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Study of the Demographic Component Quality of Life of the Population of the Radioactively Contaminated Territory of the Zhytomyr Region Using ArcGIS Software

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ABSTRACT
The article provides the assessment of the demographic component of the quality of life of the population resident in the radioactively contaminated areas of the Yemilchynskyi, Malynskyi, Narodytskyi, Olevskyi, Luhynskyi, Ovrutskyi, Novohrad-Volynskyi, Khoroshivskyi districts and city of Korosten of the Zhytomyr region. The basis for the study and assessment of the quality of life of the population were the statistical data of the Head Office of Statistics in Zhytomyr Region. The uhe use of ArcGIS software made it possible to determine the effectiveness of mapping to assess the demographic component of the quality of life of the population. It was defined that for the period between 2002 and 2021, the population of radioactively contaminated areas decreased by 23.4%, while in the territory of Zhytomyr region as a whole – it by 13.9%. Natural population decline rates in rural settlements exceeded the corresponding values for urban settlements from 1.1 (Yemilchynskyi district) to 20.1 times (Narodychi raion). The values of birth rates (6.2 (Korosten city) – 10 (Olevsk raion) per 1,000 of the present population) did not have a positive effect on the demographic situation as a whole because of the high mortality rate exceeding the birth rate by 1.7 (Olevsk raion) – 3.3 times (Ovruch raion). The main causes of death are diseases of the circulatory system (76.7%), cancer (10.2%), and external factors (5.8%). In order to improve the quality of life of the population of radioactively contaminated territories in the Zhytomyr region, it is necessary to reform the state policy, to provide financial support for their revival and creation of favorable living and reproduction conditions for the population.

Keywords: size of the population, natural population decline, birth and mortality rate, causes of death.

INTRODUCTION

Quality of life is a multidimensional concept of the general state of well-being of an individual in relation to the values, environment, cultural and social context in which they live (Kuyken et al., 1995). The quality of life category is an extremely broad concept that has a number of component indicators, one of which is socio-demographic characteristics. The quality of life of the population is one of the most important social categories, which is the basis of the concepts of economic growth and development of society (Romanchuk, 2015; Romanchuk et al., 2015; Herasymchuk et al., 2019). Today, improving the quality of life is a general societal idea and is considered to be a priority of the government at all levels, as well as an indicator of the effectiveness of state policy.

According to the quality of life index, Ukraine ranks 60th among 87 countries of the world, and 32nd among 36 European countries (Numbeo, 2019), despite the fact that a number of goals have been defined at the legislative level to achieve an increase in the level and quality of life of the population in order to ensure the national interests of Ukraine in terms of sustainable development of the economy, civil society and the state in the Decree of the President of Ukraine dated September 30, 2019 No. 722/2019 "On the Sustainable Development Goals of Ukraine for the period until 2030".

Considering that the human factor is decisive in the development of any state, domestic and foreign scientists actively study the quality of life issues in their territories, including Ukraine (Romanchuk, 2015; Romanchuk et al., 2015; Herasymchuk et al., 2019), Portuguese cities (Barreira et al., 2021), Bangalore (South India) (Krishnappa et al., 2021), Greece (Beletsioti, Niakas, 2019), Pakistan (Lodhi et al., 2019), southeastern Poland (Ćwirlej-Sozańska et al., 2018), Germany (Huber et al., 2017), the capital of Slovenia Ljubljana (Tiran, 2016), Romania and Lithuania (Streimikiene, 2014), Italy (Bonatti et al., 2017; Cecchini et al., 2019), Czech Republic (Liberec) (Murgaš, Klobučník, 2018).

Among the factors affecting the decline in the quality of life, we note an increase in the age of the population (Ćwirlej-Sozańska et al., 2018; Lodhi et al., 2019), an increased risk of mortality (Phyo et al., 2020), an increase in the number of chronic diseases (Ćwirlej-Sozańska et al., 2018), the COVID-19 pandemic (Melo-Oliveira et al., 2021; Nandasena et al., 2022), living in rural areas (Ćwirlej-Sozańska et al., 2018; Lodhi et al., 2019; Krishnappa et al., 2021), financial crisis (Beletsioti, Niakas, 2019), armed conflicts and military operations (Keles, 2012; Simancas-Fernández et al., 2021), environmental component (Streimikiene, 2014; Herasymchuk et al., 2019). Most of such studies concerned either individual countries or megacities. The question of assessing the quality of life of the population living in the territories exposed to radioactive contamination remained outside the attention of scientists.

In the 36 years period after the accident at the Chornobyl Nuclear Power Plant (ChNPP), there have been significant changes in the levels of environmental contamination, food products contamination, the socio-economic development of radioactively contaminated territories, but no positive trends have been observed in quality of life indicators, especially for rural residents (Romanchuk, 2015; Romanchuk et al., 2015; Herasymchuk et al., 2019). During the past period, all the efforts of the state were directed to anti-radiation countermeasures, social and medical protection of the population, but due attention was not paid to the development of quality characteristics of the living conditions of the rural population residing in the radioactively contaminated territories of Zhytomyr region. In the Development Strategy of Zhytomyr region for the period until 2027, approved by the decision of the regional council No. 1722 dated 18.12.2019 with amendments No. 16 dated 24.12.2020, measures are prescribed to create a modern and safe living environment in territorial communities, to improve health population, increasing the demographic potential. In particular, in the territories radioactively contaminated by the accident at the ChNPP, the evaluation and determination of the possibilities of involving the land in agricultural turnover, which will have economic and social effects for the further development of the territories, are relevant in a strategic perspective.

Based on the above, the issue of assessing the demographic component of the quality of life in the radioactively contaminated territories of Ukraine, namely Zhytomyr region, is extremely relevant and requires comprehensive research.

MATERIALS AND METHODS

The statistical data of the Head Office of Statistics in Zhytomyr Region became the information base for the assessment of the demographic component of the quality of life of the population living in the territory of radioactively contaminated administrative districts of Zhytomyr region. According to the resolution of the Cabinet of Ministers of the Ukrainian SSR dated July 23, 1991 No. 106, which approved the list of settlements classified as zones of radioactive contamination as a result of the Chernobyl disaster, in Zhytomyr region, the exclusion zone includes 4 rural settlements in Narodytskyi district, 3 in Ovrutskyi district; the zone of unconditional (mandatory) resettlement includes one rural settlement each in Korostenskyi and Malynskyi districts, 4 rural settlements – in Luhynskyi district, 35 rural settlements and an urban-type settlement – in Narodytskyi district, 10 rural settlements – in Ovrutskyi district (according to calculations of additional radiation doses – 9 villages), a rural settlement and an urban-type settlement - in Olevskyi district; the zone of guaranteed voluntary resettlement – 44 rural settlements in Yemilchynskyi district, 24 rural settlements, a village and a city – in Korostenskyi district, 32 rural settlements, a village and 2 urban-type settlements – in Luhynskyi district, 36 rural settlements – in Narodytskyi district, 7 rural settlements and an urban-type settlement – in Novohrad-Volynskyi district, 103 rural settlements, 2 settlements and an urban-type settlement – in Ovrutskyi district, 38 rural settlements, 3 settlements and 4 urban-type settlements

– in Olevskyi; to the zone of enhanced radiological control – 7 rural settlements and an urban-type settlement in Khoroshiv (Volodarsk-Volynskyi) district, 73 rural settlements and 2 urban-type settlements in Yemilchynskyi district, 87 rural settlements and 3 settlements – in Korostenskyi district, 11 rural settlements points – in Luhynskyi district, 101 rural settlements, villages and urban-type settlements – in Malynskyi district, 9 rural settlements – in Narodytskyi district, 24 rural settlements, villages and small towns – in Novohrad-Volynskyi district. These areas were taken for research.

The demographic component of the quality of life of the population living in the radioactively contaminated territories of the Zhytomyr region was assessed using the following indicators: number, natural decline, distribution of the population by sex, place of residence and age groups, birth and death rates, causes of death. The obtained results were presented in the form of map diagrams created in the ArcGIS environment, which made it possible to determine the effectiveness of mapping for assessing the demographic component of the quality of life of the population in the radioactively contaminated territories of Zhytomyr region.

RESULTS

During the period 2002–2021, the number of people living in radioactively contaminated territories of Zhytomyr region decreased on average by 23.4% (or by 101.4 thousand people), while in the territory of Zhytomyr region as a whole – by 13.9%. In terms of the administrative districts of the region, the maximum values of total population reduction were characteristic of the Malinsky district, the number of which decreased by 65.8% (or 34.3 thousand people). Such a large percentage of the population decrease in the territory of the Malynskyi district is explained by the fact that, according to the Resolution of the Verkhovna Rada of Ukraine dated November 18, 2003, the city of Malyn was included in the cities of regional subordination and, therefore, removed from the demographic statistics of the district. Further values of population reduction over five-year periods in the territory of Malinskyi District did not exceed 6%. Reductions in the population at the level of 25.5–27.1% took place in Yemilchynskyi (by 10.7 thousand people), Luhynskyi (by 5.4 thousand people) and Korostenskyi (by 9.3 thousand people) districts (in while in the city of Korosten, the population decreased by 6.5% (or 4.3 thousand people)). In Ovrutskyi and Narodytskyi districts, which were the most affected by the accident at the Chernobyl nuclear power plant, the population decreased by 21.8% and 18.1%, respectively. The lowest rates of population decline were recorded for Novohrad-Volynskyi (by 16.7%, or 8.8 thousand people), Olevskyi (by 13.8%, or 6.5 thousand people) and Khoroshivskyi (by 13.3%, or 5.1 thousand people) districts (Fig. 1). It should be noted that the number of the population living in radioactively contaminated territories decreased more intensively over five-year periods (on average from 3.7 to 4.9%), compared to the Zhytomyr region as a whole (from 2.3 to 3.8%).

It was established that the values of the general coefficients of natural population decline in radioactively contaminated areas exceeded the corresponding indicator for the region in 2010 by 1.1–2.5 times (with the exception of Novohrad-Volynskyi, Olevskyi, Khoroshivskyi districts and the city of Korosten), in 2015 – by 1.1–2.6 times (excluding Olevskyi and Khoroshivskyi districts), in 2020 – by 1.1–1.5 times (excluding Olevskyi district). It should be noted that in all districts of Zhytomyr region, the territory of which was affected by the accident at the ChNPP, the coefficients of natural population decline in rural settlements exceeded the corresponding values for urban settlements from 1.1 (Yemilchynskyi district, 2015) to 20.1 (Narodytskyi district, 2010) times. The maximum values of the coefficients of natural population decline in rural settlements compared to the corresponding values for urban settlements were recorded in Narodytskyi district: in 2010 – -17.3 per 1,000 of the available population against 8.6; in 2015 – -18.5 per 1,000 of the available population against -4.9; in 2020 – -16 per 1,000 of the available population against -4.9 (Fig. 2). The decrease in the number of the population is connected, first of all, with a low birth rate and high rates of emigration. Migration reduction of the population in 2020 on the territory of Yemilchynskyi district amounted to 307 people (or -98.2 per 10,000 available population), Malynskyi district – 47 people (or -26.3 per 10,000 available population), Korostenskyi district – 189 people (or -75.6 per 10,000 available population), Olevskyi district – 87 people (or -21.5 per 10,000 available population), Luhynskyi district – 63 people (or -40.5 per 10,000 available population), Ovrutskyi district – 209 people (or -39.1 per 10 thousand available

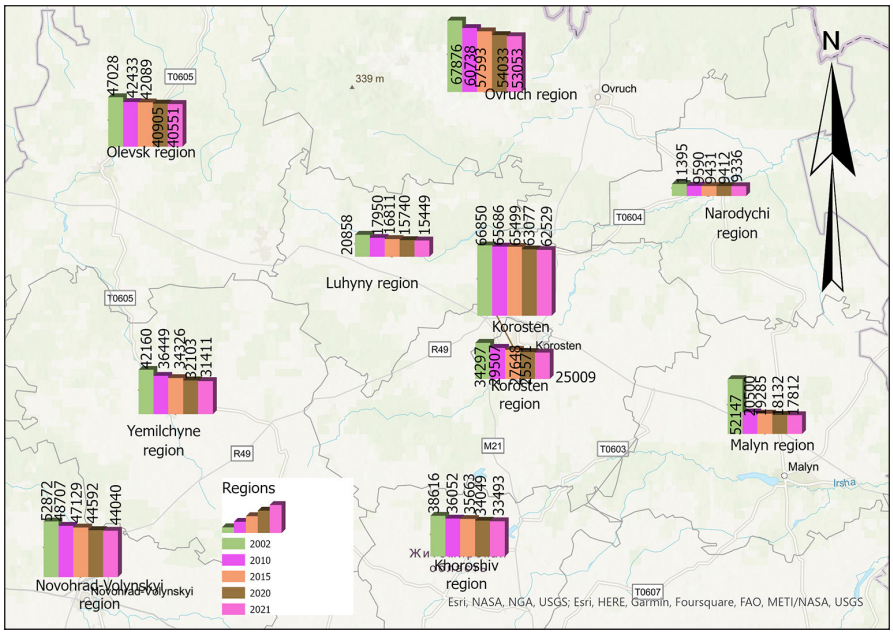

Fig. 1. Dynamics of changes in the size of the permanent population in the section of radioactively contaminated regions of Zhytomyr region (number of persons) for the period 2002–2021

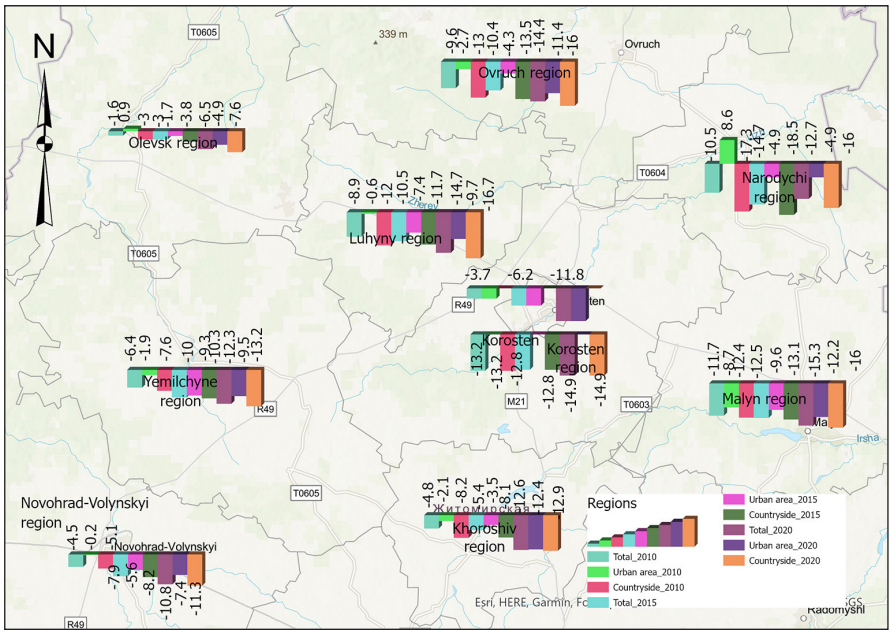

Fig. 2. Dynamics of natural population reduction in radioactively contaminated territories of Zhytomyr region (per 1,000 existing population) for the period 2010–2020

population), Novohrad-Volynskyi district – 81 people (or -18.6 per 10 thousand available population), Khoroshivskyi district – 132 people (or -39.3 per 10 thousands of available population). Migration growth in 2020 took place only in the territory of Narodytskyi district – 43 people (or 45.6 per 10 thousand available population) and the city of Korosten – 191 people (or 30.5 per 10 thousand available population).

A decrease in the number of the rural population was noted, the share of which in the total population as of 2021 amounted to 42% in Khoroshivskyi district, 62.7% in Olevskyi district, 66.6% in Ovrutskyi district, 69.3% in Narodytskyi district, and 70.8% in Luhynsky district. %, Yemilchynskyi district – 76.1%, Malynskyi district – 82%, Novohrad-Volynskyi district – 87.9%. The most intense decrease in the share of

the rural population was characteristic of Narodytsky district (Fig. 3).

The structure of the population by gender is uneven across the studied districts of Zhytomyr region: for every 1,000 women, there were 837 (2002) to 922 (2020) men. The fewest number of men per 1,000 women was recorded in 2002 and 2010 in the territory of the Korostenskyi district – 837 (men – 15,631 people, women – 18,666 people) and 841 (men – 13,477 people, women – 16,030 people), respectively; in 2015 – Narodytskyi district – 842 (men – 4311 people, women – 5120 people); in 2020 and 2021 – the city of Korosten – 847 (men – 28,917 people, women – 34,160 people) and 845 (men – 28,647 people, women – 33,882 people), respectively; the largest number of men during the observation period was recorded in the territory of Olevskyi district – from 902 to 922 (Fig. 4). In general, this ratio for radioactively contaminated territories did not differ from the same ratio in the region, where there were 865 (2002) to 873 (2021) men per 1,000 women.

Along with the decrease in the number of the population, there is also an unprecedented aging of it. The largest share of elderly people (65 years and older) – 21.7% (5435 people) and 20% (10625 people) – live in the territory of Korostenskyi and Ovrutskyi districts, the children's population – 19.9% (7619 people) – in the territory Olevskyi district (with the smallest share of elderly people – 13.4%), the working-age population – in the territory of the city of Korosten – 67.9% (42,481 people) (Fig. 5). It should be noted that compared to the share of people aged 65 and older in the total population of the region as a whole, where it is 16.8%, the share of such people is higher in radioactively contaminated territories: in the city of Korosten – 16.9% (10,540 people), Yemilchynskyi district – 17.2% (5,410 people), Malynskyi district – 17.6% (3,141 people), Luhynskyi district – 19.6% (3,021 people), Narodytskyi district – 19.7% (1,836 people). The only exceptions were the territories of Novohrad-Volynskyi, Khoroshivskyi and Olevskyi districts, where the share of people aged 65 and older was 16.3% (7176 people), 15.9% (5341 people) and 13.4% (5442 people), respectively. Such a structure is quite logical, taking into account the above data. Population aging, characterized by a reduction in the share of children and an increase in the share of elderly people, has a direct impact on the level of demographic burden. The main indicator characterizing population reproduction is the birth rate. The birth rates of the population in the section of radioactively contaminated districts of Zhytomyr region decreased annually and their values in 2010 ranged from 9.9 (Ovrutskyi district) to 22.6 (Malinsky district) per 1,000 of the available population, with the average value for the region as a whole – 11.4; in 2015 – from 7.6 (Narodytskyi district) to 13.6 (Olevskyi district) per 1,000 of the available population, while the average value for

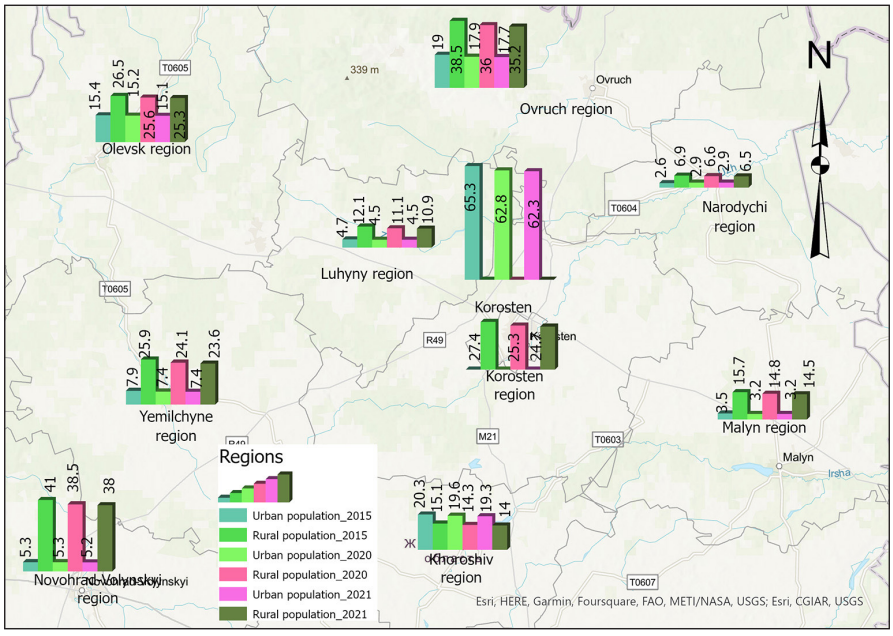

Fig. 3. Dynamics of population distribution by place of residence in the radioactively contaminated territory of Zhytomyr region (thousands of people) for the period 2015–2021

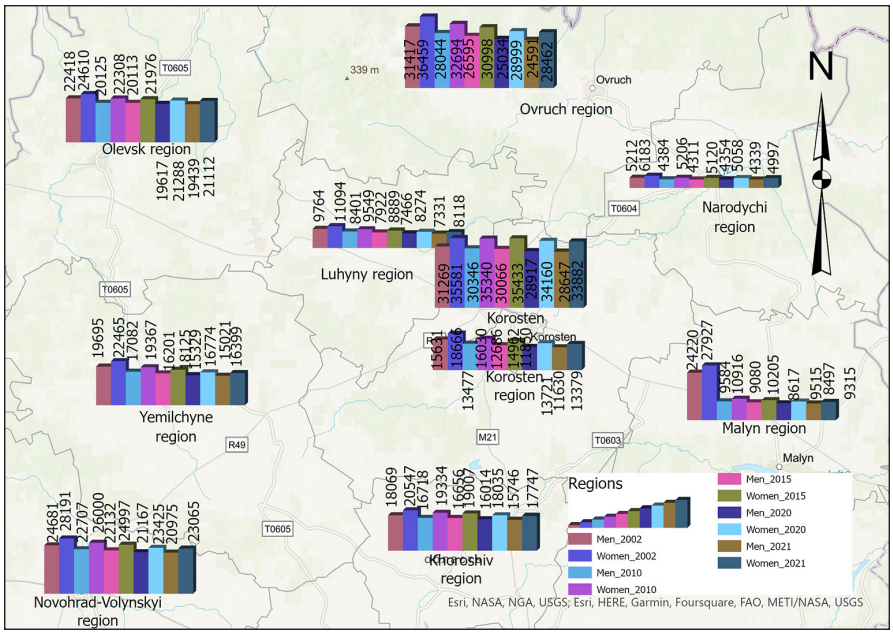

Fig. 4. Structure of the population of radioactively contaminated areas of Zhytomyr region by sex (persons) for the period 2002–2021

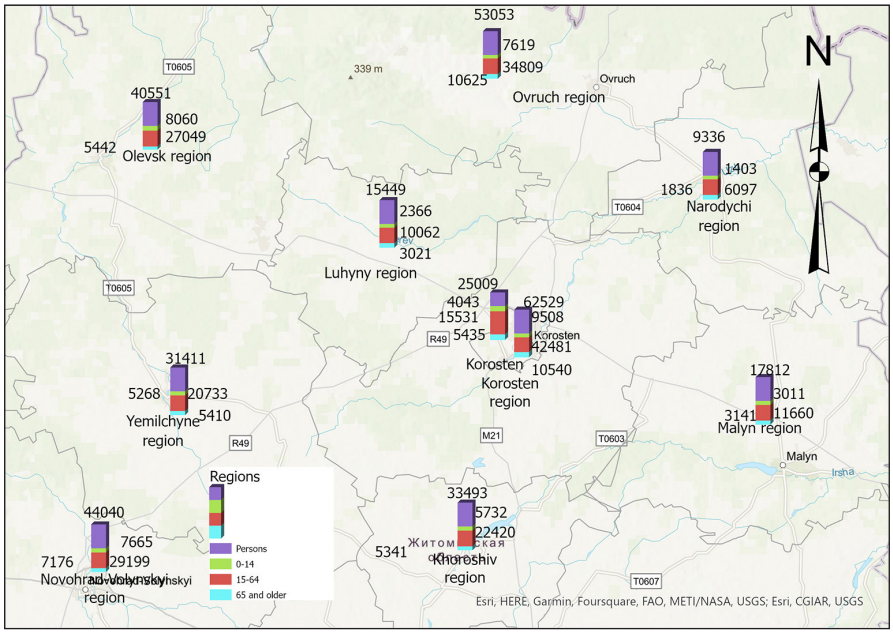

Fig. 5. Distribution of the population permanently living in the radioactively contaminated territories of Zhytomyr region by age groups (persons) as of January 1, 2021

the region as a whole is 11; in 2020 – from 6.2 (Korosten city) to 10 (Olevskyi district) per 1,000 of the available population, while the average value for the region as a whole is 7.6 (Fig. 6).

For the most part, fertility rates in rural areas exceeded the corresponding values in urban areas by 1.1–2.6 times. Thus, in 2010, the fertility rates of the population in rural areas varied from 9.7 (Ovrutskyi district) to 25.9 (Narodytskyi district), in urban areas – from 9.8 (Narodytskyi district) to 17.9 (Malynskyi district) on 1000 available population with average values for the region as a whole – 11.5 and 11.4, respectively; in 2015, in rural areas – from 6.6 (Narodytskyi district) to 14.3 (Olevskyi district), in urban areas – from 8.2 (Malynskyi district) to 12.4 (Olevskyi district) per 1,000 of the available population with average values for the region as a whole – 14.3 and

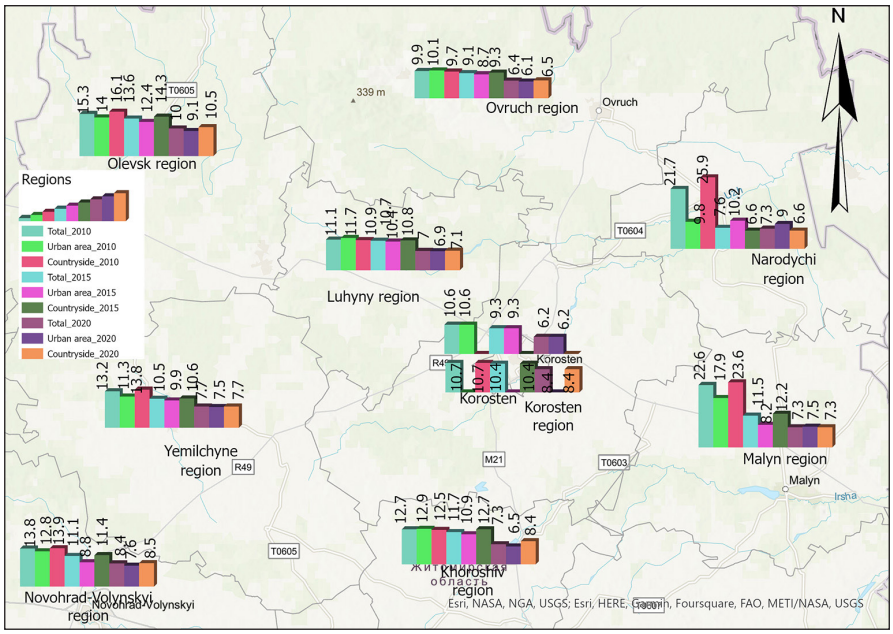

Fig. 6. Dynamics of the total birth rates of the population living in the radioactively contaminated territories of the Zhytomyr region (per 1,000 people of the existing population) for the period 2010–2020

12.4, respectively; in 2020, in rural areas – from 6.5 (Ovrutskyi district) to 10.5 (Olevskyi district), in urban areas – from 6.1 (Ovrutskyi district) to 9.1 (Olevskyi district) per 1,000 of the available population with average values for the region as a whole – 6.5 and 6.1, respectively (Fig. 6).

The given values of birth rates in the radioactively contaminated territories of Zhytomyr region did not have a positive effect on the demographic situation as a whole due to the high mortality rate. And if a certain regularity was observed for birth rates in relation to their maximum values on the territory of Olevskyi district for different types of terrain in 2015 and 2020, then no such trend was found in death rates. However, if the fertility rates were characterized by an excess of values in urban areas over rural areas in certain districts (Luhynskyi, Ovrutskyi and Khoroshivskyi districts in 2010, Malynskyi in 2020, Narodytskyi in 2015 and 2020), then the values of mortality rates in rural areas significantly exceeded similar values in urban areas. Thus, the greatest excesses of mortality rates in rural areas compared to similar values in urban areas were characteristic of Narodytskyi (2.6 times in 2010 and 1.6 times in 2020) and Ovrutskyi (1.8 times in 2015) districts.

The population mortality rates had the lowest values in the city of Korosten and Olevskyi district and varied from 14.3 (city of Korosten) to 23.9 (Korostenskyi district) per 1,000 of the available population, while the average value for the region as a whole was 16.6 (2010); from 15.5 (Korosten city) to 24 (Malinskyi district) per 1,000 of the available population, while the average value for the region is 16.7 (2015); from 16.5 (Olevskyi district) to 23.3 (Korostenskyi district) per 1,000 available population, while the average value for the region is 17.6 (2020) (Fig. 7).

It should be noted that in radioactively contaminated areas, mortality rates significantly exceeded the average values for Zhytomyr region (with the exception of the city of Korosten in 2010 and 2015 and Olevskyi district in 2015 and 2020). The values of death rates exceeded the corresponding birth rates, and this excess grew from year to year. Thus, if in 2010 the values of mortality rates were equal to birth rates (Malynskyi and Narodytskyi districts) or exceeded them by 1.1 (Olevskyi district) – 2.2 (Korostenskyi district) times, then in 2015 and 2020 their constant excess was recorded 1.2 (Olevsky district) – 2.9 (Narodytskyi district) and 1.7 (Olevskyi district) – 3.3 (Ovrutskyi district) times, respectively. It should be noted that in 2010, the excess of mortality over birth rate by more than 2 times was observed in the territory of Korostenskyi district only, in 2015 Malynskyi, Ovrutskyi and Naroditskyi districts were added, and in 2020 – Yemilchynskyi, Luhynskyi, Novohrad-Volynskyi and Khoroshivskyi districts and the city of Korosten (Fig. 7). In our opinion, population reproduction in these areas is closely interconnected with the socio-economic features

of the territory's development. The structure of the causes of mortality of the population of Zhytomyr region as a whole and its radioactively contaminated territories as a whole coincides: diseases of the circulatory system (75.2%), cancer (11.8%), external factors (5.6%), diseases of the digestive organs (4.1%), respiratory diseases (2.2%), some infectious and parasitic diseases (1.2%). The maximum values of mortality rates in 2020 were recorded as a result of: some infectious and parasitic diseases, neoplasms, diseases of the circulatory system and external causes – in the territory of Malinskyi district – 27.5, 241.9, 1638.3 and 164.9 per 100,000 of the available population, respectively; respiratory diseases – in the territory of Narodytskyi district – 95 per 100,000 of the existing population; diseases of the digestive organs – in the territory of the Korostenskyi district – 101.9 per 100,000 of the existing population (Fig. 8). Another one of the most sensitive indicators of the socio-economic

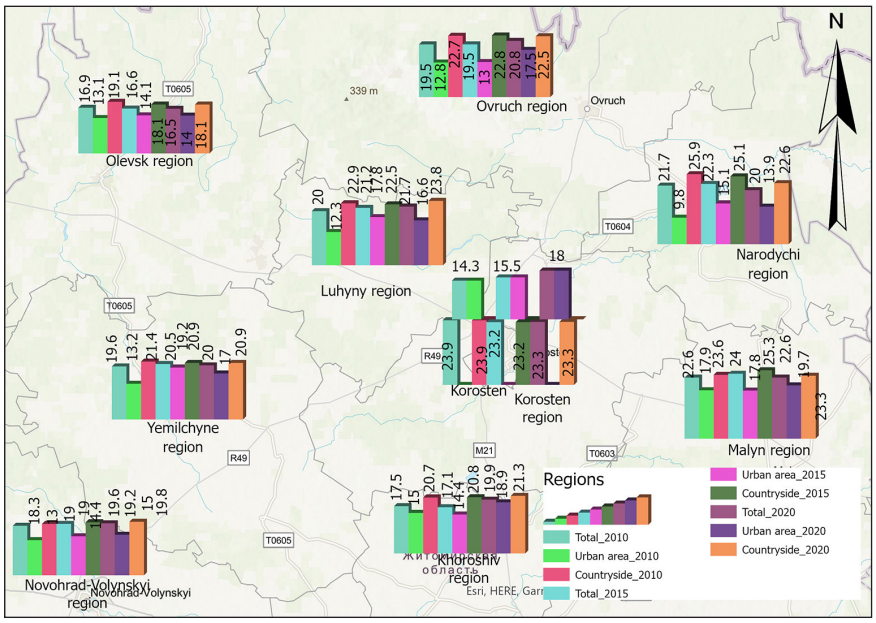

Fig. 7. Dynamics of the total mortality rates of the population of radioactively contaminated areas of Zhytomyr region (per 1,000 of the available population) for the period 2010–2020

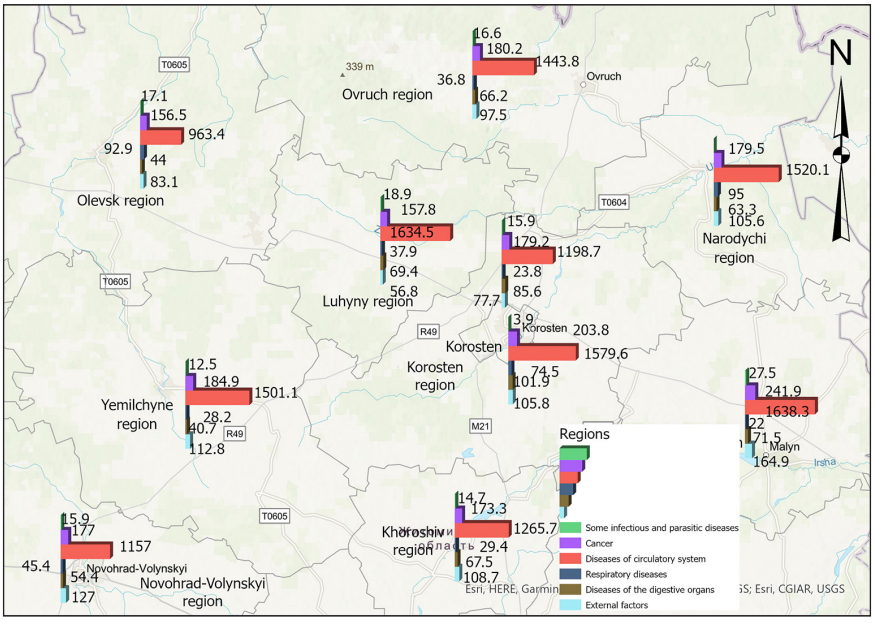

Fig. 8. Mortality rates of the population by the main causes in the section of radioactively contaminated areas of Zhytomyr region (per 100,000 of the available population), 2020

well-being of the country is the infant mortality rate. Examining the changes in the dynamics of the mortality rates of children under the age of 1 in Zhytomyr region, a clear pattern of their decline can be observed (5.9 dead children per 1,000 live births in 2020 versus 10.7 in 2002). As for child mortality rates in radioactively contaminated territories, the peak values were recorded in different years: 2002 – Yemilchynskyi (18.7) and Novohrad-Volynskyi (17.7) districts; 2005 – Narodytskyi district (22), 2010 – Yemilchynskyi (23.4) and Narodytskyi (18.5) districts, 2015 – Narodytskyi district (32.4), 2020 – Luhynskyi (27.4) and Ovrutskyi (14.7) districts (Fig. 9). We believe that environmental and social barriers are one of the causes of child mortality.

DISCUSSION

The concept of quality of life is closely linked with the concept of a good life (Murgaš, 2016). The life processes of households in radioactively contaminated territories take place under the conditions of the long-term factor of radioactive pollution, which determines certain features of the formation of the quality of life of this region's population. It has been confirmed (Keles, 2012; Streimikiene, 2014; Pereira et al., 2015; Herasymchuk et al., 2019) that the environmental component is one of the most important components determining the quality of life. Along with socio-economic parameters of development, the ecological state of the territory has a direct impact on demographic processes. It is the demographic indicators (number, birth rate, mortality, natural increase (decrease) of the population) that indicate positive or negative trends in the change in the quality of life in a certain territory (Romanchuk et al., 2019; Herasymchuk et al., 2019). The report "World Population Prospects 2022" (UN DESA, 2022) states that Ukraine (as well as Bulgaria, Latvia, Lithuania and Serbia) is expected to experience the largest population decline by 2050, with losses of 20% or more. We note that the sharp reduction in the number of the population also poses serious challenges for all authorities at all levels. The change in the number of the population, including birth rate, mortality and migration, was also affected by the COVID-19 pandemic, which is also confirmed in the works (Melo-Oliveira et al., 2021; Nandasena et al., 2022). In the National Economic Strategy for the period until 2030 dated March, 2021 No. 179, it is emphasized that in recent years some regions have come close to a demographic crisis, and rural areas will suffer the greatest losses, as their depopulation is an urgent problem. The data we obtained about the decrease in the number of the rural population do not contradict the research of other scientists (Kuczabski, Michalski, 2013; Chornyi, Shevchuk, 2013; Kohler et al., 2017;

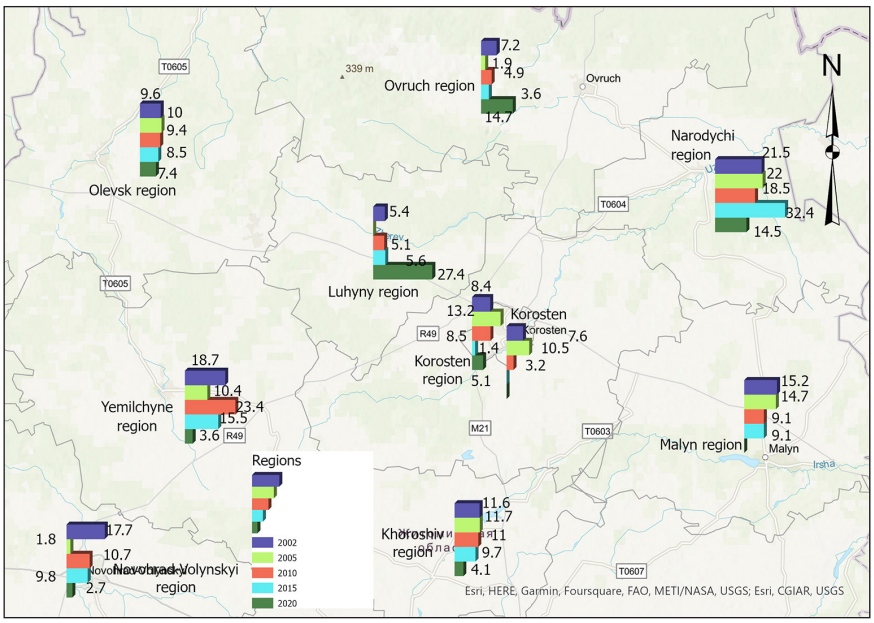

Fig. 9. Dynamics of mortality rates of children under the age of 1 year in radioactively contaminated areas of Zhytomyr region (deaths of children under the age of 1 year per 1,000 live births) for the period 2010–2020

Johnson, Lichter, 2019; Krishnappa et al., 2021). In particular, it is stated (Chornyi, Shevchuk, 2013) that the depopulation of rural settlements poses threats to national security, the preservation of the gene pool of the Ukrainian people, and the development of labor potential in general. According to data (Ubarevičienė, van Ham, 2017), demographic differences between regions lead to their spatially unbalanced development.

Along with the decrease in the number of the population, there is also an unprecedented aging of it – a process that began in the middle of the 20th century on the territory of Ukraine, during which the number of elderly people increases both in number and in terms of the share of the total number. According to forecasts (UN DESA, 2022), the share of the world population aged 65 and older will grow from 10% in 2022 to 16% in 2050, and their number will exceed twice as many children under 5 years of age. Such negative shifts in the age distribution of the population are associated with a steady decline in the birth rate. The study (Vogelsang, Raymo, 2014) shows that differences in the composition of the population play an important role in shaping the observed relationships between the age structure at the local level and health at the individual level. It was noted (Cecchini et al., 2019) that the population size and its structure affect regional stability and are important drivers of land use, and the analysis of demographic trends allows to determine socio-economic stability, to form strategies aimed at stimulating the faster recovery of local systems from external shocks. As noted (Vogelsang, Raymo, 2014), depopulation and aging have consequences beyond demography, as aging will require increased health and social care, which will lead to increased costs and reduced tax revenues, as well as local capacity for innovation and development.

The main indicator characterizing population reproduction is the birth rate. The report (UN DESA, 2022) noted that in 2021 the average birth rate of the world population was 2.3 births per woman during the year (in 1950 – 5 births per woman), and it is projected to decrease to 2.1 births per woman by 2050 is approximately the level required for zero growth in the long term for a population with low mortality, while in Zhytomyr region the total fertility rate in 2020 was 1.198. High mortality, primarily in rural areas, is often caused by the inaccessibility and low quality of health care services, the insufficiency of preventive measures to prevent mortality from cardiovascular, oncological and other diseases, and the deterioration of the environmental situation (Strategy of the Cabinet of Ministers of Ukraine No. 16 dated 24.12.2020).

Among the factors affecting the decline in the quality of life, was noted environmental component (Streimikiene, 2014; Herasymchuk et al., 2019). In our previously published studies (Herasymchuk et al., 2019), a close relationship was established between population radiation doses and the risk of malignant neoplasms in radionuclide-contaminated regions of Zhytomyr region, which is described by the linear equation: $D = 327.2159 – 1.8395x$ ($R = 0.7353$), where: D – morbidity risk, per 100,000 population; x is the radiation dose of the population. Another one of the most sensitive indicators of the socio-economic well-being of the country, an indicator of the general state of health of the nation and an important criterion for assessing the quality of life is the infant mortality rate. This indicator was used to monitor progress towards the fourth goal of the UN Millennium Development Goals (Millennium Development Goals, 2015) and reflects the broad socio-economic conditions and educational status of the population, as well as the quality and availability of health services. Reducing under-5 child mortality is now goal number 3 of the Sustainable Development Goals (SDGs) (Decree of the President of Ukraine No. 722/2019 dated September 30, 2019).

We believe that environmental and social barriers are one of the causes of child mortality. It was noted (Ratnasiri et al., 2020) that the socio-demographic factors associated with higher child mortality include the low level of education of mothers, very young and older age of mothers, and living in rural areas. Lower economic status is also strongly associated with higher infant mortality. It is noted (Lorenz et al., 2016; Ortigoza et al., 2021) that all determinants of action that negatively affect health – personal behavior, social factors, availability and quality of medical care, and the environment – disproportionately affect low-income segments of the population.

A persistently high level of child and maternal mortality, epidemics, violence and conflicts cause a decrease in life expectancy by 7.0 years from the world average in the least developed countries (UN DESA, 2022). We note that the obtained results require further research, because a more complete and reliable picture will be obtained after the All-Ukrainian population census

is conducted in 2023, determined by the order of the Cabinet of Ministers of Ukraine dated December 9, 2020 No. 1542.

Analysis and generalization of the cartographic image of the assessment of the quality of life of the population living in radioactively contaminated territories, created by means of ArcGIS Pro, makes it possible to evaluate and analyze the main demographic indicators, make effective management decisions and develop practical recommendations for improving the quality of life of the population within Zhytomyr region.

At the state level, insufficient attention is paid to regional development, including the territories affected by the accident at the ChNPP, especially rural ones. We believe that the authorities need to develop a balanced and effective demographic policy. This statement was also reflected in a number of works (Kuczabski, Michalski, 2013; Chornyi, Shevchuk, 2013; Sheykhi, 2021). In particular, it was emphasized (Sheykhi, 2021) that in order to achieve population development, it is constantly recommended to control it, and despite the fact that today people in the world generally live healthier and longer, there is a great inequality between different layers of the population in different territories, which in itself requires greater attention and application of regional and specific growth mechanisms. In addition, in the future, in order to eliminate the damage caused by military aggression, special attention will need to be paid to the territories that were most affected and to the socio-demographic characteristics of each victim and the type of aggression they experienced.

In order to improve the demographic situation, it is necessary to reform the state policy regarding the rural population, as well as to develop a strategy for the demographic regional development of Ukraine, providing sufficient financial support for it. It was noted (Chornyi, Shevchuk, 2013) that without solving this problem, it is possible to lose the possibilities of reproduction of the rural population, the rural labor potential, and as a result, chances for effective development of rural areas in the future.

CONCLUSIONS

Depopulation (compared to 2002, the population decreased by 23.4%, and its maximum values were characteristic of the territories of Malynskyi (due to the classification of the city of Malyn as a city of regional importance), Korostenskyi (27.1%), Luhynskyi (25.9%) and Yemilchinskyi (25.5%) districts), significant disparities between the high values of mortality rates in rural and urban areas (1.6–2.6 times in Narodytskyi district, 1.3–1.8 times in Ovrutskyi district), low values of fertility rates and natural decline (the decrease in their values relative to 2010 was recorded in the range of 1.3 (Korostenskyi district) to 3 (Narodytskyi district) times and from 1.5 (Ovrutskyi district) to 4.1 (Olevskyi district) times, respectively), the aging of the population (the largest share of people aged 65 and older live in Korostenskyi (21.7%), Ovrutskyi (20%) and Luhynskyi (19.6%) districts) indicate negative trends in demographic component of the quality of life of the population on radioactively contaminated territories of Zhytomyr region. The main reason for this situation is the long-term adverse effect of an environmental factor (according to the results of previous studies, a close relationship was established between the doses of exposure to the population and the risk of developing malignant neoplasms in the radionuclide-contaminated regions of Zhytomyr region, $R = 0.7353$). To improve the quality of life of the population of the radioactively contaminated territories of Zhytomyr region, it is necessary, first of all, to ensure the collection of modern demographic data, including population censuses and household surveys, in peacetime, because the quality of demographic estimates and forecasts, as well as progress in achieving Social Development Center and regional development planning, as well as reshaping state policy by providing financial support for their revival and creating favorable conditions for living and reproduction of the population in accordance with the Development Strategy of Zhytomyr region for the period until 2027.

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