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Application of Cartographic Modeling as a research method when monitoring the spatial behaviour of population

Annotation

There is presented the cartographical modeling as efficient method to monitor the spatial behaviour of population. The author examines the common notion of a method, the cognition properties of cartographical models and necessary methodical premises to ensure an adequate representation of essential features of the population's spatial behaviour or other investigated phenomena (processes, structures). In the author's opinion the cartographical modeling may be regarded as one of the modifications of latent structure analysis which is able to reveal and distinguish the latent groups of population with peculiar social organization, material and cultural consumption, goals, preferences and behaviour. There are demonstrated the cartographical models of spatial disposition of rural population in able-bodied age in Ukraine which give a clear view of the geographical location of rural inhabitants and their concentration or dispersion in certain regions of countryside. These models discover the important spatial relations between movements of rural inhabitants and urbanization in Ukraine. Comparing these models we come to the conclusion that concentration of urban and concentration of rural population within the bounds of the Ukraine are two sides of one and the same process of urbanization. In this process, towns and cities perform the duties of peculiar nuclei for crystallization of new socio-spatial structures of rural resettling. The demographic consequences of spatial self-organization of country people are highly various, closely tied and are displayed first of all in different types of dynamics. With a view to investigate the types of population changes in the countryside of Ukraine in 1970–1978 – in a moment when the demographic transition was over – the author elaborated the cartograms with types of rural population dynamics after J. W. Webb's model. It is obvious that the depopulation and migratory losses brought about the irreparable consequences for rural population practically in all regions of Ukraine.

Keywords: *cartographical method of research, latent structures of population, spatial self-organization of country people as on-going process, types of population changes after J. W. Webb's model, the end of demographic transition in Ukraine*

The common notion on a method

The cartographical modeling belongs to the system of common scientific methods used in search of new knowledge and its proving. The study of spatial relations is based on a map providing the most complete description and comprehension of any territorial problems.

Many researchers perceive the maps only as illustration for text or figures having no independent scientific value. Meanwhile the map is none other than information system, channel for transmitting of spatial information. Cartographical language can be regarded as the peculiar sign system: the cartographical images are the primary means to transfer the information. Giving rise to visual notions, the cartographical images enable to obtain the integral perceiving of spatial structures. When analyzing the figures in the tables the thought and attention of researcher are distracted from the general to the particular. Cartographical images, as a means of transmitting of spatial relations, prove to be immeasurably stronger than algebraic symbols because the object mode of thinking is more effective than formal.

The cartographical language has many positive qualities. It is universal and gets over all speech barriers without difficulties. It has a laconic and capacious character and enables to express the judgments in the lapidary form. And at last it has the two-dimensional nature. All these properties of a map language enlarge to a considerable extent the information capacities of a cartographical model. Just the two-dimensional character of cartographical linguistic system affords the possibilities for the investigation of spatial relations.

The map gives new information of more high order on mapping phenomena which is hidden in initial figures. This new information one have got due to generalization of statistics is of particular value to scientific research and practical needs. The process of generalization results in discovery of the cartographical structures forming a certain system. Analysis of these structures enables the revelation of spatial regularities in disposition, proportion, combination and dynamics of socio-demographic and socio-economical processes and phenomena.

The cognition properties of cartographical model

The cartographical model represents the scientific abstraction received in consequence of generalization of concrete properties of studied objects. The abstract character of generalized cartographical model A. Berliant defines as one of the main positive qualities of a map: applying to its contents the researcher can observe not only separate or systematized factual statistics but also an integral spatial image. He meets with “system of notions”, appearing in the course of map composition and fixed in the cartographical model and its legend [Berliant, 1978: p. 19].

Besides, the cartographical modeling provides the transition from discrete to continuous knowledge. This is the only method to obtain the continuous picture of spatially unbroken phenomena on the basis of discrete factual information [Aslanikashvili, 1974]. The importance of uninterrupted knowledge contained in the cartographical model is conditioned not only by its possibility to reveal the changes of investigated process or phenomena “from place to place” but also by its

potentialities to bring to light a significant spatial relations between them and other social and natural processes and phenomena represented in the given model (map). A new knowledge obtained in the course of modeling serves as a basis for working out of the management decisions.

The methodological premises

It is expedient from the methodological point of view to research the spatial structures and regularities of their development on the basis of cartographical analysis of fractional administrative units – rural administrative regions and within the bounds of the last – on a scale of village councils. The regions and provinces are too large-scale territorial units for such investigation. Cartographical modeling on a scale of provinces enables to carry out the macro-division of territory into districts by examined sign and to reveal only the levels of its intensity in the spatial aspect.

The preparation of initial data is a previous stage of cartographical modeling. Relevant methods are defined by goals and tasks of modeling in every concrete case. The method of data groups, for example, is used as a basic principle when composing the statistical maps known as cartograms that are instrumental for revealing of regularities in spatial distribution of mapping signs. The grouping of statistical data is simultaneously carried out by geographical sign and by size of indices.

The correct choice of value intervals of statistical indices used for procedure of grouping is especially important stage when working out the cartogram. Precision of spatial model depends on size of these intervals. It is expedient to select them by method of consecutive approximation. On the one hand, such an order helps to avoid the excessive, unnecessary detailing in the picture of spatial structure of modeling process or phenomena and, on the other hand, to ensure an adequate representation of its essential features. There is no need to use any standardized scale of gradation or purely mechanical statistical methods/modes.

In every concrete case when defining the limits of intervals, one must take into consideration not only the range of values distribution proper but also the necessity to show the existing differences in the spatial structure of investigated phenomena (processes, structures).

Cartographical modeling of latent structures

The cartographical modeling may be regarded as one of the modification of latent structure analysis which pursues an object to reveal and distinguish the latent groups of population with peculiar social organization, material and cultural consumption, goals, preferences and behaviour.

The analysis of latent structure is to be started with appraisal of empirical data and working out of hypothesis on the presence of a few definite groups of population forming the latent structure. And after that the proposed hypothesis has to be verified in the statistical respect on the basis of factual data. The model of latent structure tests the fact of presence of postulated groups, but more deep penetration into essence of problem calls for additional information.

The revelation of latent structures as the instrument of analysis may be of use also when studying the population attitudes towards different problems, for statistical interpretation of regional distinctions in the structure of people's consumption, for explaining of the intensity of population moving within the urban and rural areas, for estimation of life conditions inside of cities and their suburbs etcetera.

The data for study of population behaviour or measuring of social structure parameters may be received in the course of sociological surveys of public opinion or may be got from current statistical returns. The last source of information is more preferable.

The cartographical model, worked out on the basis of a current statistics on size and structure of rural population, enables to reveal the system of regions with specific socio-group organization of their inhabitants. In other words, this model confirms the existence of latent groups of population in the countryside and indicates their localization in the space.

Monitoring of spatial behaviour of rural population

The permanent observation of current statistical information during a long time creates the necessary prerequisites for organization of data base. The collection of statistical data, their standardization and compiling of series of relevant maps are integral parts of monitoring as a system of supervision and control after the processes of spatial behaviour of population.

The appropriate statistical data for analysis should to meet the demands of a highest possible spatial detailing, uniformity, simultaneity, authenticity, continuity and comparability. The infringement of least one of these demands results in lowering of cognitive value of initial information and obtaining rather probable than true knowledge of the research subject.

The scientific programme of monitoring includes also the working out of prognoses concerning eventual changes in the course of spatial self-organization of people, providing it with necessary information on possible unfavorable consequences, appraisals of regulation decisions and their efficiency.

The revealing of regularities in behaviour of rural population in Ukraine in process of spatial self-organization is based on the analysis of statistics for the last fifty years. So far as territorial movement of population is closely bound up with alteration of place and character of labour (in other words it is the movement of mainly able-bodied contingents), only the rural population in working age was chosen as an object of modeling.

The cartographical models of spatial disposition of rural population in able-bodied age in Ukraine give a clear view of the geographical location of rural inhabitants and their concentration or dispersion in definite regions of countryside (Figures 1, 2, 3, 4). The comparison of identical models gives us the notion about the nature and rate of changes and development of spatial structures and discovers the important spatial relations between movements of rural inhabitants and urbanization in Ukraine. We come to the conclusion that *concentration of urban and concentration of rural population within the bounds of the Ukraine are two sides of one and the same process of urbanization. Towns and cities perform in*

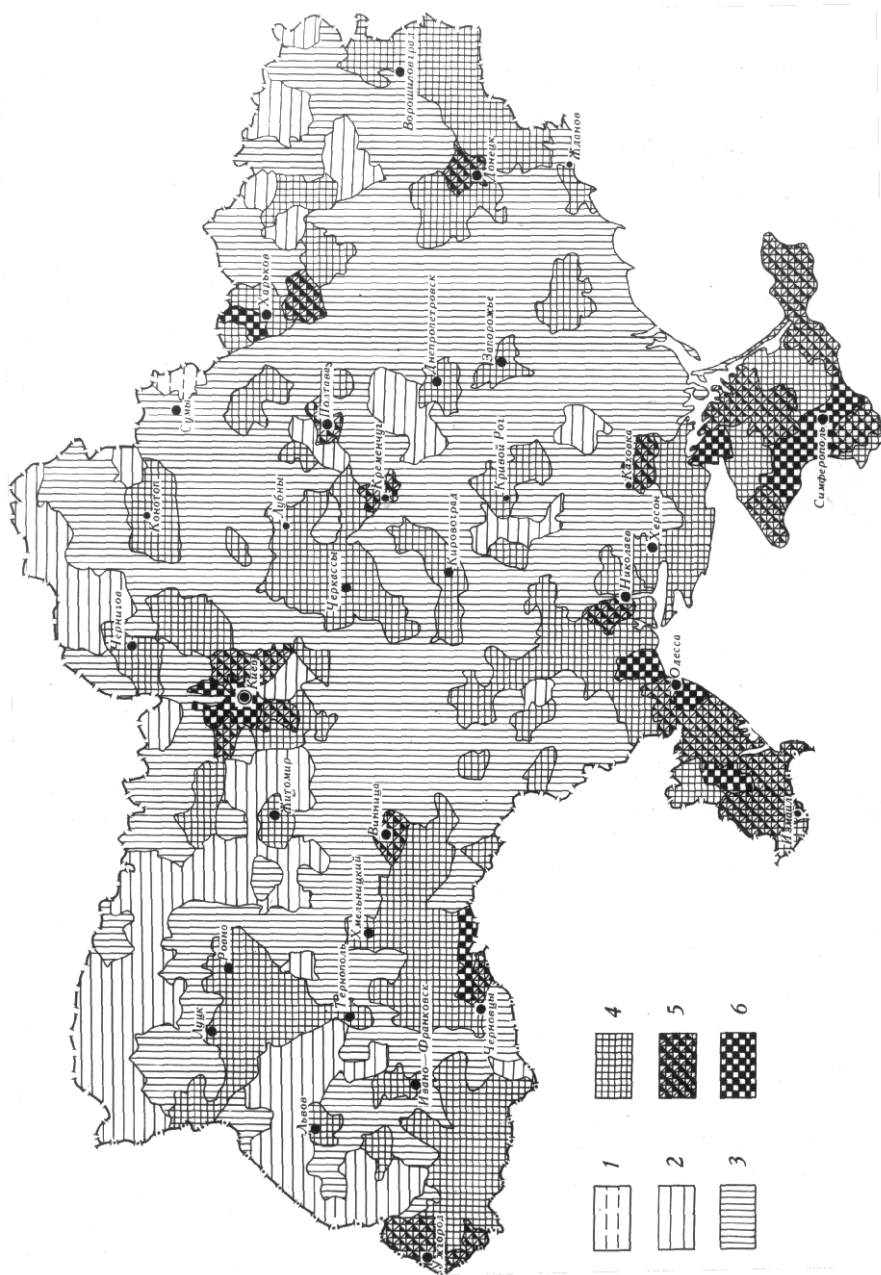


Fig. 1. Cartographical model of spatial self-organization of rural population in the Ukraine in 1967. Share of rural inhabitants in able-bodied age:
 1 — 42.5–45.0%; 2 — 45.1–47.5%; 3 — 47.6–50.0%; 4 — 50.1–52.5%; 5 — 52.6–55.0%; 6 — 55.1–57.5; 7 — 57.6–60.0%

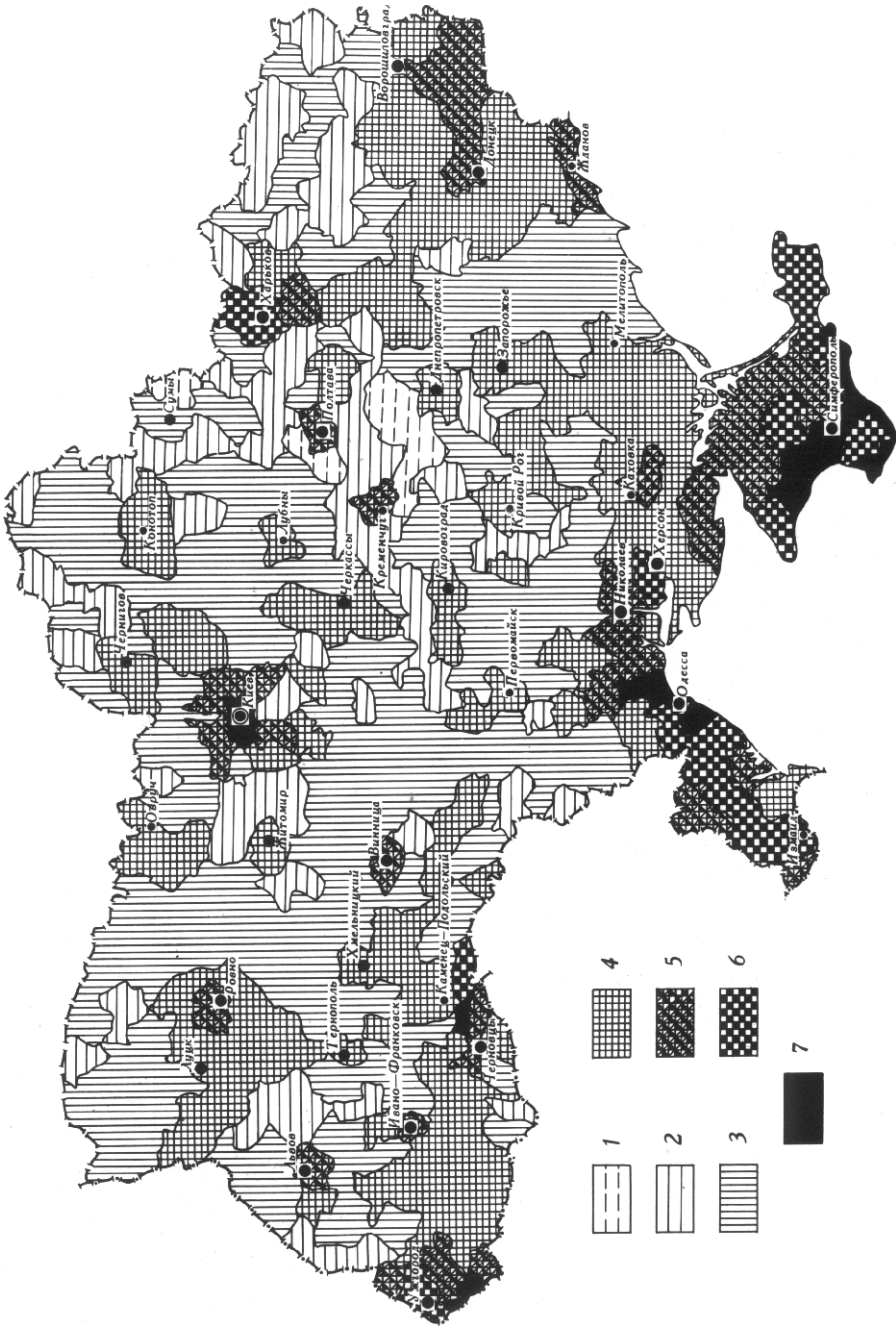


Fig. 2. Cartographical model of spatial self-organization of rural population in the Ukraine in 1973. Share of rural inhabitants in able-bodied age: 1 — 42.5–45.0%; 2 — 45.1–47.5%; 3 — 47.6–50.0%; 4 — 50.1–52.5%; 5 — 52.6–55.0%; 6 — 55.1–57.5; 7 — 57.6–60.0%

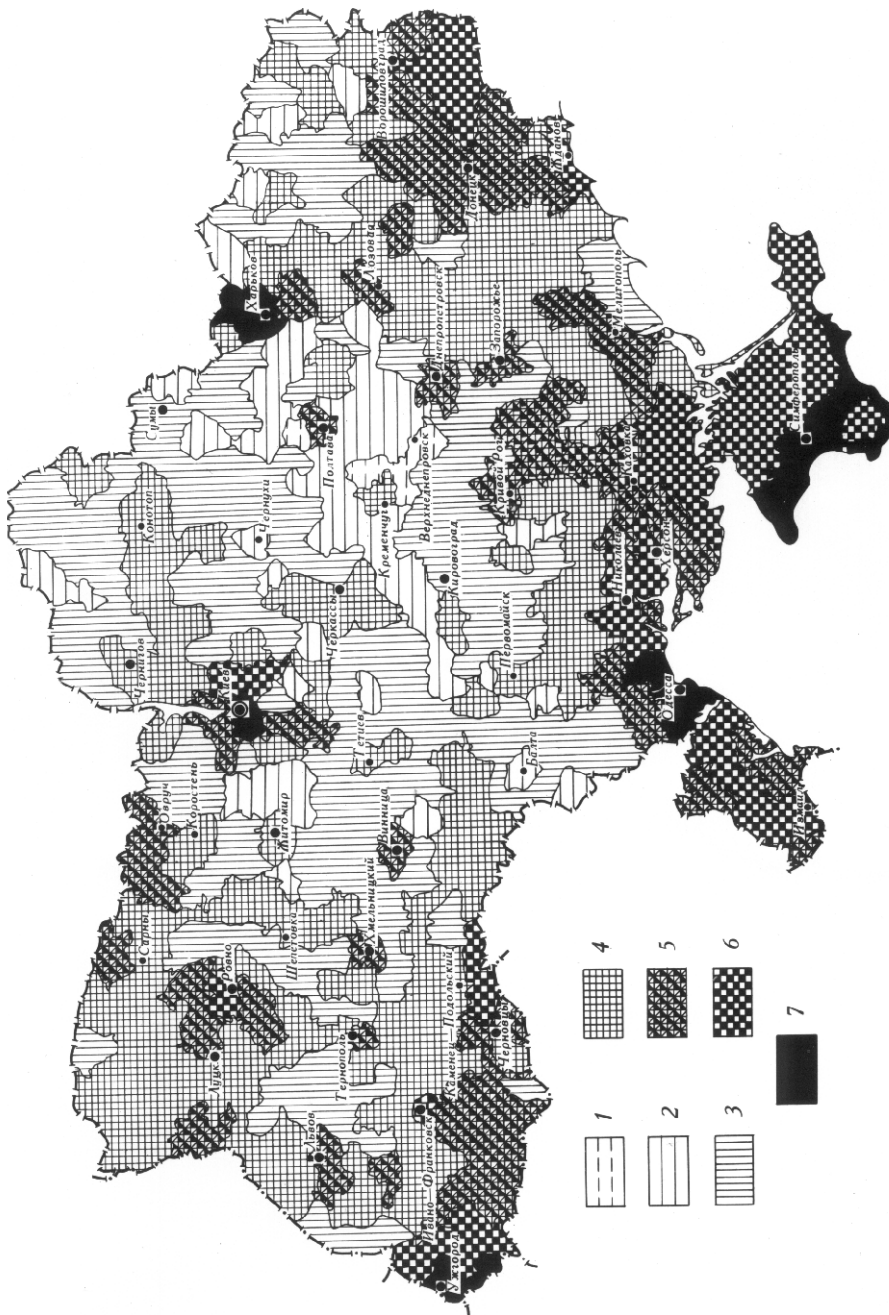


Fig. 3. Cartographical model of spatial self-organization of rural population in the Ukraine in 1977. Share of rural in habitants in able-bodied age: 1 — 42.5–45.0%; 2 — 45.1–47.5%; 3 — 47.6–50.0%; 4 — 50.1–52.5%; 5 — 52.6–55.0%; 6 — 55.1–57.5; 7 — 57.6–60.0%

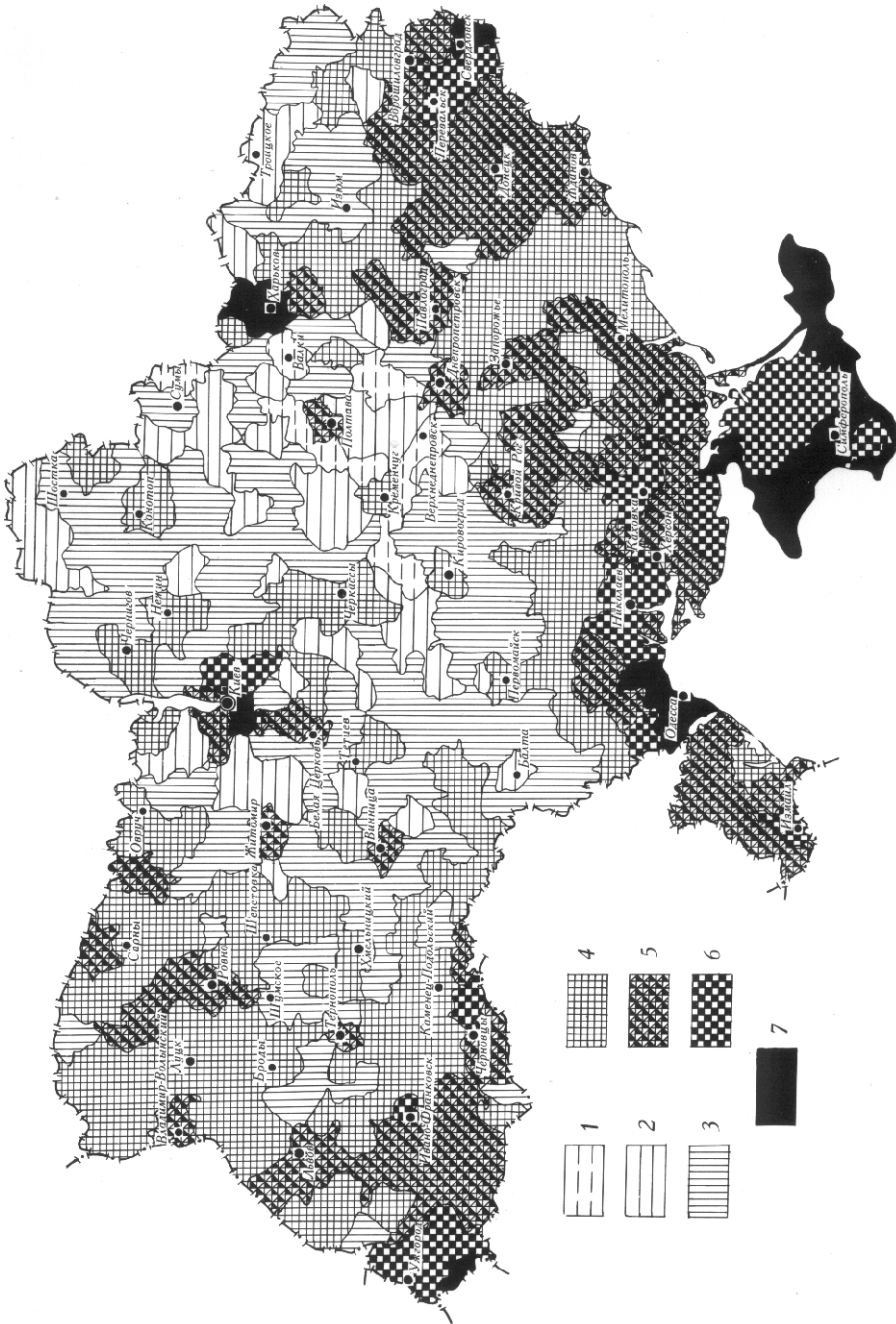


Fig. 4. Cartographical model of spatial self-organization of rural population in the Ukraine in 1981. Share of rural inhabitants in able-bodied age:
 1 — 42.5–45.0%; 2 — 45.1–47.5%; 3 — 47.6–50.0%; 4 — 50.1–52.5%; 5 — 52.6–55.0%; 6 — 55.1–57.5; 7 — 57.6–60.0%

this process the duties of peculiar nuclei for crystallization for a new socio-spatial structures of rural resettling. The large cities with strong economical potential and diverse functions have the greatest influence on the level of concentration of rural able-bodied inhabitants and area of their location in suburbs. At the same time, one can observe the rise of separate hotbeds and then whole zones where the dispersion of rural population and destructive demographic processes advance with a high speed.

The deep changes in the structure of spatial self-organization of rural population take place over a long period of time. The main point of this process lies in the permanent deepening of its territorial polarization. The demographical consequences of spatial self-organization of country people are highly various, closely tied and are evinced first of all in different types of dynamics and age structure of rural population in the regions of its concentration and dispersion [Pribytkova, 2009: p. 95-96].

Types of rural population changes in Ukraine in 1970-1978

At a moment, when the demographic transition was over, the depopulation and migratory losses brought about the irreparable consequences for rural population practically in all regions of Ukraine. Let us address the results of analysis, fulfilled after J. W. Webb's model, with a view to investigate the types of population changes in the countryside of Ukraine in 1970-1978. This method gives a possibility to mark out eight basic types of dynamics that reflect not only the direction of population change (growth or diminution) but also the correlation of its forming sources (natural and migration movements) and the character of its dynamics (Figure 5).

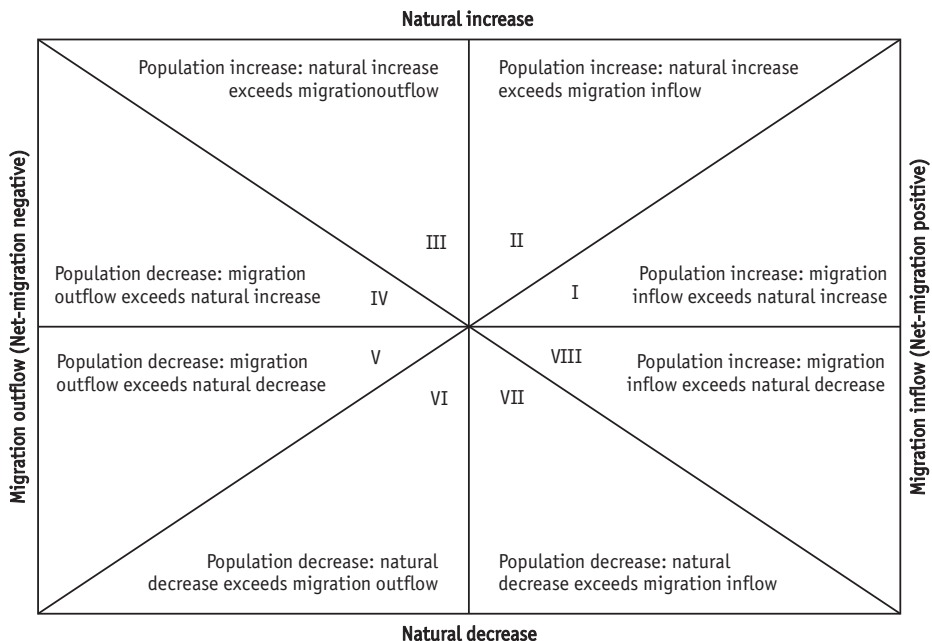


Fig. 5. Types of population changes (after J. W. Webb's model)

The grouping of rural administrative regions of Ukraine by J. W. Webb's model (Webb J. W., 1963) shows that the tendencies and structure of rural population changes keep within the next types of dynamics in 1970-1973: I, II, III and VIII (growth of population); IV and V (decrease of population); and intermediate type of stationary population. The overwhelming majority of rural administrative regions in Ukraine (400 out of 476) belong to IV and V types; 270 regions, where the migration outflow exceeds a natural increase, belong to IV type; and 130 regions belong to V type (migration outflow exceeds natural decrease). The stationary population (natural increase and migration outflow are equal in size) is observed only in two rural administrative regions (Figure 6).

The growth of population took place only in 76 regions. 12 out of them belong to I type. Those ones are mainly the suburban regions of large administrative, industrial and cultural centres of Ukraine – Kiev, Kharkov, Dnipropetrovsk, Lugansk, Poltava, Kryvoi Rog. Here the population has grown under exceeding of migration inflow above the natural increase. The population increase by II type was observed in other 10 rural administrative regions. Here a natural increase exceeded the migration inflow. Those were mainly the regions of Black Sea coast.

The positive dynamics was present also in 52 other rural regions: here the natural increase exceeded the migration outflow (III type). Those were, as a rule, the suburban regions of province centres of Ukraine. And, at last, the growth of population took place in two suburban regions of Dnipropetrovsk, where the migration inflow exceeded a natural decrease (VIII type).

Analysis of rural population changes over the longer period of time – from 1970 to 1978 – leads to conclusion on extremely high rate of its worsening towards the end of demographic transition. There were only 60 rural regions by 1979 where the growth of population was observed. At the same time the number of regions with negative dynamics of rural population has grown to 417. All four types of rural population increase (I, II, III and VIII) are represented within the Ukraine. The decrease of rural population proceeds by IV, V and VI types. And VII type of dynamics (natural decrease exceeds migration inflow) was absent in Ukraine in 1970-1978 (Figure 7).

The number of regions, where diminution of rural population proceeds by V type (migration outflow exceeds natural decrease), has noticeably grown and ran to 170. Its portion constituted 35.6% of whole number of rural administrative regions in Ukraine. The upgrowth of their number took place at the expense of those regions which have belonged before to IV type (migration outflow exceeds natural increase).

In central regions of Ukraine and its north a vast zone has shaped where the decrease of population proceeded in 1970-ties on a large scale and with heightened speed. It led to irreversible demographic losses within the bounds of these territories and to spreading of sparsely populated areas within the countryside [Pribytkova, 2009: p. 153-154].

Concluding remarks

- Rise in the number of rural inhabitants at the able-bodied age and increase in amount of large villages in the suburbs are accompanied by improving of demographical structure of rural population in these areas. A social and

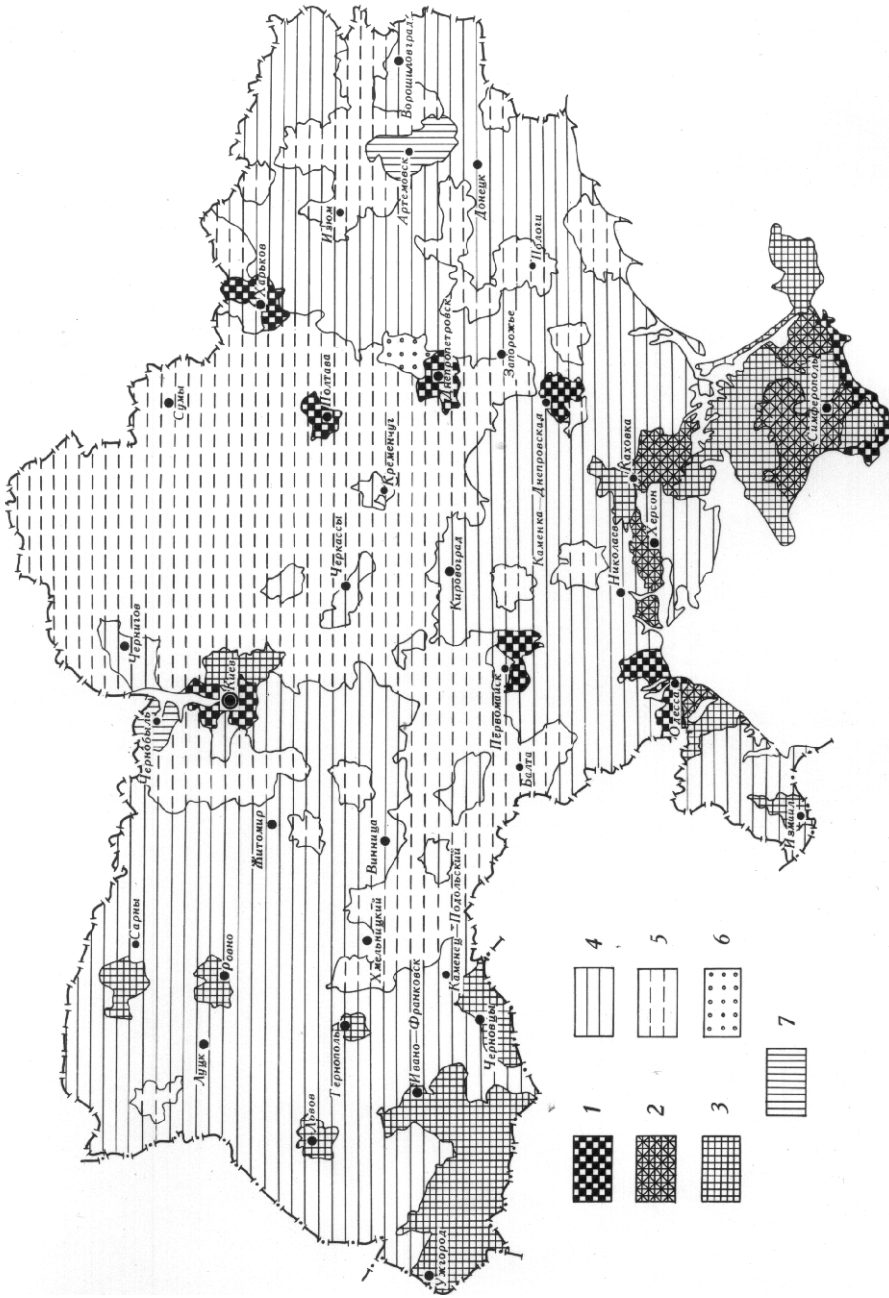


Fig. 7. Types of rural population changes in Ukraine in 1970-1978 (by J. W. Webb)
 1 — I type; 2 — II type; 3 — III type; 4 — IV type; 5 — V type; 6 — VI type; 7 — VIII type

territorial mobility of village inhabitants is gaining in strength and scope, the structure of employment changes for the better.

- At the same time destructive demographical processes are observed in the rural areas of dispersion. Reproductive activity is reduced, mortality rises rapidly, the life expectancy at birth is growing shorter, and the age structure of rural population is getting worse and worse.
- The spatial self-organization of rural inhabitants within the Ukraine is on-going process. It should be expected for subsequent deepening of disproportion in age structure of rural population in the areas of dispersion, lessening of their number and decrease of labour potential in countryside.

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