Land use patterns in a Mewar village. Rajasthan*, Geographical Review of India 25, 1963, pp. 11—34.
47. Christ F., *Untersuchung zur Automation der kartographischen Bearbeitung von Landkarten*, Nachrichtenkarten und Vermessungswesen 41, 1969, 114 p.
48. Christians C., *Cartes inventaires et cartes perspectives de l'utilisation du sol en Belgique*, A paper read on the International Conference on Land Use Maps in Budapest in 1968.
49. Christodoulou D., *The evolution of the rural land use pattern in Cyprus*, The World Land Use Survey, Monograph No 2, 1959, 230 p.
50. Christodoulou D., *Land use mapping in Cyprus*, Land use in semi-arid mediterranean climates. UNESCO, International Geographical Union Symposium Iraklion (Greece), 19—26 September 1962, UNESCO, 1964, pp. 151—154.
51. Christofolletti A., *Land utilization; methods and problems of research (The review)*, Sociologia 26, Sao Paulo 1964, 4.
52. Ciołkosz A., *Zastosowanie zdjęć lotniczych w pracach związanych z wykonywaniem map rolniczego użytkowania ziemi. (Air surveys in mapping agricultural land use)*, Fotointerpretacja w geografii 6, 1968, pp. 60—72.
53. Ciołkosz A., *Analiza struktury zasiewów na zdjęciach lotniczych. (The analysis of sowing structures on air surveys)*, Przegląd Geodezyjny 1970, 7, pp. 309—311.
54. *Coding standards for general land use mapping*, Task Force Committee on Land Use Mapping, Philippine Planning Journal 1, 1969, 1, pp. 18—25.
55. Colamonico C., *Per la carta della utilizzazione del suolo d'Italia*, Memorie di Geografia Economica 7, Napoli 1952, 66 p.
56. Colamonico C., *For a land use map for Italy. A contribution to the investigation promoted by the IGU in the World Land Use*, Bollettino della Società Geografica Italiana, Roma 1952, pp. 453—459.
57. Colamonico C., *La carte de l'utilisation du sol de l'Italie Méridionale*, XIX Congrès International de Géographie (Stockholm 1960), Institut de Géographie de l'Université de Naples, 1960, 7 p.
58. Colamonico C., *Carta della utilizzazione del suolo d'Italia. Attività svolta*

- dal 1956 al 1963, Supplemento de „La Ricerca Scientifica” 34, 1964, 3, serie 2, pp. 167—170.
59. Colamonico C., *Le développement de la carte à grande échelle de l'utilisation du sol de l'Italie*, XX Congrès International de Géographie (London 1964), Consiglio Nazionale delle Ricerche, Roma 1964, 7 p.
  60. Colamonico C., *Come si è giunti all costruzione della grande carta della utilizzazione del suolo d'Italia*, „Atti” dell'Accademia Pontaniana 17, 1968, 7 p.
  61. Colamonico C., *La carta della utilizzazione del suolo d'Italia sia per essere ultimata*, Atti del XX Congresso Geografico Italiano, Roma 1967, Società Geografica Italiana, Roma 1968, 8 p.
  62. Colamonico C., *Rapport sur la „Carte de l'utilisation du sol de l'Italie” présentée à Budapest à l'occasion de l'Exposition internationale des cartes de l'utilisation des terres. Budapest 1968*, Consiglio Nazionale delle Ricerche, Roma 1968, 3 p.
  63. Colamonico C., *Completata la pubblicazione della carta della utilizzazione del suolo d'Italia a grande scala*, XXI Congresso Internazionale di Geografia (Nuova Delhi 1968), Consiglio Nazionale delle Ricerche, Roma 1968, 8 p.
  64. Colamonico C., *La geografia agraria delle regioni Italiane*, Bollettino della Società Geografica Italiana 1971, pp. 593—604.
  65. Colby C. C., *Changing currents of geographic thought in America*, Annals of the Association of American Geographers 26, 1936, 1, pp. 1—37.
  66. Cole M., *Elgin, Caledon District, Cape Province. A land utilization survey*, South African Geographical Journal 31, 1949, pp. 36—76.
  67. Cole M., *Land use surveys in South Africa*, XVII International Geographical Congress 1952, Abstracts of Papers, pp. 14—15.
  68. Cole M., *Land use studies in the Transvaal Lowveld*, The World Land Use Survey, Occasional Papers No 1, 1956, 41 p.
  69. Coleman A., *The Second Land Use Survey: progress and prospects*, The Geographical Journal 127, 1961, 2, pp. 168—180.
  70. Coleman A., *Some cartographical aspects of the second series land use maps*, The Geographical Journal 130, 1964, 1, pp. 167—170.
  71. Coleman A., *Some technical and economic limitations of cartographic colour representation on land use maps*, The Cartographic Journal 2, 1965, pp. 90—94.
  72. Coleman A., *A wildscape atlas for England and Wales*, The Geographical Magazine 43, 1970, 1, pp. 19—26.
  73. Coleman A., Maggs K. R. A., *Land use survey handbook*, London 1961, 31 p.
  74. Colwell R. N., *Remote sensing of natural resources*, Scientific American 218, 1968, pp. 54—69.
  75. *Contribution to land use survey methods*, Hans Boesch (ed.), The World Land Use Survey, Occasional Papers No 10, London 1971, 67 p.
  76. Cornwall B., *A land use reconnaissance of the Annapolis-Cornwallis Valley. Nova Scotia*, Geographical Bulletin 9, 1957, pp. 22—51.
  77. Crkvenčić I., *Land use mapping under Yugoslav conditions*, Geographical Studies 31, Warszawa 1962, pp. 187—194.
  78. Crkvenčić I., Klemenčić V., *Bodennutzung in 4 ausgewählten Katastergemeinden Jugoslawiens (Podgorje, Sebeborci, Trebijovi 1:25 000, Nunska Graba 1:15 000)*, Institut für Agrarökonomik der Martin Luther Universität Halle-Wittenberg, 1967 (maps).

79. Csati E., *Graphic methods of data evolution for land use maps*, The World Land Use Survey, Occasional Papers No 9, 1970, pp. 85—91.
80. Darby H. C., *Domesday book — the first land utilization survey*, The Geographical Magazine 42, 1970, 6, pp. 416—423.
81. Davies D. H., *Observations on land use in Iraq*, Economic Geography 33, 1957, 2, pp. 122—134.
82. *Detailed Land Utilization Map, preliminary sheet, M-34-54-C-a Chroberz, 1:25 000*, Polish Academy of Sciences, Institute of Geography Dept. of Agr. Geography, Warszawa 1964.
83. Dziewoński K., *Studia geograficzne do planu regionalnego. (Geographical studies for regional planning)*, Przegląd Geograficzny 25, 1953, 4, pp. 3—10.
84. Dziewoński K., *Detailed survey of land utilization in Poland*, Przegląd Geograficzny, Supplement 1956, pp. 26—31.
85. Dziewoński K., Kostrowicki J., *Detailed land use survey in Poland*, Comptes Rendus du Congrès International de Géographie. Rio de Janeiro 1956, 4, 1966, pp. 108—113.
86. Dziewoński K., Kostrowicki J., Piskorz H., Szczęsny R., *Tymczasowa instrukcja sporządzania szczegółowych map użytkowania ziemi (projekt). (Preliminary instruction for the detailed land use mapping)*, Dokumentacja Geograficzna 1956, 1, 35 p.
87. Ellefsen R., *Land use in Delhi state. Testing the applicability of the World Land Use Survey classification system*, The Indian Geographer 5, 1960, 1—2, pp. 59—68.
88. Enyedi G., *La cartographie de l'utilisations du sol de la Hongrie*, Institutum Geographicum. Academia Scientiarum Hungarica Publicationes, 75, 1960, pp. 65—70.
89. Enyedi G., *Sostawienie kart ispolzowania ziemel w Wengrii*, Geographical Studies 31, Warszawa 1962, pp. 195—199.
90. Enyedi G., *A brief chacterization of the agricultural land utilization in Hungary*, Studies in Geography 4, Budapest 1967, pp. 74—88.
91. Enyedi G., *A mezőgazdasági földhasznosítás térképezése. (Agricultural land use mapping)*. Magyar Tudományos Akadémia, Földrajztudományi Kutató Intezet, Közlemenyek 203, 1969, pp. 309—323.
92. Enyedi G., *Land use map of Kerecsend and Maklar, 1:25 000*, Budapest 1969.
93. Faulkner C. N., *Terrace district land utilization survey*, British Columbia, Dept. of Lands and Forests, Victoria 1950.
94. Faulkner C. N., *Pemberton Valley land utilization survey*, British Columbia, Dept. of Lands and Forests, Victoria 1951.
95. Field E. E., *The land utilization map of Northampton*, Geography 15, 1930, pp. 408—412.
96. Finch V. C., *Geographic surveying*, Geographic Society of Chicago, Bulletin 9, 1933, pp. 3—11.
97. Flatres P., *Cartographie de l'utilisation du sol dans le Nord*, Hommes et terres du Nord 1966, 2, pp. 8—34.
98. Forward C. N., *Land use of the Victoria area*, B.C. Geographical Paper No 43, 1969, 25 p.
99. *Four island studies, Santa Maria, Faial (Azores), Eastern Madeira, Zanzibar*. The World Land Use Survey, Monograph No 5, 1968, 18 + 23 + 29 + 23 p.
100. Fox J. W., *Land use survey. General principles and a New Zealand example*,

- Auckland University College Bulletin No 49, Geography Series 1, Auckland 1956, 46 p.
101. Gądomski W., Kulikowski R., *Użytkowanie ziemi i specjalizacja rolnictwa we wschodnich Rodopach na przykładzie TKZS Sziroko Polje*. (Land utilization in the tobacco zone of the Eastern Rhodope Mountains. The case of the collective farm Shiroko Polje), Dokumentacja Geograficzna 1969, 5, pp. 73—90.
  102. Ganguli B. N., *Land use and agricultural planning with special reference to Eastern Uttar Pradesh*, Geographical Review of India, 1964, pp. 53—72.
  103. Garenc P., *Un exemple de mise en valeur des terroirs dans le S-O de la France d'après les cartes des cultures dominantes*, Acta Geographica 28, Paris 1958, pp. 31—36.
  104. Gerasimov I. P., *The geographical study of agricultural land use*, The Geographical Journal 124, 1958, pp. 452—461.
  105. Gluziński J., Rzymowski S., *Użytkowanie ziemi i gospodarka rolna pow. elbląskiego*. (Land utilization and agriculture of the Elbląg powiat), Zeszyty Geograficzne WSP 8, Gdańsk 1966, pp. 73—151.
  106. Gourou P., *Enquête sur l'utilisation du sol dans le monde*, Bulletin de la Société Belge d'Études Géographiques 20, 1951, pp. 427—434.
  107. Grocholska J., *Z metodologii badań nad użytkowaniem ziemi w miastach*. (A contribution to the methodology of research on land use in towns), Przegląd Geograficzny 42, 1970, 2, pp. 349—358.
  108. Guzik C., *Z zagadnień użytkowania ziemi w powiecie bocheńskim*. (Land use in the Bochnia powiat), Zeszyty Naukowe UJ, Prace Geograficzne, vol. 15, Kraków 1967, pp. 61—94.
  109. Guzik C., *Użytkowanie ziemi w powiecie chrzanowskim*. (Land use in the Chrzanów powiat), Zeszyty Naukowe UJ, Prace Geograficzne, vol. 20, Kraków 1968, pp. 23—80.
  110. Haggett P., *Regional and local component in land-use sampling: a case study from the Brazilian Triangulo*, Erdkunde 17, 1963, 1—2, pp. 108—114.
  111. Haggett P., Board C., *Rotational and parallel traverses in the rapid integration of geographic areas*, Annals of the Association of American Geographers 54, 1964, 3, pp. 406—410.
  112. Hauzer S., *Przeładowe zdjęcie użytkowania ziemi. Założenia i metoda*. (The method of the simplified land use map), Dokumentacja Geograficzna 1968, 4, pp. 68—73.
  113. Herzog W., Troll C., *Die Landnutzungskarte Nordhein 1:100 000, Blatt 1, Köln-Bonn*, Arbeiten zur Rheinischen Landeskunde 28, Bonn 1968, 19 p.
  114. Holub-Pacewiczowa Z., *Mapa gospodarczo-osadnicza pasterstwa w Tatrach i mapka etnograficzna z zasięgiem wędrowek pasterskich i typów szalańskich*. (An economic map of shepherd population in the Tatra Mountains including the distribution of their settlements; an ethnographic map presenting the range of pastoral wanderings and summer-time pasturing). Pamiętnik II Zjazdu Słowiańskich Geografów i Etnografów w Polsce w r. 1927. (Proceedings of the II Congress of Slavonic Geographers and Ethnographers in Poland in 1927), vol. 2, Kraków 1930, pp. 98—101.
  115. Holub-Pacewiczowa Z., *Osadnictwo pasterskie i wędrowki w Tatrach i na Podtatrzu*. (Pastoral settlement and migrations in the Tatras and Tatra foothills), PAU, Prace Komisji Geograficznej No 1, Kraków 1931, 508 p.
  116. Howe G. M., *A note on the application of air photography to the agricultu-*

- ral geography of North-West Cardiganshire, *Geography* 36, 1951, 1, pp. 15—20.
117. Hudson G. D., *Methods employed by geographers in regional surveys*, *Economic Geography* 12, 1936, pp. 98—104.
  118. Hudson G. D., *The unit area method of land classification*, *Annals of the Association of American Geographers* 26, 1936, 2, pp. 99—112.
  119. Hult J., *A method for surveying land use*, *Publicationes Instituti Geographici Universitatis Ouluensis*, 1969, 40 p.
  120. Hutton C. L. A., *Mapping present land use in Alberta: an ARDA project*, *The Albertan Geographer* 2, University of Alberta, Edmonton 1965, pp. 31—40.
  121. Ilešič S., *Obrabljena zemlja u Slovenji. (Cultivated land in Slovenia)*, *Glasnik Geografskog Društva* 21, 1935, pp. 29—39.
  122. Ilešič S., *Mednarodna proučitev kmetijskega iskoriščevanja tal. (International investigation on agricultural land utilization)*, *Geografski Vestnik* 24, 1952, pp. 204—205.
  123. Ilešič S., *Studije o kmetijski izrabi tal v treh vaseh Jugoslavije. (A study on the utilization of land in three Yugoslav villages)*, *Geografski Vestnik* 34, 1962, pp. 61—62.
  124. Ilešič S., *L'état actuel et les problèmes des recherches sur l'utilisation du sol en Yougoslavie*, *Geographical Studies* 31, Warszawa 1962, pp. 182—186.
  125. Imhof E., *Thematische Kartographie. Beiträge zu ihrer Methode*, *Die Erde* 93, 1962, 2, pp. 72—116.
  126. *Instrukcja szczegółowego zdjęcia użytkowania ziemi. (Instruction for the detailed land use survey)*, J. Kostrowicki (ed.), *Dokumentacja Geograficzna* 1959, 2, pp. 9—128.
  127. *Instrukcja szczegółowego zdjęcia użytkowania ziemi. (Instruction for the detailed land use survey)* 2nd edition, J. Kostrowicki (ed.), *Dokumentacja Geograficzna* 1959/60, 2, 124 p.
  128. *Instrukcja szczegółowego zdjęcia użytkowania ziemi. (Instruction for the detailed land use survey)* 3rd edition, improved and completed, J. Kostrowicki (ed.), *Dokumentacja Geograficzna* 1962, 129 p.
  129. *The IGU Newsletter* 8, 1957, 1, p. 9.
  130. *IGU Bulletin* 20, 1969, 2, pp. 15—16.
  131. *IGU Bulletin* 24, 1973, 1—2, pp. 30—31.
  132. *International Conference on Land Use Maps, Budapest 1968*, Radó S. (ed.), Budapest 1970, 255 p.
  133. *International Geography 1972. Papers submitted to the 22nd International Geographical Congress in Canada*, Montreal, vol. 1 — 694 p., vol. 2 — pp. 695—1354.
  134. Ivanička K., *Land utilization of the region of the East-Slovakian Iron-Works. 1:50 000*, *Acta Geologica et Geographica Universitatis Comenianae, Geographica* No 4, Bratislava 1964.
  135. Ivanička K., *Land use map of the area of Bratislava. 1:50 000*, Bratislava 1972.
  136. Jacks G. V., *Land classification for land use planning*, *Technical Communication* No 43, Imperial Bureau of Soil Science, 1946.
  137. Jačimović B., *Iskorišćavanje zemljišta u selu Sremcici u Beogradskom Mero-krasu. (Land utilization in the village Sremcica in the Mérokars of Belgrade)*, *Zbornik Radova, Geografski Institut PMF*, 17, Belgrade 1970, pp. 141—160.
  138. Jačimović B., *Socijalno-geografske transformacije i iskorišćavanje zemljišta u Ostružnici u Beogradskoj Posavini. (Socio-geographical transformations and*

- land utilization in Ostružnica in the region of Belgrade Posavina), Zbornik Radova, Geografski Institut PMF, 18, Belgrade 1971, pp. 217—241.
139. Jahn A., *Studia nad użytkowaniem ziemi w Polsce. Stan dotychczasowych badań i projekt instrukcji. (Land use studies in Poland; the present state and a project of instruction)*, Duplicated manuscript, 1947, 26 p.
  140. Jankowski W., *Drugie brytyjskie zdjęcie użytkowania ziemi. (The second land utilization survey of Britain)*, Przegląd Geograficzny 42, 1970, 4, pp. 757—762.
  141. Jankowski W., *Carta della utilizzazione del suolo d'Italia 1:200 000*, Polski Przegląd Kartograficzny 3, 1971, 3, pp. 135—136.
  142. Jankowski W., *Mapy użytkowania ziemi. (Land use maps)*, [in] Materiały Ogólnopolskich Konferencji Kartograficznych. (Proceedings of Cartographic Conferences in Poland), vol. 1, Lublin 10—11. 5. 1968, Lublin-Warszawa 1971, pp. 128—132.
  143. Jankowski W., *Mapy użytkowania ziemi w Polsce. Dorobek i perspektywy. (Maps of land utilization in Poland. Achievements and perspectives)*, Polski Przegląd Kartograficzny 4, 1972, 1, pp. 14—26.
  144. Jankowski W., Kowalczyk D., *Użytkowanie ziemi i rolnictwo we wsi Żeleznik, strefa podmiejska Belgradu, Jugosławia. (Land utilization and agriculture in the village of Zeleznik, Belgrade suburban zone; Yugoslavia)*, Dokumentacja Geograficzna 1969, 5, pp. 51—72.
  145. Jankowski W., Kulikowski R., *Polska mapa użytkowania ziemi w skali 1:200 000. (Land use map of Poland 1:200 000)*, Polski Przegląd Kartograficzny 5, 1973, 3, pp. 11—116.
  146. Janlekha K., *Saraphi. A survey of socio-economic conditions in a rural community in north-east Thailand*, The World Land Use Survey, Occasional Papers No 8, 1968, 63 p.
  147. Jarosz S., *Badania geograficzno-leśne w Gorcach. (Geographical research of Gorce forests)*, Prace rolniczo-leśne No 16, PAU, Kraków 1935, 125 p.
  148. Jeffers J. N. R., *The use of electronic computers in land use surveys based on photo-interpretation*, Photogrammetric Record 30, 1967, 5.
  149. Jelić D., Jeršič M., Lojk J., Vojvoda M., *Kmetijska proizvodnja in izraba tal v katastrski občini Trebijovi v Hercegovini. (Agricultural production and land utilization in the cadaster commune of Trebijovi in Hercegovina)*, Geografski Vestnik 34, 1962, pp. 97—113.
  150. Jeršič M., Lojk J., Olas L., Vojvoda M., *Kmetijska proizvodnja in izraba tal v vasi Sebeborci v Prekmurju. (Agricultural production and land utilization in the village of Sebeborci in Prekmurje)*, Geografski Vestnik 34, 1962, pp. 81—97.
  151. Jones W. D., Sauer C. O., *Outline for field work in geography*, Bulletin of the American Geographical Society 47, 1915, pp. 520—525.
  152. Karan P. P., *Land use mapping in Nepal (From 35 mm serial kodachrome slides)*, The Oriental Geographer 4, 1960, 2, pp. 110—117.
  153. Karan P. P., *Nepal. A cultural and physical geography*, University of Kentucky Press, Lexington 1960, 100 p.
  154. Keller Coelho de Souza E., *Contribucao à metodologia de pesquisa em geografia agraria*, Conferencia Regional Latinoamericana, Mexico 1966, vol. II, pp. 605—613.
  155. Keller Coelho de Souza E., *Projeto do mapeamento da utilização da terra*, Aerofotogeografia 3, São Paulo 1969, pp. 15.



156. Khan F. K., *Land use in Rampal Union*, East Pakistan Geographical Society, Monograph No 1, Dept. of Geography, University of Dacca 1961, 43 p.
157. Klemenčič V., *Kmetijska proizvodnja in izraba tal vasi Podgorje pri Kamniku. (Agricultural production and land utilization in the village of Podgorje at Kamnik)*, Geografski Vestnik 34, 1962, pp. 62—81.
158. Klemenčič V., Crkvenčič I., *The mapping of land utilization in Yugoslavia*, Studies in Geography 4, Budapest 1967, pp. 67—73.
159. Klimaszewski M., Leszczycki S., Ormicki W., *Geograficzny opis okolicy Krakowa widzianej z Kopca Kościuszki. (Geographical description of the Cracow vicinity as seen from Kościuszki Mound)*, Kraków 1934, 42 p.
160. Koch P. H., *Interpretation of air photographs of shifting cultivation — Liberia: and aid in agro-geographical analysis*. The World Land Use Survey, Occasional Papers No 10, London 1971, 21 p.
161. Kostrowicki J., *Uwagi o geografii rolnictwa w krajach anglosaskich. (Remarks on the geography of agriculture in English-speaking countries)*, Przegląd Geograficzny 29, 1957, 1, pp. 47—65.
162. Kostrowicki J., *Polskie zdjęcie użytkowania ziemi. (Polish land utilization survey)*, Dokumentacja Geograficzna 1959, 2, pp. 1—8.
163. Kostrowicki J., *Badania nad użytkowaniem ziemi w Polsce. (Research studies on land utilization in Poland)*, Przegląd Geograficzny 31, 1959, 3—4, pp. 517—533.
164. Kostrowicki J., *Land utilization survey as a basis for geographical typology of agriculture*, Przegląd Geograficzny, Supplement, 1960, pp. 169—183.
165. Kostrowicki J., *The aims, concept and method of Polish land utilization survey*, Dokumentacja Geograficzna 1960, 2, 43 p.
166. Kostrowicki J., *Problematyka geograficzno-rolnicza szczegółowego zdjęcia użytkowania ziemi Polski. (Geographic-agricultural problems in the detailed survey of land utilization in Poland)*, Przegląd Geograficzny 32, 1960, 3, pp. 227—279.
167. Kostrowicki J., *Polish land utilization survey*, Geographical Studies 25, Warszawa 1961, pp. 45—56.
168. Kostrowicki J., *X Międzynarodowy Kongres Nauk o Pacyfiku. Honolulu 22. 8—6. 9. 1961. (Xth Pacific Science Congress)*, Przegląd Geograficzny 34, 1962, 3, pp. 585—593.
169. Kostrowicki J., *The Polish detailed survey of land utilization. Methods and techniques of research*, Dokumentacja Geograficzna 1964, 2, 72 p.
170. Kostrowicki J., *II konferencja geografów krajów socjalistycznych Europy w sprawie metod i problematyki badań nad użytkowaniem ziemi. Budapeszt 6—10. V. 1964. (IInd Conference of geographers from socialist countries in Europe on methods and problems concerned with land use research)*, Przegląd Geograficzny 37, 1965, 1, pp. 258—260.
171. Kostrowicki J., *Zdjęcie użytkowania ziemi i jego przydatność praktyczna. (Land utilization survey and its practical importance)*, Biuletyn KPZK 42, 1966, pp. 211—217.
172. Kostrowicki J., *Methods applied in elaborating the material of land utilization survey*, Studies in Geography No 4, Budapest 1967, pp. 9—13.
173. Kostrowicki J., *Regional subcommission for East Central Europe*, The IGU Newsletter 19, 1968, 2, pp. 32—35.
174. Kostrowicki J., *Land use studies as a basis of agricultural typology of East-central Europe*, Geographia Polonica 19, 1970, pp. 263—279.

17. Kostrowicki J., *III konferencja geografów krajów Europy środkowo-wschodniej w sprawie badań użytkowania ziemi*. Maribor, Jugoslavia 7—11. 10. 1969. (*The 3rd Land Use Conference of East-central European geographers*), *Przegląd Geograficzny* 42, 1970, pp. 561—567.
176. Kostrowicki J., *3rd Conference on Land Use held by the East-Central European Geographers*. Maribor, Yugoslavia, October 7—11, 1969, *IGU Bulletin* 21, 1970, 1, pp. 48—52.
177. Kostrowicki J., *Data requirements for land use survey maps*, *The World Land Use Survey*, Occasional Papers No 9, 1970, pp. 73—81.
178. Kostrowicki J., Biegajło W., *Badania Zakładu Geografii Rolnictwa IG PAN na terenie Jugosławii w latach 1962—64. (Investigations carried out in Yugoslavia in 1962—64 by the Department of Agricultural Geography of the Polish Academy of Sciences*, *Przegląd Geograficzny* 37, 1965, pp. 697—702.
179. Kostrowicki J., Hauzer S., Velchev I., Borisov Z., *The collective farm of Petarch in the suburban zone of Sofia*, *Geographia Polonica* 5, 1965, pp. 345—372.
180. Kostrowicki J., Kulikowski R., *Przeglądowe zdjęcie użytkowania ziemi (projekt instrukcji)*. — (*Land use surveys, a project of the instruction*), *Dokumentacja Geograficzna* 1971, 2, 27 p.
181. Kostrowicki J., Stola W., Velchev I., Borisov Z., *The collectivized village of Dermantsi in the Northern Foothills of the Balkan Range*, *Geographia Polonica* 5, 1965, pp. 373—406.
182. Kostrowicki J., Tyszkiewicz W., *Land use studies in East-central Europe. The report of the Regional Subcommission*, *Dokumentacja Geograficzna* 1968, 3, 89 p.
183. Kubijowicz W., *Rozmieszczenie kultur i ludności we Wschodnich Karpatach*. (*Cultural and population distribution in the Eastern Carpathians*), *Krakowskie Odczyty Geograficzne* No 7, Kraków, 1924, 34 p.
184. Kubijowicz W., *Z antropogeografii Nowego Sącza*. (*From the human geography of Nowy Sącz*), *Prace Instytutu Geografii UJ* 8, 1927, 67 p.
185. Kusiński W., *Międzynarodowa konferencja w sprawie metod badania użytkowania ziemi*. (*An international conference on methods of land use research*), *Przegląd Geograficzny* 32, 1960, 4, pp. 611—614.
186. Lakov L., *Otnosno principite i metodite pri sostavlanie na karti za ispolzovanie na zemite v Balgarija*. (*On principles and methods of mapping land use in Bulgaria*), *Godishnik na Sofijskij Universitet* 62, *Geographija*, 1967/68, pp. 95—114.
187. *The Land cover of the Hunter Valley 1:253 440*, *The Hunter Valley Research Foundation* 1961.
188. *Land use map of Europe 1:2 500 000*, The example of Hungary, Csati E. (coordinator), *The Geocartographic Research Department of the Institute of Geodesy and Cartography*, Budapest, 1974.
189. *Land utilization map of Ceylon*, Quarter inch to one statute mile (1:253 140), Ceylon 1949, Survey Dept. (Four sheets).
190. *Land utilization. Methods and problems of research. Proceedings of the International Seminar, Poland, 30 May—8 June 1960*, *Geographical Studies* 31, Warszawa 1962, 250 p.
191. *Land utilization in East-central Europe. Case Studies*, J. Kostrowicki (ed.), *Geographia Polonica* 5, 1965, 498 + 17 p.

192. *Land utilization in Eastern Europe*, Bela Sarfalvi (ed.), Studies in Geography 4, Budapest 1967, 88 p.
193. *Land utilization survey in Sehore (Bhopal)*, The Geographer 5, 1952, 2, pp. 28—33.
194. *Land utilization survey in Faridkot (Punjab)*, The Geographer 8/9, 1956/7, p. 59.
195. Latham J. P., *Methodology for an instrumented geographic analysis*, Annals of the Association of American Geographers 53, 1963, 2, pp. 194—209.
196. Lebed'ev P. N., Osetrov A. E., *Zadači i metody izucenija sel'skochozjajstvennogo ispol'zovanija zemel'*, Vestnik Moskovskogo Universiteta Geografija, 1969, 3, pp. 123—125.
197. Lebon J. H. G., *Land use mapping in Sudan*, Economic Geography 35, 1935, 1, pp. 60—70.
198. Lebon J. H. G., *The land use survey of Sudan: some problems of classification and mapping. Land use in semi-arid mediterranean climates. UNESCO, International Geographical Union Symposium, Iraklion (Greece), 19—26 September 1962*, UNESCO, 1964, pp. 139—147.
199. Lebon J. H. G., *Land use in Sudan*, The World Land Use Survey, Monograph No 4, 1965, 191 p.
200. Leszczycki S., *Badania geograficzne nad osadnictwem w Beskidzie Wyspowym. (Geographical research on settlement activity in Beskid Wyspowy)*, Prace Instytutu Geograficznego UJ, vol. 14, Kraków 1932, 83 p.
201. Leszczycki S., *Region Podhala, podstawy geograficzno-gospodarcze planu regionalnego. (The Podhale region, geographico-economic premises of the regional plan)*, Prace Instytutu Geograficznego UJ, vol. 20, Kraków 1938, 286 p.
202. Light R. and M., *Contrasts in African farming. Aerial views from the Cape to Cairo*, The Geographical Review 28, 1938, 4, pp. 529—555.
203. McClellan J. B., *The land-use sector of the Canada Land Inventory*, Geographical Bulletin 7, 1965, 2, pp. 73—78.
204. MacFadden C. H., *Some preliminary notes on the use of the light airplane and 35 mm camera in geographic field research*, Annals of the Association of American Geographers 39, 1949, pp. 188—200.
205. MacFadden C. H., *The uses of aerial photographs in geographic research*, Photogrammetric Engineering 18, 1952, p. 732.
206. MacKay J. R., *Some cartographic problems in the field of special (thematic) maps*, Canadian Cartography 1, 1962, pp. 42—47.
207. MacKinder H. J., *The scope and methods of geography*, Proceedings of the Royal Geographical Society 9, 1887, pp. 141—160.
208. McMaster D. M., *A subsistence crop geography of Uganda*, The World Land Use Survey, Occasional Papers No 2, 1962, 111 p.
209. McMurry K. C., *Geographic contributions to land-use planning*, Annals of the Association of American Geographers 26, 1936, 2, pp. 91—98.
210. *Malaya land utilization map 1:760 320*, Survey Dept. Federation of Malaya 1953.
211. Malicki A., *Polożenie geograficzne miast na Nadbużu. (Geographical situation of towns along the Bug river)*, Czasopismo Geograficzne 15, 1937, 1, pp. 18—42.
212. *Manual of photographic interpretation*, American Society of Photogrammetry, Washington 1960, 868 p.

213. Marschner F. J., *Major land uses in the United States, 1:5 000 000*. US Dept. of Agriculture, Agricultural Research Service, 1958.
214. Matusik M., *Niektóre problemy użytkowania ziemi a rzeźba terenu na Pojezierzu Kaszubskim. (Some problems of land utilization and the relief of the Cassubian lakeland)*, Zeszyty Geograficzne WSP, 8, Gdańsk 1966, pp. 153—178.
215. Meienberg P., *Die Landnutzungskartierung nach Pan-, Infrarot- und Farbluftbildern*, Münchner Studien zur Sozial- und Wirtschaftsgeographie Band 1, 1966, 133 p.
216. *Metodika izučeniya chozjajstvennogo ispol'zovanija zemel' dija sostavlenija krupnomasštabnykh kart*, Moskovskij Gosudarstvennyj Universitet Geografičeskij fakul'tet, Moscow 1962, 22 p.
217. Mill H. R., *Proposed geographical description of the British Islands based on the Ordnance Survey*, The Geographical Journal 7, 1896, 4, pp. 345—356.
218. Mill H. R., *A fragment of the geography of England. Southwest Sussex*, The Geographical Journal 15, 1900, pp. 205—227, 353—378.
219. Milne T., *Milne's plan of the cities of London and Westminster, circumadja-cent towns and parishes etc. laid down from a trigonometrical survey taken in the year 1795—99. 1: 31 680 (2 inches to 1 mile)*, 11th March 1800.
220. *New possibilities and technique for land use and related surveys with special reference to the developing countries*, The World Land Use Survey, Occasional Papers No 9, 1970, 138 p.
221. Nicholson N. L., *Rural settlement and land use in the New Glasgow Region*, Geographical Bulletin 7, 1955, pp. 38—64.
222. Nicholson N. L., *Land use mapping in Canada*, Proceedings of IGU Regional Conference in Japan 1957, Tokyo 1959, pp. 564—570.
223. Nicholson N. L., Cornwall I. H. B., Raymond C. W., *Canadian land use mapping*, Geographical Branch of the Federal Dept. of Mines and Technical Surveys, Ottawa, Geographical Paper 31, 1961, 40 p.
224. Niddrie D. L., *Land use and population in Tobago*, The World Land Use Survey, Monograph 3, 1960, 59 p.
225. Nunnally N. R., Witmer R. E., *Remote sensing for land-use studies*, Photogrammetric Engineering 36, 1970, 5, pp. 449—453.
226. *Objectives, scope and organization. The Canada Land Inventory*. Report No 1/1965 (2nd edition 1970), Ottawa, 61 p.
227. Ormicki W., *Przyczynek do kartowania użytkowania powierzchni ziemi. (A contribution to the cartography of the utilization of the Earth's surface)*, Sprawozdanie z czynności i posiedzeń PAU 37, 1932, 10, pp. 34—35.
228. Oyeless J. O., *The mapping of land use patterns from air photographs in the Forest Zone of Ibadan division*, Nigerian Geographical Journal 2, 1968, 1, pp. 27—37.
229. Packman D. J., Philpotts L. E., *Elementary agricultural air photo interpretation*, Canadian Dept. Agricultural Economic Division, Ottawa 1955.
230. Paulov J., *Land utilization in Krasna nad Hornádóm — 1961. 1:25 000*, Acta Geologica et Geographica Universitatis Comenianae, Geographica 4, Bratislava 1964.
231. Perpillou A., *L'évolution de l'utilisation du sol par l'agriculture dans huit départements du Midi de la France*, Mémoires et Documents, Centre de Documentation Cartographique et Géographique 7, 1960, pp. 119—134.

232. Perpillou A., Ducharry M., *L'utilisation agricole du sol dans les Alpes françaises du Nord*. Acta Geographica 40, 1961, pp. 2—9.
233. Popović M., Milojević M., *Agrarno-geografska karta NR Srbije — razmestaj biljne proizvodnje*. (Agro-geographical map of Serbia; distribution of crop production), Belgrade 1962.
234. Prothero R. M., *Some problems of land use survey in Nigeria*, Economic Geography 30, 1954, 1, pp. 60—69.
235. Prothero R. M., *Land use at Soba, Zaria Province, Northern Nigeria*, Economic Geography 33, 1957, 1, pp. 72—86.
236. *Przeglądowa mapa użytkowania ziemi 1:200 000 (wzór mapy)*. (Simplified land utilization map. Sample sheet), J. Kostrowicki, W. Jankowski, R. Kulikowski (ed.), Instytut Geografii PAN, Zakład Geografii Rolnictwa, Warszawa 1971.
237. Przepiórski W., *Z geografii osadnictwa w karpacczym dorzeczu Czeremoszu*. (From settlement geography in the Carpathian basin of the Czeremosz River), Czasopismo Geograficzne 1935, 1, pp. 36—55.
238. Radó S., *International Bibliography of Land Use Maps*, IGU Bulletin 21, 1970, 1, pp. 47—48.
239. Rakitnikov A. N., *Metody izučenija i kartografirovanija ispol'zovanija zemel'*, Vestnik Moskovskogo Universiteta, Geografija, 1964, 1, pp. 12—17.
240. Rakitnikov A. N., *Geografija sel'skogo chozajajstva*, Moscow 1970, 342 p.
241. Rakowicz J., *Trzczińsko-Zdrój, użytkowanie ziemi w mieście*. (Land utilization in the Trzczińsko-Zdrój town), Dokumentacja Geograficzna 1958, 2, pp. 26—45.
242. Rakowicz J., *Miasto Mrągowo, środowisko geograficzne, rozwój i użytkowanie ziemi*. (Mrągowo Town: natural environment, development and land utilization), Dokumentacja Geograficzna 1959, 1, pp. 60—102.
243. Rakowicz-Grocholska J., *Investigations of urban land use in Polish geographical studies*. Studies in geographical methods, Geographia Polonica 18, 1970, pp. 85—92.
244. Ratajski L., *Polska kartografia ekonomiczna XX wieku*. (Polish economic cartography in the 20th century), Prace Geograficzne 49, Warszawa 1965, 143 p.
245. Ratajski L., *Z problematyki kartografii tematycznej*. (Some problems concerning thematic cartography), Polski Przegląd Kartograficzny 1, 1969, pp. 13—19.
246. Ratajski L., *Metodyka kartografii społeczno-gospodarczej*. (Methodology of socio-economic cartography), PPWK, Warszawa 1973, 380 p.
247. Ratajski L., Winid B., *Kartografia ekonomiczna*. (Economic cartography) PPWK, Warszawa 1963, 2nd edition, 274 p.
248. Rawson R. R., Sealy K. R., *Land utilization map Cyprus 1:250 000*, Geographical Publications London 1956.
249. Raymond C. W., McClellan J. B., Rayburn J. A., *Land utilization in Prince Edward Island*, Geographical Branch of the Federal Dept. of Mines and Technical Surveys, Memoir 9, Ottawa 1963, 109 p.
250. Reeds L. G., *Land utilization in Central Ontario*, Economic Geography 22, 1946, pp. 289—306.
251. Reeds L. G., *Land classification as part of a geographical survey of the Avalon Peninsula of Newfoundland*, Geographical Bulletin 5, 1954, pp. 58—78.

252. Reeds L. G., *The land-use survey of the Niagara Peninsula — a critical review*, Geographical Bulletin 7, 1965, 3/4, pp. 200—211.
253. *Report of the Commission on World Land Use Survey for the period 1949—1952*, Worcester, Mass. 1952, 23 p.
254. *Report of the Commission on Inventory of World Land Use*, Worcester, Mass. 1956, 67 p.
255. *Report of the Ghugli land utilization survey camp. February 1951*, The Geographer 4, 1951, 1, pp. 71—72.
256. Remy A., *Les travaux polonais sur l'utilisation du sol*, Etudes Rurales 12, 1964, pp. 134—136.
257. Romanowski J., *Geographic research and methodology on East-central and South-east European agriculture*, [in] Eastern Europe, *Essays in Geographical Problems*, Hoffman G. W. (ed.), London 1971, pp. 127—159.
258. Roubitschek W., *Investigations into the regional pattern of land utilization in the German Democratic Republic*, Geographical Studies 31, Warszawa 1962, pp. 201—212.
259. Roy B. K., *Some characteristics of land use in Doaba Pargana of Ballia (U. P.) India*, The Geographical Review of India 26, 1964, 3, pp. 100—111.
260. Roy B. K., *Land utilisation in the margins of the old and new alluvium soils of Ballia District (U. P.) Village Dumari: a case study*, The Indian Geographical Journal 42, 1967, 3—4, pp. 56—63.
261. Roy B. K., *Arable uses need adjustment for land use planning: a case study of the Ganga-Ghaghara Doab East*, The National Geographical Journal of India 15, 1969, 2, pp. 105—124.
262. Ruppert K., Lehmann P., *Über Möglichkeiten zur Verfeinerung und Objektivierung der agrargeographischen Interpretation panchromatischer Luftbilder*, Mitteilungen der Geogr. Gesellschaft in München. 13, 1961, pp. 87—97.
263. Ruppert K., Meienberg P., *Das Luftbild als Hilfsmittel agrargeographischer Forschung*, Umschau Heft 7, 1964, pp. 207—210.
264. Rühle E., *Użycie i rozmieszczenie ludności na zachodnim Polesiu. (Land utilization and population distribution in western Polesie)*, Wiadomości Służby Geograficznej 4, 1930, 3, pp. 229—263.
265. Rzymowski S., *Rolnicze użytkowanie ziemi na Pobrzeżu Kaszubskim — gromada Sasino. (Agricultural land utilization on the Cassubian coast, gromada Sasino)*, Zeszyty Geograficzne WSP Gdańsk 9, 1967, pp. 155—184.
266. Sauer C. O., *Mapping the utilization of the land*, Geographical Review 8, 1919, 7, pp. 47—54.
267. Schmid R., *Land use mapping in Hill Country, Eastern Nepal: Interpretation of air photographs in compilation of agricultural statistics*, The World Land Use Survey, Occasional Papers No 10, London 1971, 19 p.
268. Schoenmann L. R., *Description of field methods followed by the Michigan land economic survey*, American Soil Survey Association, Bulletin 4, 1923, pp. 44—52.
269. Shafi M., *A plea for land utilization survey*, The Geographer 4, 1951, 2, pp. 63—69.
270. Shafi M., *Report of land use survey at Ajmer — 1952*, The Geographer 4, 1951, 2, pp. 71—72.
271. Shafi M., *Geographical research in India*, The Geographer 5, 1952, 2, pp. 38—47.

272. Shafi M., *Land utilization in Eastern Uttar Pradesh*, The Dept. of Geography, Muslim University Aligarh, 1960, 280 p.
273. Shafi M., *Technique of rural land use planning with reference to India*, The Geographer 13, 1966, pp. 13—24.
274. Shafi M., *Land use planning, land classification and land capability. Methods and techniques*, The Geographer 16, 1969, pp. 1—8.
275. Shawcross (Lord), *The Law of the continental shelf with special reference to the North Sea*, The World Land Use Survey, Occasional Papers No 5, 1964, pp. 35—42.
276. Shotzky V. P., *Kartografičeskije metody isledovanija geografičeskich problemov sel'skogo chozjajstva. Na primere juga Vostocnoj Sibiri*, Leningrad 1970, 139 p.
277. Simche Z., *O typach planów krajobrazowych miast. (On the types of urban landscape plans)*, Przegląd Geograficzny 8, 1928, pp. 67—76.
278. Simche Z., *Tarnów i jego okolica. (Tarnów and its vicinity)*, Tarnów 1930, 303 p.
279. Singh H. S., *Land use planning in India with special reference to agriculture*, The Indian Geographer 5, 1960, 1—2, pp. 45—58.
280. Stamp L. D., *The land utilization survey of Britain*. The Geographical Journal 78, 1931, 1, pp. 40—47.
281. Stamp L. D., *The land of Britain, its use and misuse*, London 1948, 507 p., 2nd edition 1950, 3rd edition 1962.
282. Stamp L. D., *Commission on a World Land Use Survey*, IGU Newsletter 11, 1960, 1—2, pp. 38—46.
283. Stamp L. D., *Applied geography*, Penguin Books 16, 1960, 207 p.
284. Stamp L. D., *Commission on a World Land Use Survey*, IGU Newsletter 13, 1962 1, pp. 28—31.
285. Stamp L. D., *Commission on a World Land Use Survey*, IGU Newsletter 15, 1964, 1—2, pp. 35—40.
286. Stamp L. D., *Land use studies in Eastern Europe*, Geographical Review 54, 1964, pp. 115—116.
287. Stamp L. D., *Land use statistics of the countries of Europe*, The World Land Use Survey, Occasional Papers No 3, 1965, 42 p.
288. Steiner D., *Eine einfache Methode der Reflexionsmessung im Gelände und ihre Anwendung bei Problemen der Landnutzungsinterpretation von Luftbildern*, Bildmessung und Luftbildwesen 29, 1961, pp. 123—133.
289. Steiner D., *Die Jahreszeit als Faktor bei der Landnutzungsinterpretation, gezeigt am Beispiel des schweizerischen Mittellandes*, Landeskundliche Luftbildauswertung im mitteleuropäischen Raum 5, 1961, 81 p. Institut für Landeskunde, Bad Godesberg.
290. Steiner D., *Zur Technik und Methodik der Landnutzungsinterpretation von Luftbildern*, Berichte zur Deutschen Landeskunde 29, 1962, pp. 99—130.
291. Stobbs A. R., *Some problems of measuring land use in underdeveloped countries: the land use survey of Malawi*, The Cartographic Journal 5, 1968, pp. 107—110.
292. Stone K. H., *Air photo interpretation procedures. Report of Commission VII, Photographic Interpretation, to International Society of Photogrammetry*, Photogrammetric Engineering 22, 1956, 1, pp. 123—132.
293. Symons L., *Agricultural geography*, London 1968, 283 p.
294. *Szczegółowa mapa użytkowania ziemi, arkusz próbny. M-34-54-C-a Chroberz*

- 1 : 25 000. (*Detailed land utilization map. Preliminary sheet*), Instytut Geografii PAN, Zakład Geografii Rolnictwa, Warszawa 1964.
295. Szczyński R., *Die Forschungen über die Bodennutzung in Polen*, International Conference on Land Use Maps, Budapest 1968. Radó S. (ed.), Budapest 1970, pp. 175—189.
296. Szczyński R., *Zarys kartografii ekonomicznej. Skrypt do ćwiczeń z geografii gospodarczej*. (*Outline of economic cartography, mimeographed lectures*), SGGW, Warszawa 1970, 86 p.
297. Siraev E. E., *Metody peredači informacii na tematičeskich kartach primenitel'no k mašinnomu i visual'nomu sčityvaniju*. *Vestnik Moskovskogo Universiteta, Geografija*, 1968, 3, pp. 63—73.
298. Tobjasz J., *Instrukcja sporządzania szczegółowych map użytkowania ziemi w skali 1 : 25 000 i 1 : 10 000*. (*An instruction on detailed land use mapping on the scale 1 : 25 000 and 1 : 10 000*), Duplicated manuscript, Warszawa 1960, 38 p.
299. Tobjasz J., *Rolnictwo obrzeża miasta Nowe Tychy (problemy geograficzno-ekonomiczne)*. (*Agriculture on the area around the town Nowe Tychy; geographic-economic problems*), PAN, Komitet dla Spraw Górnos Śląskiego Okręgu Przemysłowego, Biuletyn 62, 1961, 142 p.
300. Tobjasz J., *Problemy struktury przestrzennej w rejonie plockim ze szczególnym uwzględnieniem użytkowania ziemi*. (*Problems of space structure in the Plock region with particular reference to land use*), *Zeszyty Badań Rejonów Uprzemysławianych* 33, 1968, 291 p. + map.
301. Tobjasz J., *Instrukcja sporządzania szczegółowych map użytkowania ziemi w skali 1 : 25 000 i 1 : 10 000*. (*Instruction on detailed land use mapping on the scale 1 : 25 000 and 1 : 10 000*), Duplicated manuscript, Zakład Geografii Ekonomicznej IG UW 1970, 31 p.
302. Tobler W. R., *L'automation dans la préparation des cartes thématiques*. *Internationales Jahrbuch für Kartographie* 6, 1966, pp. 81—93.
303. *The Transformation of rural communities*, The World Land Use Survey, Occasional Papers No 7, 1966, 52 p.
304. Tregear T. R., *Land utilization in Hong Kong*, Hong Kong University Press 1955, 8 p.
305. Tregear T. R., *Land use in Hong Kong and the new territories*, The World Land Use Survey, Monograph No 1, Hong Kong University Press 1958, 75 p.
306. Tufescu V., Velcea J., *Study and mapping of land use in Rumania*, *Revue de Géologie, et de Géographie; serie de Géographie* 8, 1964, pp. 233—237.
307. *Tymczasowa instrukcja sporządzania szczegółowych map użytkowania ziemi — projekt na 1957 r.* (*A provisional instruction on detailed land use mapping, a project for 1957*), Duplicated manuscript, Pracownia Geografii Rolnictwa IG PAN, 38 p. + 2 tables of signs.
308. *Tymczasowa instrukcja sporządzania szczegółowych map użytkowania ziemi — projekt na 1958 r.* (*A provisional instruction on detailed land use mapping, a project for 1958*), Duplicated manuscript, Pracownia Geografii Rolnictwa IG PAN, 39 p. + 10 p. of explanations.
309. Uboma. *A socio-economic and nutritional survey of a rural community in Eastern Nigeria*, The World Land Use Survey, Occasional Papers No 6, 1966, 116 p.
310. Uhorczak F., *Polska przeglądowa mapa użytkowania ziemi 1 : 1 000 000*. (*Poland's general land utilization map in 1 : 1 000 000 scale*). *Prace Geograficzne IG PAN*, 1969, 19 p.



311. Użytkowanie ziemi w krajach Europy Środkowo-Wschodniej. Wyniki badań na terenie Czechosłowacji i Jugosławii w latach 1962—1964. (*Land utilization in East-central Europe; case studies from Czechoslovakia and Yugoslavia*), J. Kostrowicki, W. Biegajło (ed.), Dokumentacja Geograficzna 1966, 2/3, 160 p. + 6 maps.
312. Użytkowanie ziemi w krajach Europy Środkowo-Wschodniej. Wyniki badań na terenie Czechosłowacji, Węgier i Jugosławii w latach 1962—1964. (*Land utilization in East-central Europe. Case studies from Czechoslovakia, Hungary and Yugoslavia*), R. Szcześniey (ed.), Dokumentacja Geograficzna 1967, 1, 125 p. + 5 maps.
313. Użytkowanie ziemi i rolnictwo w krajach Europy Środkowo-Wschodniej. Wyniki badań na terenie Macedonii, Serbii, Bulgarii i Czech. (*Land utilization and agriculture in East-central Europe. Case studies from Macedonia, Serbia, Bulgaria and Bohemia*), J. Kostrowicki (ed.), Dokumentacja Geograficzna 1969, 5, 108 p. + 5 maps.
314. Van Valkenburg S., *The world land use survey*, Economic Geography 26, 1950, pp. 1—5.
315. Velcea I., Jacob G., *Delta Dunarii — structure si modul de utilizare a terenurilor*. (*Agricultural use of the Danube Delta*), Nature 5, 1962, pp. 3—13.
316. Velcea I., Jacob G., *Types of land use in the Danube Delta*. Revue de Géologie et de Géographie 8, 1964, pp. 239—244.
317. Velcea I., Jordan I., *Harta utilizării terenurilor în R. P. România*. (*A map of the utilization of the land in the Rumanian People's Republic*), Probleme de Geografie 10, 1963, pp. 21—29.
318. Velcea I., Jordan I., *Karta zemlepolzovania Ruminskoj Narodnoj Respubliki*. (*A map of land utilization of the Rumanian People's Republic*), Revue de Géologie et de Géographie 7, 1963, pp. 179—185.
319. Virone L. E., *Borgo a Mozzano*, The World Land Use Survey, Occasional Papers No 4, 1963, 36 p.
320. Watanabe A., *Present status of land use survey and land use studies in Japan*, Ochanomizu University 22, 1969, pp. 95—98.
321. Wikkramatilleke R., *Problems of land use mapping in the tropics: an example from Ceylon*, Geography 44, 1959, 2, pp. 79—95.
322. Willats E. C., *Present land use as a basis for planning*, Geography 23, 1938.
323. Wilmet J., *Photo-interpretation et cartographie de l'utilisation du sol en milieu rural*, Bulletin de la Société Belge d'Etudes Géographiques 39, 1970, 1, pp. 31—112.
324. *World Atlas of Agriculture*, International Association of Agricultural Economists, Instituto Geografico de Agostini, Novara 1969.

## KARTOWANIE UŻYTKOWANIA ZIEMI. ROZWÓJ I METODY

### Streszczenie

Przedmiotem pracy jest analiza porównawcza i ocena map użytkowania ziemi rozumianych jako mapy obrazujące przestrzenne rozmieszczenie form pokrycia powierzchni ziemi, użytkowanych lub nieużytkowanych przez człowieka, w ich związkach przestrzennych i wzajemnej współzależności. Pominięte natomiast zostały pokrewne opracowania, jak mapy roślinności, mapy leśne, mapy produkcji roślinnej, zwierzęcej, mapy ekonomicznych i społecznych aspektów rolnictwa oraz mapy atlasowe.

Nie spotykana wcześniej liczba, zakres i forma opracowań wykonanych w XX w. wskazują jednoznacznie na nasze stulecie jako okres właściwego rozwoju badań użytkowania ziemi. W tej dziedzinie wiodącą rolę odegrała Wielka Brytania i ona dała początek pracom na dużą skalę. Z inicjatywy L. D. Stampa w latach 1930—1945 wykonano zdjęcie Anglii, Walii i Szkocji zakończone m. in. drukiem serii 166 arkuszy mapy w podziałce 1 : 63 360. Znaczenie praktyczne i naukowe zdjęcia brytyjskiego spowodowało dynamiczny rozwój tego rodzaju prac na świecie. W 1949 r. na pierwszym powojennym Międzynarodowym Kongresie Geograficznym w Lizbonie powołano Komisję Światowego Zdjęcia Użytkowania Ziemi, której podstawowym zadaniem było zorganizowanie światowego zdjęcia według jednolitych założeń wypracowanych przez Komisję. W 1956 r. na Kongresie w Rio de Janeiro Komisja w swym raporcie donosiła o pracach prowadzonych już w blisko 60 krajach.

Wpływ jaki wywarło zdjęcie Stampa, uznane za klasyczne, na inne prace prowadzone w wielu krajach, pozwala połączyć je w znaczną grupę i określić mianem szkoły angielskiej. Wpływ ten miał charakter zarówno bezpośredni, jak i w pewnej części pośredni poprzez Komisję, która założenia swojej działalności oparła na doświadczeniach zdjęcia Stampa. Do grupy tej należą: drugie zdjęcie brytyjskie, rozpoczęte w 1960 r. i kierowane przez A. Coleman z mapami 1 : 25 000 oraz szereg zdjęć i map innych krajów, np. Hongkongu 1 : 80 000, Cypru 1 : 250 000, opracowania wykonane dla obszaru Indii i Pakistanu, mapa Iraku 1 : 1 000 000, sudańskie arkusze mapy w tej samej podziałce i mapa Sudanu 1 : 4 000 000, opracowania M. Cole i C. Boarda dotyczące Afryki Południowej, próby kartowania użytkowania ziemi w Nigerii, a przede wszystkim zakrojone na szeroką skalę prace kanadyjskie oraz australijskie.

Z prac nie związanych ze szkołą brytyjską należy wymienić rozpoczęte w 1915 r. amerykańskie próby przedstawienia przestrzennego rozmieszczenia głównych użytków ujętych łącznie. W późniejszym jednak okresie prace amerykańskie ograniczały się głównie do oceny warunków środowiska geograficznego. Jednym z pierwszych krajów, które przystąpiły do opracowania mapy podejmując inicjatywę Komisji, nie stosując się przy tym do jej zaleceń, były Włochy, gdzie wydano 26 arkuszy

mapy 1 : 200 000 pokrywających cały kraj. W Japonii oprócz podstawowej mapy w skali 1 : 50 000 ukazują się opracowane według tych samych założeń mapy w podziałkach 1 : 25 000 i 1 : 200 000. Specjalna sekcja zdjęć użytkowania ziemi Dyrektoriatu Zdjęć Zamorskich z siedzibą w Londynie wydaje mapy opracowane na podstawie zdjęć lotniczych dla krajów nie posiadających szczegółowej dokumentacji kartograficznej. Ukazały się m. in. mapy Gambii, Ghany, Sierra Leone, Malawi.

Godny podkreślenia jest udział Polski w tej dziedzinie badań. Już na wspomnianym Kongresie w Rio de Janeiro, w skład Komisji powołany został przedstawiciel Polski, co było wyrazem uznania dla zademonstrowanych tam polskich map: przeglądowej mapy Polski 1 : 1 000 000 i szczegółowej mapy okolic Mrągowa 1 : 25 000.

W rozwoju polskich prac wyróżnić można dwa zasadnicze okresy. Pierwszy to okres międzywojenny, w którym badania i prace związane z użytkowaniem ziemi miały charakter rozproszony, obejmowały małe obszary i wykonywane były przy okazji prowadzenia innych badań geograficznych. Dla drugiego okresu, powojennego, charakterystyczna była dążność do wypracowania metody szczegółowego zdjęcia całego kraju i niemal wszystkie, nawet odosobnione i obszarowo niewielkie, badania terenowe służyły temu celowi. Polskiej metodzie wypracowanej w kraju nadano ostatecznie uniwersalną formę w oparciu o badania prowadzone w innych krajach. Polska zaliczana jest do krajów wiodących w tej dziedzinie badań, chociaż w publikacji map, pod względem ilościowym, zajmuje daleką pozycję.

Z licznych graficznych form przekazu informacji, czyli metod kartograficznych, na mapach użytkowania ziemi znalazło zastosowanie tylko kilka. Powszechnie stosowana jest metoda powierzchniowa, nie wymagająca obliczeń, prezentująca rezultaty pracy terenowej tzw. kartowania bądź wyniki interpretacji zdjęć lotniczych, przy czym wydzielane powierzchnie są niezależne od podziału administracyjnego. Kartogram rozumiany jako odpowiednio przetworzona względna wartość statystyczna odniesiona do jednostki powierzchni, najczęściej administracyjnej, zastosowany został w zasadzie tylko na polskiej mapie i to nie w czystej postaci, lecz jako pseudokartogram strukturalny nazwany kartogramem paskowym. Wykreślony na powierzchni gruntów ornych, odniesiony do jednostki administracyjnej jak wieś lub gromada, obrazuje nie strukturę, lecz kierunek użytkowania gruntów ornych. Często stosowana jest metoda sygnatur. Są to przeważnie sygnatury jakościowe, bezwymiarowe używane w połączeniu z metodą powierzchniową np. do oznaczania przeważających gatunków drzew w sadach lub lasach.

Oddzielną specyficzną grupą są metody, znane z prac amerykańskich i kanadyjskich, które można nazwać szyfrowymi. Trudno je zaszeregować do którejś z powszechnie stosowanych metod. Można przyjąć, że do wyznaczania jednostek na materiale podkładowym stosowana jest metoda zasięgów. Jednostki te tworzą jednak obraz typowy dla metody powierzchniowej, tyle że powierzchnie różnicowane są kodem liczbowym zamiast kolorem czy kreskowaniem. Sam kod może być uznany za specyficzny rodzaj sygnatur liczbowych. Przedstawiony tą metodą materiał zebrany w terenie zawiera dane o rodzaju gospodarki, jakości ziemi, wydajności, warunkach fizycznych terenu i in. oznaczonych literami bądź liczbami. Tego rodzaju zapis nie daje i nie może dać na mapie wyraźnego zróżnicowania terenu i w celu ułatwienia wizualnego uchwycenia rejonizacji zjawisk wymaga on przełożenia na obraz graficzny.

Rozwój wykonywania i interpretowania zdjęć lotniczych wywarł znaczny wpływ na zmianę sposobów kartowania terenu. Wywołał również w pewnym sensie ujemne dla geografii zjawisko odchodzenia od pracy w terenie i przechodzenia na bardziej kameralny, gabinetowy sposób opracowań. Zauważyć można dwie tendencje

w badaniach użytkowania ziemi. Jedna stosując metodę gruntownych badań terenowych kosztem większego nakładu czasu i pracy prowadzi do uzyskania maksymalnej ilości informacji o badanym terenie i co za tym idzie wzbogacenia treści mapy. Druga korzystając z fotografii lotniczej prowadzi do szybkiego pokrycia zdjęciem znacznych obszarów, jednak kosztem treści. Ograniczenie treści map, opracowanych drogą interpretacji zdjęć lotniczych, do głównych form użytkowania ziemi wynika m. in. z trudności bezbłędnego odczytania bardzo ważnej cechy — struktury zasiewów. W wielu krajach pracuje się nad zwiększeniem stopnia precyzyjności interpretacji struktury upraw ze zdjęć lotniczych. W Polsce badania nad mikrofotometryczną metodą odczytu prowadzone są w Pracowni Fotointerpretacji Instytutu Geografii Uniwersytetu Warszawskiego. Metoda ta jest jednak żmudna i kosztowna i na obecnym etapie również nie jest dokładna. W optymalnych warunkach, przy jej zastosowaniu można uzyskać dokładność odczytu około 80%, przy czym na obszarach o silnym rozdrobnieniu pól wartość ta ulega znacznemu zmniejszeniu.

Oprócz utartych metod, powszechnie stosowanych w dziedzinie badań użytkowania ziemi, występują również próby bardziej problemowego ujmowania zagadnień oraz próby analizy i interpretacji układów użytkowania ziemi na wybranych, małych obszarach. Metody reprezentacyjne są niewątpliwie przydatne w badaniach procesów kształtujących strukturę użytkowania ziemi, pozwalają uzyskiwać charakterystyki sposobów użytkowania, lecz nie zastępują mapy użytkowania ziemi jako pełnego, a nie wycinkowego, obrazu przestrzennego rozmieszczenia użytków.

Zdjęcia satelitarne, zdobyczone ostatnich lat, są na razie przedmiotem intensywnych prac prowadzonych w Związku Radzieckim i Stanach Zjednoczonych. Zmierzają one, poprzez doskonalenie techniki wykonywania, do rozszerzenia zakresu stosowania tych zdjęć.

Zarysowała się również wyraźna tendencja automatyzacji prac kartograficznych m. in. w wyniku wprowadzenia metod matematycznych do badań geograficznych. W ostatnim okresie nastąpił znaczny rozwój produkcji plotterów, czyli automatycznych urządzeń rysujących, połączonych z komputerami i bezpośrednio przez nie sterowanych. Do 1969 r. opracowano 44 systemy numeryczne z możliwością zastosowania ich w kartografii. W ten sposób uzyskuje się jednak mapy małoskalowe, nie przekazywane do publikacji i pozostawiane z reguły w formie pierwowrysów.

Przydatność mapy użytkowania ziemi dla praktyki wykazana została przez pionierskie zdjęcia Stampa przeprowadzone w trudnym okresie zarówno kryzysu, jak i II wojny światowej, kiedy poznanie każdego wolnego lub źle użytkowanego kawałka ziemi, a następnie jego pełne i właściwe wykorzystanie przez rolnictwo miało wielkie znaczenie dla przetrwania niemieckiej blokady wyspy. W Indii geografowie wśród wielu przyczyn żywnościowego kryzysu wymieniają m. in. właśnie brak mapy użytkowania ziemi i apelują o przeprowadzenie zdjęcia w celu ustalenia stopnia wadliwości użytkowania ziemi i opracowanie mapy, która pozwoliłaby usystematyzować i właściwie ukierunkować indyjskie rolnictwo. W innym przeludnionym kraju Japonii, również doceniono znaczenie takiej mapy dla poprawy stanu rolnictwa przeprowadzając szeroko zakrojone szczegółowe zdjęcia.

W obecnym okresie powszechnego dążenia do zwiększenia produkcji rolnej, gdy sprawą wielkiej wagi jest problem utraty użytków rolnych na rzecz innych działów gospodarki, znaczenie zdjęcia i mapy użytkowania ziemi wydaje się oczywiste. Mapa przedstawiająca przestrzenny układ użytków, w powiązaniu z ich wartością przyrodniczą i stanem zagospodarowania pozwala na właściwy wybór terenów przeznaczonych pod budownictwo mieszkaniowe, przemysłowe, komunikacyjne i in.

Aktualny i ważny problem ochrony środowiska naturalnego wymaga poznania i inwentaryzacji terenu oraz wydzielenia obszarów szczególnie cennych gospodarczo i zasługujących na ochronę. Doskonałą pomocą w tych czynnościach jest mapa użytkowania ziemi wyróżniająca zarówno obszary zdewastowane, nieużytki, jak i obszary o dużej przydatności i wartości, m. in. obszary intensywnie użytkowane rolniczo, wartościowe zbiorowiska leśne, zbiorniki i cieki czystych wód.

Wnioski wynikające z analizy zebranych materiałów kartograficznych i tekstowych wykazują przydatność map użytkowania ziemi w badaniach naukowych i praktyce gospodarczej, potrzebę kontynuacji tego rodzaju badań oraz konieczność dalszego doskonalenia techniki zdjęć terenowych, a szczególnie metod szybkiego przetwarzania zebranych materiałów i kartograficznego ich przedstawiania.

## КАРТОГРАФИРОВАНИЕ ИСПОЛЬЗОВАНИЯ ЗЕМЛИ. РАЗВИТИЕ И МЕТОДЫ

### Резюме

Предмет работы — это сравнительный анализ и оценка карт использования земли, понимаемых как отображение территориального размещения форм покрытия земной поверхности, использованных или неиспользованных человеком, в их территориальных связях и взаимозависимости. Зато не приняты во внимание смежные разработки как карты растительности, лесов, растительной и животной продукции, карт экономических и социальных аспектов сельского хозяйства, а также атласных карт.

Не наблюдаемое до сих пор количество, предел и форма разработок, выполненных в XX в., однозначно указывают на наше столетие как на период надлежащего развития исследований по использованию земли. В этой области ведущую роль сыграла Великобритания, которая дала начало работам в крупном масштабе. По инициативе Л. Д. Стэмпа, в 1930—1945 гг. была сделана съемка Англии, Уэльса и Шотландии, в результате которой вышла из печати серия 166 листов карты в масштабе 1:63360. Практическое и научное значение британской съемки вызвало динамическое развитие этого типа работ в мире. В 1949 г., на первом послевоенном Международном Географическом Конгрессе в Лисабоне была создана Комиссия Мировой Съемки Использования Земли, основной задачей которой являлась организация мировой съемки по одинаковым положениям, выработанным Комиссией. В 1956 г. на конгрессе в Риоде-Жанейро Комиссия докладывала о работах, ведущихся уже почти в 60 странах.

Влияние съемки Стэмпа, считающейся классической, на другие работы, ведущиеся во многих странах, позволят объединить их в значительную группу и назвать английской школой. Это влияние было непосредственное, а через Комиссию — посредственное, т. к. основной деятельности Комиссии явился опыт съемки Стэмпа. К этой группе принадлежат: вторая британская съемка с картами 1:25 000, начатая в 1960 г. под руководством А. Кольман, а также ряд съемок и карт других стран, напр., Гонконга 1:80000, Кипра 1:250000, работы касающиеся территории Индии и Пакистана, карта Ирака 1:1000000, суданские листы карты в том же масштабе и карта Судана 1:4000000, работы М. Коле и К. Борда касающиеся Южной Африки, попытки картирования использования земли в Нигерии, а прежде всего широко задуманные канадские и австралийские работы.

Работы небританской школы — это начатые в 1915 г. американские попытки отобразить территориальное размещение главных угодий, взятых вместе. Однако, в более позднее время американские работы ограничивались, главным образом, оценкой условий географической среды. Одной из первых стран, которая начала разработку карты согласно инициативе Комиссии, но без соблюдения ее предписаний, явилась Италия, где издано 26 листов карты 1:200000, покрывающих всю страну. В Японии, кроме основной карты 1:50000, по тем же положениям, изданы карты в масштабах 1:25000 и 1:200000. Специальная секция

съепок использования земли Директориата заморских съепок, находящегося в Лондоне, издает карты, разработанные на основании авиаснимков, для стран, не обладающих детальной картографической документацией. Вышла в свет, м. пр., карта Гамбии, Ганы, Сьерра Леоне, Малави.

Необходимо подчеркнуть участие Польши в этой области исследований. Уже на упомянутом Конгрессе в Рио-де-Жанейро, в состав Комиссии вошел представитель Польши, что являлось признанием для продемонстрированных там польских карт — обзорной карты Польши 1:1000000 и детальной карты окрестностей Мронгова.

В развитии польских работ наблюдаются два основных периода. Первый — это межвоенный период, в котором исследования и работы по вопросам использования земли были разрознены, охватывали небольшие площади и велись заодно с другими географическими исследованиями. Второй, послевоенный период характеризуется стремлением к выработке метода детальной съемки всей страны. Этой цели служили почти все, даже обособленные и территориально небольшие полевые исследования. Поскольку методу, выработанному в стране, придана в конце концов универсальная форма на базе исследований, ведущихся польскими географами в других странах, поэтому Польша считается ведущей страной в исследованиях в этой области, хотя в публикации карт, в количественном отношении, занимает далекое место.

Из многих графических форм передачи информации, т. е. картографических методов, только несколько нашло применение на картах использования земли. Повсеместно применяется поверхностный метод, не требующий вычислений, представляющий результаты полевой работы т. н. картирования или результаты интерпретации авиасъемок, причем выделенные площади не зависят от административного деления. Картограмма, понимаемая как соответственно переработанная относительная статистическая величина, отнесенная к территориальной единице, чаще всего административной, применена только на польской карте и то не в чистой форме, но в виде структурной псевдокартограммы, названной полосовой картограммой. Вычерченная на поверхности пахотных земель, отнесенная к административной единице как село или громада, она изображает не структуру, а направление использования пахотных земель. Часто применяется метод сигнатур. Преимущественно это качественные сигнатуры, безразмерные, употребляемые совместно с поверхностным методом, напр., для обозначения преобладающих видов деревьев в садах или лесах.

Отдельную специфическую группу составляют методы, известные по американским и канадским работам, которые можно назвать кодовыми. Их трудно причислить к каким-либо обычно применяемым методам. Можно принять, что для обозначения единиц на основном материале применяется метод объемов действия. Однако, эти единицы дают типичную картину поверхностного метода, с тем, что площади дифференцированы числовым кодом, а не цветом или штриховкой. Сам код можно считать специфическим типом числовых сигнатур. Представленный этим методом собранный материал включает данные о типе хозяйства, качестве почвы, производительности, физических условиях местности и пр., имеющих буквенное или числовое обозначение. Такая запись не дает и не может дать на карте отчетливой дифференциации местности, и чтобы легче было оптически уловить районирование явлений, необходимо представить ее графически.

Развитие выполнения и интерпретации авиасъемок оказало значительное влияние на изменение способов картирования территории. Это вызвало, в некотором смысле, отрицательное для географии явление отхода от полевых и переходу к более камеральным, лабораторным работам. Можно отметить две тенденции в исследованиях по землепользованию. Одна, при применении метода основательных полевых исследований с большой затратой времени и труда, ведет к получению максимального количества информации о исследуемой

территории и, что за этим следует, обогащению содержания карты. Вторая, пользуясь авиасъемками, ведет к быстрому покрытию съемкой значительных пространств, но, однако, за счет содержания. Содержание карт, разработанных путем интерпретации авиасъемок, ограничено главными формами использования земли, т. к. возникают трудности в точном отсчете очень важного признака — структуры засевов. Во многих странах ведутся работы по увеличению степени точности интерпретации структуры засевов по авиасъемкам. В Голландии исследования по микрофотометрическому методу отсчета ведутся в Лаборатории Фотоинтерпретации Института Географии Варшавского Университета. Этот метод, однако, кропотливый и дорогостоящий и в настоящее время также неточный. В оптимальных условиях применяя этот метод, только ок. 80% можно прочесть точно, причем на территориях с сильной раздробленностью полей эти проценты значительно снижаются.

Кроме привычных методов, везде применяемых в исследованиях по использованию земли, наблюдаются также попытки более проблемного подхода к исследованиям, а также попытки анализа и интерпретации систем использования земли на избранных, небольших участках. Представительные методы являются, несомненно, пригодными в изучении процессов, формирующих структуру использования земли, позволяют получать характеристики способов использования, но они не могут заменить карты использования земли как полей, а не частичной территориальной картины размещения угодий.

Спутниковые съемки, достижения последних лет, являются пока предметом интенсивных работ, ведущихся в Советском Союзе и Соединенных Штатах. Они стремятся, путем усовершенствования техники выполнения, к расширению их применения.

Зарисовалась также отчетливая тенденция автоматизации картографических работ, м. пр., в результате внедрения математических методов в географические исследования. В последнее время наступило значительное развитие производства плоттеров, т. е. автоматических рисующих приспособлений, соединенных с ЭВМ и непосредственно ими управляемых. До 1969 г. было разработано 44 нумераторных систем с возможностью применения их в картографии. Этим способом получают, однако, мелкомасштабные карты, которые не публикуются, а остаются обыкновенно в виде оригиналов.

Пригодность карты использования земли для практических целей доказал Стэмп своими пионерскими съемками, которые были сделаны в трудное время кризиса и II мировой войны, когда выявление каждого свободного или ненадлежаще использованного участка земли, а затем его полное и целесообразное использование сельским хозяйством имело большое значение для того, чтобы пережить немецкую блокаду острова. В Индии, одной из многих причин пищевого кризиса географы считают, м. пр., отсутствие карты использования земли и призывают делать съемки, чтобы определить степень неправильного использования земли, а также разработать карту, которая позволила бы систематизировать и дать надлежащее направление индусскому сельскому хозяйству. В другой перенаселенной стране Японии также должным образом оценено значение такой карты для улучшения состояния сельского хозяйства, и поэтому там в широком размере проводится детальная съемка.

Теперь, когда наблюдается всеобщее стремление к увеличению сельскохозяйственной продукции, когда большей вес приобретает проблема утраты сельскохозяйственных угодий в пользу других отраслей народного хозяйства, значение съемки и карты использования земли становится бесспорным. Карта, отображающая территориальную систему угодий, в связи с их природным качеством и состоянием благоустройства, позволяет правильно выбирать участки под жилищное, промышленное, транспортное и пр. строительство. Актуальная и важная проблема охраны естественной среды требует оценки и инвентаризации территории, а также выделения районов, особенно ценных в хозяйственном отношении и заслуживающих охраны. Большую помощь оказывает тут карта использования земли, которая выделяет непригодные земли, а также пригодные и весьма ценные, как напр., инген-



сивно возделываемые площади, ценные лесные комплексы, водоемы и водотоки чистой воды и пр.

Из анализа собранных картографических и тактовых материалов можно сделать вывод, что карты использования земли пригодны и для научных исследований и для хозяйственной практики. Необходимо продолжать такие исследования, а также дальше совершенствовать технику полевых съемок, а особенно метод быстрой переработки собранных материалов и их картографического отображения.

*Перевел Богдан Миховски*



- nej struktury regionalnej Polski. 1971, s. 114 + 13 ilustr. + 11 map pod opaską, zł 38,—
93. Kostrubiec B., *Analiza zjawisk koncentracji w sieci osadniczej. Problemy metodyczne*. 1972, s. 117 + 43 ilustr., zł 24,—
  94. Klimek K., *Współczesne procesy fluwialne i rzeźba równiny Skeidararsandur (Islandia)*. 1972, s. 139 + 31 ilustr. + 48 fot., zł 32,—
  95. Kraujalis M. W., *Udział ciepła ze sztucznych źródeł w bilansie cieplnym na obszarze Polski*. 1972, s. 74 + 10 ilustr., zł 12,—
  96. Kotarba A., *Powierzchniowa denudacja chemiczna w wapienno-dolomitowych Tatrach Zachodnich*. 1972, s. 119 + 25 ilustr. + 15 fot., zł 24,—
  97. Chaves L. F., Jerczyński M., Siemek Z., *Studia nad strukturą funkcjonalną miast*. 1973, s. 385 + 96 ilustr., zł 80,—
  98. Praca zbiorowa. *Zmiany w rolnictwie tradycyjnym i migracje ludności wiejskiej w krajach rozwijających się (Irak, Maroko, kraje Afryki Zachodniej, kraje andyjskie)*. 1973, s. 179 + 6 ilustr., zł 34,—
  99. Kozłowska-Szczęśna T., *Promieniowanie pochłonięte na obszarze Polski*. 1973, s. 119 + 34 ilustr., zł 22,—
  100. Biegajło W., *Typologia rolnictwa na przykładzie województwa białostockiego*. 1973, s. 164 + 30 ilustr., zł 35,—
  101. Werwicki A., *Struktura przestrzenna średnich miast ośrodków wojewódzkich w Polsce*. 1973, s. 168 + 49 ilustr., zł 30,—
  102. Matusik M., *Próba typologii i regionalizacji rolnictwa na obszarze Dolnego Powiśla*. 1973, s. 152 + 30 ilustr. + 6 fot., zł 32,—
  103. Ziemońska Z., *Stosunki wodne w polskich Karpatach Zachodnich*. 1973, s. 124 + 23 ilustr., zł 25,—
  104. Drozdowski E., *Geneza Basenu Grudziądzkiego w świetle osadów i form glacialnych*. 1974, s. 139 + 41 ilustr. + 17 fot., zł 32,—
  105. Pulina M., *Denudacja chemiczna na obszarach krasu węglanowego*. 1974, s. 159 + 52 ilustr. + 10 fot., zł 36,—
  106. Baumgart-Kotarba M., *Rozwój grzbietów górskich w Karpatach fliszowych*. 1974, s. 136 + 39 ilustr. + 16 fot. + 3 zał. pod opaską, zł 40,—
  107. Tyszkiewicz W., *Rolnicze użytkowanie ziemi a formy własności i rozmiary gospodarstw rolnych na Kujawach*. 1974, s. 127 + 17 ilustr., zł 30,—
  108. Leszczycki S., *Problemy ochrony środowiska człowieka*. 1974, s. 88 + 7 ilustr. + 4 wkładki, zł 22,—
  109. Gawryszewski A., *Związki przestrzenne między migracjami stałymi i dojazdami do pracy oraz czynniki przemieszczeń ludności*. 1974, s. 155 + 18 ilustr., zł 35,—
  110. Żurek S., *Geneza zabagnienia Pradoliny Biebrzy (w druku)*.



W. JANKOWSKI: LAND USE MAPPING, DEVELOPMENT AND METHODS