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**GEOINFORMATION SYSTEM FOR DEVELOPING SCENARIOS OF GLOBAL
DEMOGRAPHIC PROCESSES**

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GEOINFORMATION SYSTEM FOR DEVELOPING SCENARIOS OF GLOBAL DEMOGRAPHIC PROCESSES (SUSTAINABLE DEVELOPMENT OF RUSSIA CASE STUDY)¹

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Abstract. Inevitable transition to the models of sustainable development of the humankind is discussed. A range of themes and indicators showing the possibility of developing scenarios of global demographic processes is described. It appears necessary to describe all thematic subjects within a hierarchical system - from global to local level - with due account to specific features of phenomena that should be represented at different scales. Of particular importance is the temporal aspect of modelling the scenarios. The structure of the geoinformation system is described. Possible ways of the system application for the elaboration of scenarios for whole world and Russia are discussed.

Introduction

Revival of Russia and its progressive development require first and foremost the moral and spiritual enthusiasm of population, as well as a certain concept of harmonisation in the system of “nature-society-economy”, because a depressed society is unable to develop resource-saving economy and improve health care, science, education and culture. A concept of sustainable social environmental development could therefore become a priority of the state politics. Moreover, a special paradigm of sustainable development has already developed basing on the ideas of Rio-92, the Action Plan for further realisation of Agenda 21, as well as the Rio+10 documents approved in 2002 in Johannesburg. The main target of this paradigm is to provide for the survival of the present and future generations in the situation when certain natural resources are of finite nature, social processes and environmental problems are rather complicated in many regions, the resource-consuming production is inefficient, etc. Evolution of these ideas could be followed in many publications [Koptuyug, 1993, 1995, 1997; Kostin, 1996; New paradigm..., 1999; Ursul, 2000; Levashov, 2001 and other]. A number of scientists have come to the conclusion that this paradigm has gained a predominant importance, while some of them think that it could become a uniting nation-wide cultural concept. For example, Academician A.V. Yablokov writes: “At present it is already widely assumed that the elaboration of the strategy of sustainable development could become a nation-wide idea which would unite the efforts aimed at the revival of Russia. Realisation of such strategy in this rapidly reforming country could put Russia well ahead of other large industrialised economies on the way to the balanced social development dreamed of by the intellectuals of all times” [Yablokov, 1997, p.13].

Information society requires the integration of all information resources describing state, trends, prospects and alternative ways of development of the “nature-society-economy” system, as well as the analysis of its spatial and temporal parameters [Tikunov, Tsapuk, 1999; Myagkov, Tikunov, 2001]. Atlas-type information systems, as classified by F.Ormeling [Ormeling, 1995], are in our opinion the most suitable means to solve these tasks. It is such system that is now being elaborated at the Laboratory of Integrated Mapping of the Moscow State University in co-operation with many experts from other research institutions of Russia and the Utrecht university as well. All materials are presented in our system in the following logical sequence: moral, spiritual and historical basis, social demographic, political and economic components, natural resource potential and nature conservation.

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According to the results of a recent sociological survey, “justice” was most often mentioned as a basis for the revival of Russia (44% of those questioned), followed by “human rights” (37%) and “order” (36%). V.K.Levashov considers justice as an integral moral, legal and ethic base of the life of Russian society; it means the primacy of good over evil and of law and human rights over violence and wilfulness, the quest for truth in the process of cognition, the religious-spiritual support of the upright way of living. The sustainable development is impossible without deliberate and voluntary self-restriction of consumption that requires profound spiritual and education base. High level of social economic development and living standards is less important for the realisation of the ideas of sustainable development than the rational consumption oriented on the preservation of the natural environment which “hosts” the society. But the environment-friendly development of economy could, of course, be welcomed.

Within the whole system the natural component has environmental (support of life on the Earth), productive (production of biological matter consumed by humans), informational (storage of information about structure and functioning of biological systems) and spiritual aesthetic (influence on human culture) functions [National Strategy..., 2001]. At present the natural resources are the principal source of wealth in Russia. Economist D.S.Lvov is right to call for the introduction of rent charges for the use of natural resources that belong to the whole society. “Human capital” is also among the valuable resources and it is necessary to increase the importance of technological, innovative and other components in the system of “nature-society-economy”. Brief review of strategic resources of Russia is given in the National Report of the same name [National Report..., 1996].

Description of the structure of the geoinformation system

The structure of the geoinformation system “Sustainable Development of Russia” is described in detail in the publication [Gubanov et al., 2000]. The information is organised in the interrelated blocks, namely social political, economic (productive), natural resource and environmental. All interrelated blocks describe the socioecosystems of different spatial range. The hierarchical changes of all thematic subjects are shown from the global to the local level with due account to specific features of phenomena that should be represented at different scales. Upper block of the hierarchically composed system would describe the position and role of Russia in the solution of global issues. World maps of this block would represent the reserves of the main natural resources and the balance of their production and consumption; dynamics of the population growth; impact of Russian and other nations on the global environmental situation. Anamorphoses, diagrams, graphs, tables and explanatory texts should stress the role of Russia for the solution of the most urgent global issues. It would be also useful to compare Russia’s regions and foreign countries within a single information massif. The work has been already done to apply multidimensional ranking using the sets of comparable parameters. According to several integral indicators the regions of Russia could be correlated to quite different countries, from Austria (the city of Moscow) to Nicaragua (Republic of Tuva). An example of the description of social health is discussed in the article [Prokhorov, Tikunov, 2001].

The sections of the federal level form the core of the system. Besides many original subjects a complete description of all components of the system of “nature-society-economy” is given with particular emphasis on the nature of ongoing changes. The themes of mapping are based on the draft list of indicators of the sustainable development compiled by the UN experts [Indicators..., 2000], which includes the groups of impact, state and management parameters. The systems of indicators could vary for different territories [Bossel, 2001]. Final elements of the blocks are the integrated estimates of social demographic stability, stable economic growth, resistance of the environment to the anthropogenic impact and other subjects represented in the quantitative form. At present there is general agreement that the quantitative measures are crucially important for the description of intricate paths which could lead the nations towards the sustainable development. For example, A.P.Fedotov writes: “Without quantitative basement the concepts of sustainable development are totally impractical” [Fedotov, 2002, p.108]. He suggested the procedures for the calculation of integrated parameters, such as index of sustainable development, index of anthropogenic pressure, index of social economic disharmony of society, etc. The index of sustainable development is a ratio of the actual spatial anthropogenic pressure to its permissible value (being 70 kWt/sq.km, according to Fedotov’s calculations). At present we are also trying to compile such index by integrating the most important, in our opinion, indicators of the social political block (preservation of spiritual and cultural heritage, social political stability of society, modified index of human potential development, which is criticised by I.A.Gundarov, A.P.Fedotov and others, parameters of public health, etc.), productive block (gross

regional product, attractiveness for investments, resource consumption and the level of innovations in the economy, etc.), natural resource and environmental block (natural resource potential, anthropogenic impact on lithosphere, pedosphere, biosphere, hydrosphere, atmosphere, etc.) in order to compare it with Fedotov's one.

The main target of mapping for both particular themes and integral characteristics was to show the actual state of phenomena, represent them in different aspects and point out the trends of their development. To illustrate this let us look at the characteristics of the elections held in Russia since 1991. Besides common subjects, such as winners or per cent of votes for particular candidates or political parties, the integral indices of manageability of the territories [Tikunov, Oreshkina, 2000] are presented, as well as their changes from one elections to another. Another example of non-traditional approach is combination of typological and evaluation characteristics, such as evaluation of public health and the types of death causes (Fig. 1).

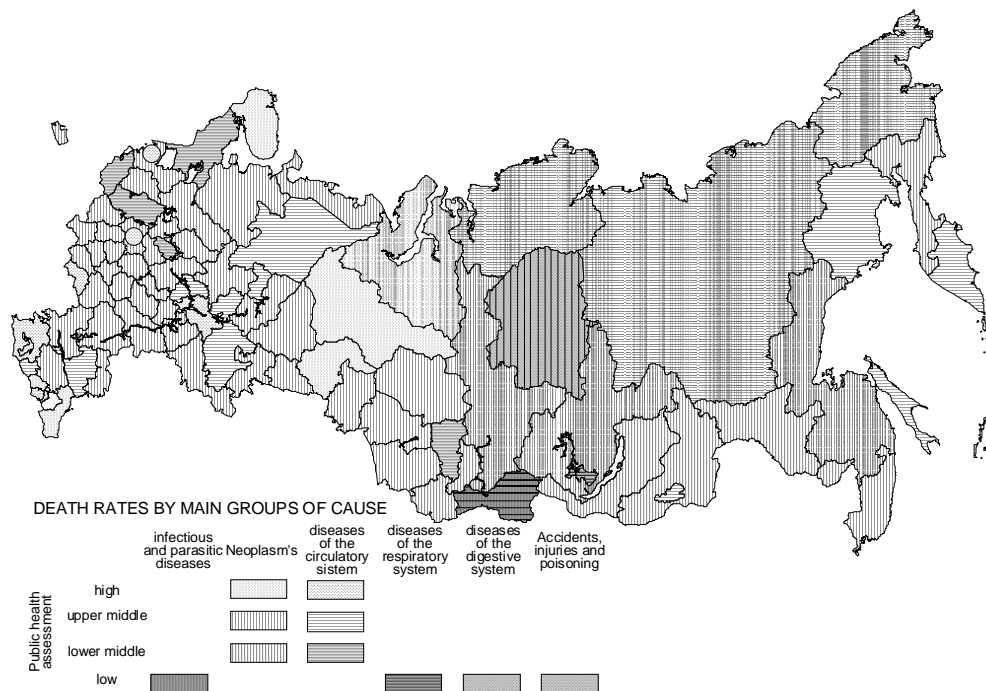


Fig. 1. State of Public Health of Russia (1997)

Deviation of parameters for all regions of Russia from those for “conventionally the best” one (most often Moscow region within the economic block) makes it possible to illustrate enormous difference, for example for the amount of investments it is 1000 times. Of particular interest is the representation of “decreasing” or “increasing” distance between the regions of Russia and Moscow during the ten-year period in terms of the changes of transportation costs normalised to the level of income in different regions for different time periods. Theoretically it is possible to account for different incomes of particular groups of population, etc., if the appropriate statistical data are available. The distance calculated in such way varies with time and is not the same if measured, for example, from Moscow to Khabarovsk and from Khabarovsk to Moscow. These examples illustrate the increasing isolation of the regions accompanied by the development of their own “closed” markets, etc., and the necessity to take proper account of this situation.

An important block of the system would be the models of transfer to sustainable development for the regions of Russia. As in other blocks of the system the main aim is to characterize the environmental, economic and social components of sustainable development of the territories. The work will soon begin on a hypermedia branch of the system for the Baikal Lake area, Irkutsk oblast and the town of

Irkutsk. The region would be analyzed as both an element of a larger territorial unit, i.e. the country, and a somewhat self-sufficient integrity capable of development on the basis of internal resources. The composed maps would make it possible to propose the strategy of development and innovative activities for the whole region and its particular areas. The typology of all regions of Russia has already been done and typical representatives of different groups, such as industrial, agrarian, poorly developed, etc., have been identified. Other regional branches of the system could represent different types of the territories within the country.

Of particular importance is the representation of possible political, environmental, economic and social risks. At present these themes are being intensively worked up.

Practically all themes related to the sustainable development requires the dynamic representation which is also realised by the geoinformation system. Generally the phenomena are described for the basic time periods or years. The anamorphoses (Fig. 2-4) give an example of population dynamics by countries for 1950, 2000 and 2025 (forecast). Several thematic animations are being worked out for the retrospective analysis, namely Changes of arable and forest lands within the Russia's regions for the recent 300 years, Development of city network in Russia, Dynamics of the population density in Russia during 1678 to 2011, Development of metallurgy in Russia during the 18th to 20th centuries and Development of railway network (expansion and electrification) in 19th and 20th centuries, the latter two being the first stage in the elaboration of a complex animation Development of industry and transport in Russia. Animations Population of Russia, Changes of administrative and territorial boundaries in Russia and some others are also in progress. The last one allows the users to see the boundaries of gubernias in the 19th century, view the hierarchy of administrative units (gubernia, uезд, volost), follow the changes of boundaries during the Soviet times and in the recent history of the country, identify stable boundaries and those frequently resited, obtain the encyclopedic information on the region, gain biographic data of the Governor, etc. A procedure of animation for anamorphoses, including two-dimensional ones, has been elaborated as well.

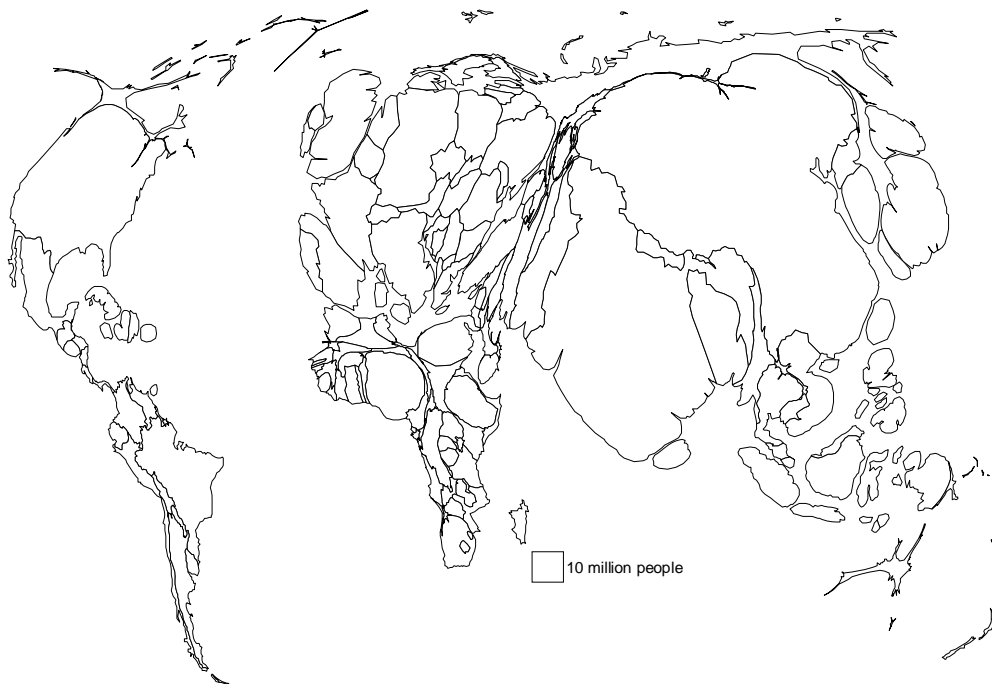


Fig. 2. Anamorphose of the world's countries based on their population numbers (1950)

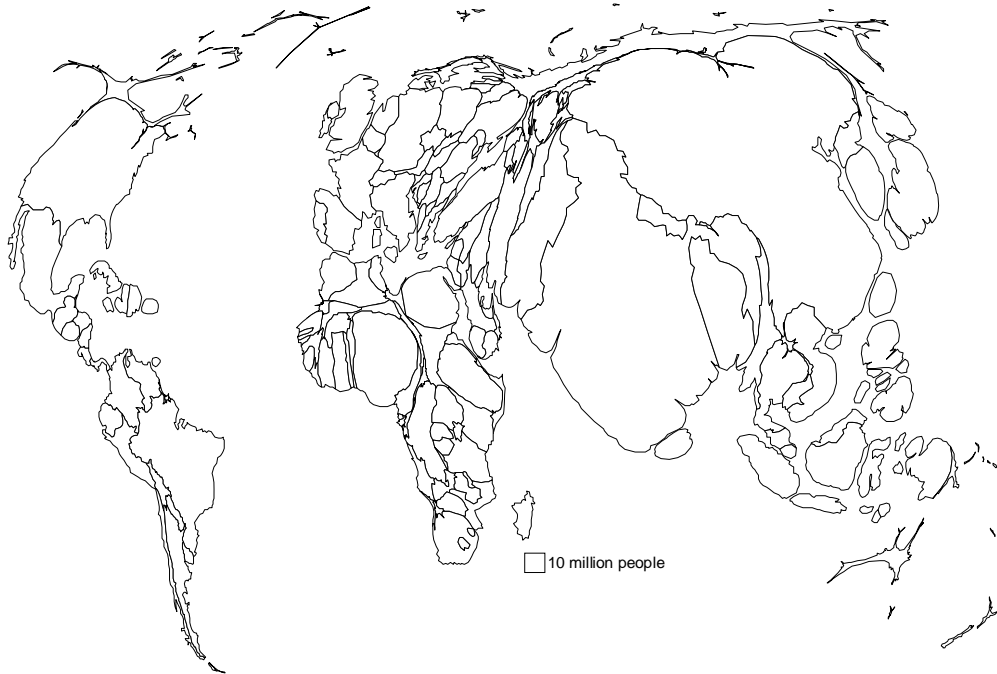


Fig. 3. Anamorphose of the world's countries based on their population numbers (2000)

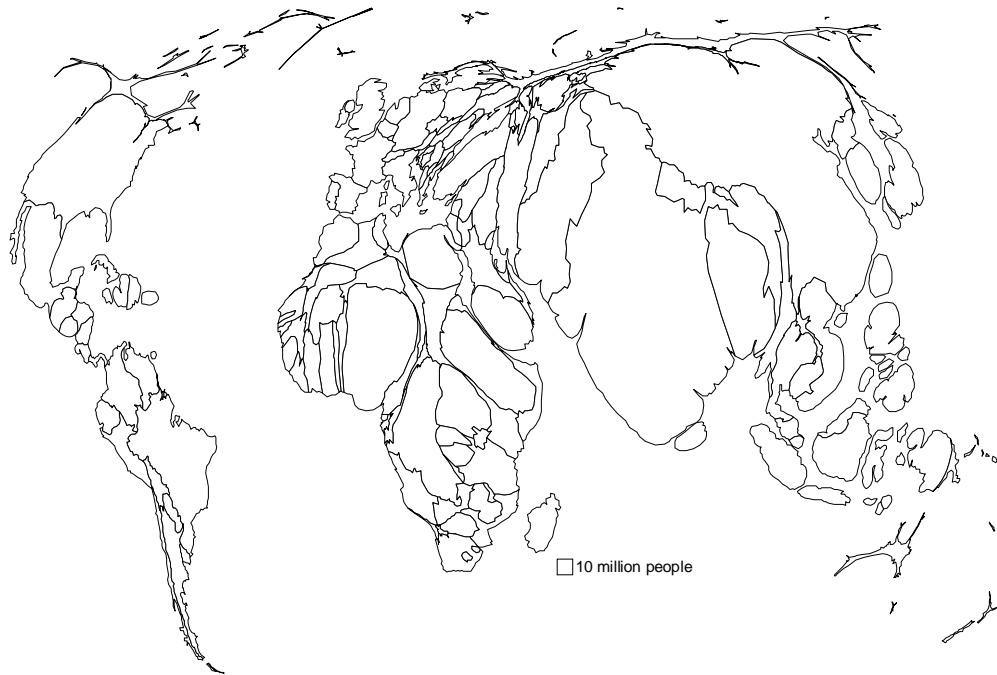


Fig. 4. Anamorphose of the world's countries based on their population numbers (2050)

Application of the system for the solution of national economy tasks

The main application of the system is for the elaboration of scenarios of development for the country and its regions. It allows to describe the changes resulting from the implementation of transportation corridors projects, such as Shanghai-Rotterdam railroad through the territory of Kazakhstan and

Russian railroads, connection of Korean and Japanese railroads with Russian ones and, in a very long run, linking China and the USA via a railroad crossing the Bering Strait. Projects of oil and gas pipelines construction are also of interest, including the alternative scenarios of the Baltic system development. Analysis of theoretically possible scenarios of development, for example under the complete exhaustion of certain natural resources, may be of interest as well. Note that oil and gas might lose their resource value in the future because within a century the technologies of power production would hardly rely on these fuels (the same situation occurred back 100 years). On the other hand, principally new technologies of the future could require these resources for some other purposes, for example non-energy production. Scenarios give rise to ideas, which in their turn generate new scenarios.

Alternative estimates of innovation potential of the Russian economy hold much promise. At present this potential is rather low, however there are rather good prospects for wider use of education resources. Expansion of all kinds of training and retraining, including distant learning, is particularly inviting, both within Russia and in the CIS countries, as well as other regions having good experience of co-operation with the former USSR in the sphere of education. It is this very sphere that, in our opinion, could become an engine for the development of Russia (available basis and experience, small investments required at the first stage, high efficiency, good reputation abroad, etc.).

Of particular importance is the modelling of complex phenomena within the information system. Such modelling is based on the integrated systematic approach to the simulation of socioecosystems. A user of the system could, for example, construct a certain structure and manage it in order to look for scenarios offering the improvement of public health or wellbeing of the population as a result of reforming and evaluate the cost of such results for each scenario. At present the most dramatic situation is in terms of life expectancy for men with considerable difference of this parameter for men and women. However, the analysis of a wide range of indicators proves that the improvement of the situation by economic means would require a lot of time and money. Thus the attention should be given to non-economic mechanisms, recommended by I.A. Gundorov [Gundarov, 2001] and analysed by S.M.Myagkov [Myagkov, 2002]. This case clearly shows the inability of the Russian authorities to choose priorities or national interests and formulate the tasks: retention of territory and population numbers, improvement of the living standards, then the quality of living and healthy life expectancy, etc. These tasks could hardly be solved all together at a time. Despite their close interrelations and orientation towards one general target they require different actions within a socioecosystem.

Russia, as well as other nations, may need more investments in the improvement of moral components of life of the society which is extremely diverse and along with the biodiversity and ethnodiversity adds to the potential of the sustainable development. Economic growth and increasing living standards with regard to the acceptable level for different peoples and social groups could be even of less importance. In the absence of proper education (in the wide sense of the word) it would be impossible to put voluntary limits to consumption which is necessary for the realisation of sustainable development concept. Moral improvement would require the improvement of all levels of education, followed by the rational organisation of economy in order to balance in with the nature which should be regarded primarily as a natural environment of humans and only then as a source of natural resources. Nobody tries to deny the importance of economic development as a material basis of the life of the society, by the priorities should be stated clearly and unambiguously.

Regional analysis of the present-day situation of indigenous peoples of the North (alcoholism, loss of native languages, etc.) and correlation of the results with the current trends revealed for the Russians lead to the dramatic conclusion about the possibility of the same situation as a pessimistic scenario of development. Further on S.M.Myagkov writes: "It would be useful for western experts to consider social demographic processes in Russia as a model of processes which are quite possible in their countries in the nearest future" [Myagkov, 2002, p.11].

We have started to develop the instruments making it possible for users to create their own subjects with the available cartographic base and the data acquired through Internet, for example. The means of mathematical modelling, aimed at the development of scenarios of transition to the sustainable development for different regions of the country would be improved as well. At the final stage of the project the intellectualisation of the whole system would result in the development of a full-scale system of decision-making support. Improvement of administration, including the territorial one is among the most urgent tasks. It means practical functioning of 7 federal okrugs (provinces) with 30-40

subokrugs and the whole system of existing units of administrative territorial division. The subokrugs should be organised on the basis of natural or natural economic units in order to create, as N.N.Moiseev wrote [Moiseev, 1999], a natural social territorial structure of the country, thus increasing the possibilities of management and the reliance on the biospheric systems, such as landscapes and biocenoses.

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