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ON METHODS OF STUDIES OF AGRICULTURAL UTILIZATION OF LAND

The principal significance of studies of land utilization can be briefly defined as follows. The basis of these is collecting and systematization of information on the existing farming, in a strictly territorial context and with fixing the data on a map, which makes it possible to compare any characteristic of agriculture with the characteristic of the natural conditions of the corresponding portion of territory, and to refer the characteristics of agriculture to the types of the natural environments. This distinguishes the primary material of the studies of land utilization from the ordinary data of the agricultural statistics. Owing to the different character of the primary data and different methods of their processing, the study of land utilization opens different possibilities, too, for the scientific analysis of the relationships between farming and the natural, as well as local economic, conditions under which it is carried on (as compared with the studies performed on the basis of the usual statistical sources).

In order to solve the problems of the most rational utilization of land resources, it is necessary to find the most appropriate type of utilization for each of the various types of lands, in other words, such utilization as would be most effective from the viewpoint of the national economy. A search for such solution should be begun with the stating of the existing correspondence of certain forms of economic utilization to some or other natural types of lands and local economic conditions. Then, resting upon the comparison of the effectiveness of some or other utilization of lands of different types, one gets a possibility to critically evaluate a certain form of utilization of lands and to substantiate its future advisable alterations.

The strictly objective description of the existing utilization of lands, as an initial base for any suggestions on its rationalization, maintains its significance with the planned national economy and with any improvement of our methods of the organization-economic projecting and planning in the sphere of agriculture. This is obvious from the fact that a choice of the best way of utilizing lands of some or other types, under some or other local economic conditions, should be based on the comparison and evaluation of the relative economic efficiency of particular forms of utilization. And in order to evaluate the relative efficiency of different forms of land utilization, data on the local economic experience are needed, the data that characterize the experience of the whole bulk of agricultural

enterprises of a given area. Since the agricultural productivity of land is not just a function of the natural conditions, it should be regarded necessarily in relation to the modes which the land is being cultivated with, and which change from place to place.

The fact to what degree a study of agricultural utilization of lands can have a constructive character and to what degree it remains a mere description depends, after all, on our proper understanding of the effect of objective factors differentiating agriculture. In other words, all depends on the fact how precisely we can evaluate (measure) the effect of unequal natural properties of lands and unequal economic conditions on the efficiency of some or other land utilization.

In order to correctly decide the question as to which agricultural utilization fits best a certain type of the natural environment, it is necessary, in particular, to elaborate the land typology itself, perfectly enough from the physical-geographic and agroecological points of view. If the typology is not sufficiently correct or not detailed enough, it frequently becomes impossible to understand the conditionality of such differences of land utilization as were established on the basis of practical experience in local farming. On the other hand, if the natural properties of lands were studied thoroughly enough, but there were no sufficiently perfect studies of agricultural utilization of the area, it would remain unknown just which particular differences in the land properties are of primary importance to the local farming and are responsible for different forms of land use and different efficiency of farms.

All the above-said shows that the study of natural environments from the agricultural standpoint and the economic-geographical study of land utilization are a support for each other and in principle should be carried on in correlation, with co-ordination of methods of the study and a scale of mapping.

The nearest practical application of the data on economic-geographical studies of land utilization in the U.S.S.R. should become, apparently, their usage in the land-evaluation (cadastral) work. It is evident that the land-evaluation work requires systematization of the data on the existing land utilization, elaboration of a classification (typology) of the existing forms of land use that change from place to place; mapping of these; finding out conditionality of their spatial distribution, in particular, their correspondence to certain natural types of lands; ascertaining the relation of the indices of land productivity to its natural types and to the forms of utilization; and, finally, estimating from the national-economic viewpoint the degree of expediency of the utilization observed. All these should make up, theoretically, the contents of any studies of land utilization in the geographical context. But of course, the scientific and practical importance of such studies is considerably wider than their use in the work on land inventory. They are one of the necessary stages in the grounding of the rational utilization of the lands in the U.S.S.R.

Before we proceed to discuss the ways of obtaining the data needed and the methods of mapping of land utilization, we shall give a rough scheme of classification of lands according to their utilization, which we believe to be the most acceptable one, in principle, for representation of the diversity of the existing agricultural utilization of lands under the conditions of the U.S.S.R. The classification is based on two criteria, na-

mely, (1) purpose of utilization, i.e., kinds of products put out, and, correspondingly, the complex of crops and of stockraising branches with the help of which the land is exploited, and (2) ways used to affect the natural environment in which the plants cultivated and the domestic animals reared are placed. Below we give a list of the classification indicators according to which every individual contour of land units (that is plotted on the land-tenure plans of the collective and Soviet farms) can be referred to one or another category. The list is far from being exhaustive, for it must vary depending on the character of the natural conditions and farming in various regions. Since the land-tenure plans of agricultural enterprises serve as an initial base, the list is made according to the columns of the division of lands into land units, accepted at the present time. To make easier the comparison and generalization of the data by individual farms, registration of data is envisaged in the form of stating the presence (or absence) of each of the indicators enumerated. In the register, each contour number is marked off in cipher, in accordance with the numbers and letters of the list, with the presence of some or other indicators listed. For example, the IVF a.d.3 cipher implies:- hayland, improved by tussock cutting and shrub removal, exploited with the use of all the haymaking machines usual in the region, accessible to motor transport during only a part of the growing season, and used for stock grazing on aftermath.

Land division according to the forms of utilization

I. Arable lands (Under crops and fallow), vegetable gardens included

Use of particular modes of agrotechnics and reclamation:

- A. Presence of a working irrigation system
- B. Presence of a working drainage system
- C. Practising of a special system of measures to prevent wind erosion (which measures)
- D. Practising of a system of measures to prevent water erosion
- E. Terracing of slopes
- F. Removal of boulders
- G. Use of organic fertilizers, regular and essential for the volume of crop yield
- H. Use of mineral fertilizers, regular and essential of the volume of crop yield
- I. Practising of repeated sowing of grain, technical or fodder crops (which crops and in what succession)
- J. Practising of over-stubble sowing for green fodder (which crops)
- K. Practising of bare fallow
- L. Recurrent abandoning for a long fallow-period (for example, in the years with an unfavourable combination of meteorological conditions, or in the years of flooding)

Use of machines and transport means:

- (a) Use of the whole set of agricultural machines usual in field-crop cultivation of a given region, and usual transport means

- (b) Combines not used (reason)
- (c) Tractors not used (reason)
- (d) Passage of motor vehicles impossible during the whole period of agricultural work
- (e) Passage of motor vehicles impossible during a part of the period of agricultural work
- (f) Accessibility of the plot is restricted by the necessity to use ferrying across the river

Composition of the actually cultivated plants:

1. Cultivation of the basic set of crops of the given region with the priority role of bare fallow as a predecessor of the main grain crops
2. Cultivation of the basic crop set of the given region with the priority role of intertilled crops as predecessors of grain and other non-intertilled crops
3. Cultivation of the basic crop set of the given region with the priority role of perennial grasses as predecessors of grain or technical non-intertilled crops
4. Cultivation of the basic crop set of the given region with the priority role of annual leguminous grasses as predecessors of grain and technical crops
5. Cultivation of the basic crop set of the given region with the approximately similar roles of intertilled crops, perennial grasses, or also annual leguminous grasses as predecessors of grain and technical crops
6. Cultivation of the basic crop set of the given region, with the exception of one the main technical or grain crops characteristic of the region (which crop)
7. Cultivation of only, or chiefly, vegetables
8. Cultivation of mainly potatoes, in alternation with other crops
9. Cultivation of mainly hemp
10. Cultivation of mainly tobacco
11. Cultivation of mainly shag (common tobacco)
12. Cultivation of mainly rice
13. Cultivation of mainly cotton
14. Cultivation of exclusively, or chiefly, maize and other silo crops
15. Cultivation of exclusively, or chiefly, annual grasses
16. Cultivation of exclusively, or almost exclusively, perennial grasses
17. Cultivation of exclusively, or almost exclusively, grain crops and annual grasses
18. Cultivation of only spring grain crops and annual grasses
19. Cultivation of only winter rye
20.
21.

II. Crops of closed ground

1. Hothouses
2. Hotbeds

III. Long-fallow lands

1. Used as hayland and pasture
2. Used as pasture only

IV. *Natural and improved meadowlands*

Use of particular modes of improvement:

- A. Improvement with the help of estuary irrigation
- B. Improvement with the help of closed drainage system
- C. Improvement with the help of open drainage system
- D. Improvement by applying fertilizers
- E. Improvement with the help of ploughing-anew and sowing grass mixtures
- F. Improvement with the help of cutting of tussocks and removal of shrubs
- G. Watering

Use of machines and transport means:

- (a) Use of all the haymaking machines usual in teh region, and of usual transport means
- (b) Haymaking machines not used (reason)
- (c) Motor transport not used (to carry hay or milk, to drive workers, etc.) during the whole growing season
- (d) Motor transport not used during a part of the growing season
- (e) Accessibility of the area is limited because of the necessity of using ferrying across the river

Forms utilization:

1. Only haymaking (one harvest)
2. Only haymaking (two harvests)
3. Haymaking (one harvest) followed by grazing
4. Haymaking (two harvests) followed by grazing
5. Haymaking in some years only, only grazing in the rest
6. Grazing of live-stock of various kinds
7. Grazing of neat cattle in general
8. Grazing of only cows
9. Grazing of only fattening cattle
10. Grazing of only sheep and goats
11. Grazing of only horses
12. Grazing of only camels
13. Grazing in summer only
14. Grazing in summer, in spring and in autumn
15. Grazing only in spring and in autumn
16. Grazing in spring, in autumn and in winter
17. Grazing in winter only
18. Grazing during the whole year
19. Grazing counting on watering from open reservoirs
20. Grazing counting on watering from wells
21. Grazing counting on watering from artesian wells
23. Grazing counting on transported water
23. Grazing counting on snow, dew, or hoar-frost
24. The plot not used at all temporarily

V. *Plantings*

Modes of agrotechnics and reclamation

- A. Presence of working irrigation system

- B. Presence of working drainage system
- C. Use of a special system of measures to prevent water erosion
- D. Practising of wind forest-belts
- E. Terracing of slopes
- F. Removal of boulders
- G. Use of organic fertilizers essential for the volume of crop yields
- H. Use of mineral fertilizers essential for the volume of crop yields
- I. Utilization of spaces between rows of young stands for cultivating herbaceous crops
- J. Utilization of spaces between rows of all plantings for cultivating herbaceous crops
- K. Growing-over of inter-row spaces with wild herbaceous plants, used for haymaking or grazing

Use of machines and transport means:

- (a) Absence of restrictions in the use of machines and transport means
- (b) Restrictions in the use of some or other machines and transport means (what restrictions)

Forms of utilization:

- 1. Fruit-trees
- 2. Berry shrubs
- 3. Vineyards
- 4. Tea-plantations
- 5. Technical woody plants

VI. Forests

- A. Natural stands
- B. Artificial plantings
- C. Nursery gardens
- D. Felled areas and burns
- E. Field-protecting and gully-side forest belts
- F. Protecting forest plantings over sands and ravines

Restrictions in utilization due to transport accessibility of the area:

- (a) Absence of such restrictions
- (b) Presence of such restrictions (what these are)

Forms of utilization:

- 1. Provision of commercial wood
- 2. Provision of wood only for the needs of the collective, or Soviet, farm or for the needs of collective farmers or workers and employees of the Soviet farm
- 3. Accessory utilization for hay provision
- 4. Accessory utilization as pasture (for grazing of what species and groups of live-stock)
- 5. Other forms of accessory utilization (which forms)

VII. Shrubs

- 1. Utilization of provision of fuel or technical wood
- 2. Utilization as hayland

3. Utilization as pasture
4. Other forms of utilization (which forms)

VIII. Bogs

1. Utilization (yearly) for provision of hay
2. Utilization in individual years for provision of hay
3. Utilization for livestock grazing (yearly)
4. Utilization for livestock grazing in some years
5. Provision of peat for fuel
6. Provision of peat for fertilization of fields
7. Other forms of utilization (which forms)

IX. Reservoirs

- A. Artificial reservoirs
- B. Reservoirs the levels of which are controlled

Forms of utilization:

1. Fish-breeding
2. Watering of live-stock
3. Water supply for populated points
4. Source of irrigation

X. Sands

- A. Realized measures on stabilization and afforestation (what measures)

Forms of utilization:

1. Live-stock grazing (of what species and groups)
2. Haymaking
3. Provision of fuel or technical wood
4. Other forms of utilization (which forms)
5. Not utilized in any way

XI. Personal holdings of collective farmers, workers and employees

- A. Presence of a working irrigation system

Forms of utilization:

1. Arable land. What crops are cultivated for the most part
2. Orchards, berry-fields, vineyards
3. Tree stands
4. Hayland
5. Grazing ground

XII. Areas outside the territory of the land-tenure of the collective, or Soviet, farm (within the national stock of forest, or stock of land), allotted to the collective, or Soviet, farm in the current year

1. For haymaking
2. For live-stock grazing

Theoretically, to study land utilization, special initial data on production are needed, that do not refer to the territory of the farm as a whole, but to separate portions of this territory, differing by the character

of their agricultural utilization: — to individual parts of the arable area, differing by crop composition and modes of their cultivation, to individual parts of the pasture and hayland, unequally used, etc. The author of the present paper stated his understanding of methods of investigation of this kind in his earlier publications (4, 5, 6, 7). The methods the way they are described in the mentioned publications were used with sample studies of individual farms situated in natural and economic conditions typical of some localities. The territories of those farms were regarded as a standard capable to characterize the given locality. A number of maps were compiled according to these methods and published (1, 3, 7, 8, 10).

Investigations of land utilization, depending on the tasks and conditions for work, can be very diverse by their detailing and composition of the initial data. Records permanently done in the farms themselves (9) are naturally the best initial material. For lack of such records, the substitutes for them are, to a certain degree, usage of the questionnaire method and first-hand observations by the investigator himself in the territory of the farms.

Detailed investigations, similar to those described in the above mentioned publications, not only require expenditure of considerable working time, but (which, in fact, limits their usage most of all) can be satisfactorily performed only by rather skilled workers with special training. This is the reason of the fact that such investigations were seldom carried out over large continuous areas. Of the maps of land utilization published in the U.S.S.R., two can be cited, compiled on the basis of the data on special studies of all the agricultural enterprises within a relatively large portion of the territory, namely, the map of utilization of pastures in the western part of the Caspian Lowland (10) and the map of economic utilization of lands of the semidesert zone in the Kustanai Province, compiled by T. A. Solovtseva (2). In both cases, land utilization was mapped in the regions of pastoral stockraising farming where the keeping of livestock is based on combinations of different-season pastures, haylands, and occasionally arable lands, situated at considerable distances. Under such conditions, the representation of land utilization even on small-scale maps is often impossible without special studies of all the individual farms. Or rather, without such special studies, only an extremely schematic characteristic of land utilization can be produced. Whereas the sizes of the enterprises here are vast in area and their number is not large. In regions of husbandry, the territories within which the production of individual enterprises is performed are usually much smaller. Here the inner organization of the territories of individual collective and Soviet farms is more alike, and a detailed study of land utilization in each of them would have shown repetition in them of an identical or similar type of organization of the territory. Under such conditions, sample investigations of a small part of the farms can be sufficient for the study of land utilization. They can serve as a basis for correct interpretation of the data of topographic maps (or the data on the agricultural survey which often does not differ very essentially by its principal contents from the topographical survey). If the number of the farms examined is sufficient and if the statistical data processed for the whole bulk of the farms confirm the uniformity of land utilization on the farms of the given area, it becomes possible to spread the mentioned

features of land utilization over the entire area and represent it correspondingly on small-scale maps.

The map of land utilization in the Samarkand and Bukhara provinces (1) can serve as an example of a map of land utilization compiled for a large territory and on a small scale on the basis of the data on the agricultural survey (maps of land-tenure of all the enterprises), statistical materials, and selective examination of a considerable number of enterprises (about 10 per cent of the total number). The map was compiled by the present author as a result of two-year expedition studies. Over this territory, most contrasting by its physical-geographic conditions, the diversity of forms of land utilization is naturally very great. 38 various forms of agricultural utilization of lands were described as a result of the investigations. Since it would be impossible to show at a small scale the actual outlines of the portions of the territory where each form of utilization is applied, contours were delimited on the map within which a combination is found (alternation in space) of one and the same forms of land utilization. For example, unirrigated arable fields extend over loess piedmonts, alternated by pasture (on steeper slopes), and also by long-fallow lands. A combination of these three, territorially interlacing, forms of land utilization is shown on the map. Such combinations were distinguished 18 in number. Thus the map, though very schematic, does not show land utilization in that oversimplified form as the ordinary maps of agricultural land-units do, but allows seeing the bounds of occurrence of each of the 38 existing forms of land utilization and their spatial combinations.

The given map is only one of the possible types of small-scale maps of land utilization. Its peculiarities refer to the fact that the data on sample investigations of a considerable number of farms could be used with its compilation, such investigations being very important in this instance on account of the very great diversity of natural conditions and types of husbandry and stockbreeding within the smallest distances. On plain localities, with more uniform farming, the number of the existing forms of land utilization is far smaller, and their similar combinations frequently repeat themselves over large territories.

The question should be touched upon as to what extent combinations of different forms of land utilization, rather than their individual forms, should be represented on medium- and small-scale maps in general. On topographic maps and on maps compiled by agricultural bodies, the contours of agricultural land-units are generalized with the transition to small scales, and each generalized contour is characterized with the name of the land-unit predominating in it in area. This means, firstly, a decrease in the number of the forms of land utilization reflected by the map, because some of them do not constitute anywhere a major part of the area and are represented by small plots, but can be of prime importance to the local farming. Such are, for example, orchards, vineyards, or mulberry groves in regions of even manifestly expressed specialization of economy in certain industries; such are arable lands and natural grasslands in the northern woody regions of the Soviet Union, where agriculture is frequently of essential economic importance, though. Secondly, this way of generalization answers but poorly the purposes of characterization of the agricultural significance of a territory for another reason, too: — an important feature of agricultural production is its being organized on the basis of

combinations of different land-units supplementing one another (arable lands and natural meadowlands, for example). To choose the trends of specialization of the farms, proportions and inter-disposition of portions of lands differently used are important.

For these reasons, we believe in to be important to use such modes of representation of an agricultural territory on small-scale maps, as would reflect the spatial combinations (and quantitative rations between the areras) of lands utilized in different ways.

The logic of economic-geographical studies of agriculture inevitably leads to the necessity of a thorough analysis of the regularities of the inner organization of the territories of agricultural enterprises. The combinations of industries and the rational proportions between them cannot be regarded other than in relation to the existence of different types of land in the territory of an individual farm, for which lands different forms of utilization turn out to be most effective.

It is impossible to understand in any regions the conditions of the formation of production forms of agriculture and the ways of their rational reconstruction without studying the laws of the formation of that complex of land-units within which it is that the agricultural production proceeds. The study of the existing geographical diversity of forms of organization of the agricultural territory (types of territorial organization) is as necessary for understanding the relations between the character of farming and the natural environment, as the study of the local forms of husbandry and the ways of keeping livestock. The tracing of the links between agriculture and the natural environment other than in relation to particular types of land and particular forms of utilization associated with them turns out to be poor in contents, too diffuse. In publications on the economy and organization of agriculture, the authors very often proceed from the notion of a homogeneity of the natural conditions within a physical-geographic zone or region. To presume a relative uniformity of the conditions is quite logical in this case, this is often necessary for the solution of certain problems. But this relative homogeneity should not be understood in the sense that the natural environment changes little within such zone or region, but that the more or less similar alternations of different types of land repeat themselves.

In connection with the above stated, of importance becomes a geographical typology of organization of the agricultural territory, that is, delimitation of areals of occurrence of similar types of the inner territorial organization within agricultural enterprises. Revealing the diversity of forms of organization of the agricultural territory, related to the variety of physical-geographic conditions, is one of the necessary methods of analysing the conditionality of spatial differences in the agricultural production.

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