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## The agrarian food consumption in Ukraine and its association with socio-demographic indicators of human development

**Abstract.** The objective of current research was to analyse the extent Ukrainian population was provided with the basic agrarian foods during 1990-2017 and to evaluate the relevant impact on the dynamics of human development indicators, such as birth rate, death rate, life expectancy at birth, mortality rate of infants and fertility rate. During the study, it was identified that consumption of basic agrarian foods did not meet the recommended nutrition norms. However, the tendency of significantly low consumption of «expensive» protein and vitamin containing foods (meat, milk, fish and fruits) was registered. Simultaneously, the tendency of «cheap» food consumption was topical. Thus the levels of bread, potato and vegetable consumption were exceeding the recommended nutrition norms. Our data suggest that nutrition degrading of agrarian food consumption corresponds with the change in the birth rate, the death rate, the life expectancy at birth and the fertility rate in Ukraine. The correlation analysis showed that the basic triggers of negative socio-demographic situation in Ukraine were low consumption of meat, milk, vegetables and fruits. The consumption of such agrarian product as bread, potato, sugar, eggs and vegetable oils did not perform a significant impact on the outcomes of the research.

**Keywords:** Agrarian-Food Products; Consumption; Social and Demographic Indicators; Correlation Analysis

**JEL Classification:** O10; C12

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### Споживання аграрно-продовольчих товарів та його взаємозв'язок із соціально-демографічними індикаторами людського розвитку

**Анотація.** Метою поточного дослідження є аналіз рівня забезпечення населення України основними аграрними продуктами протягом 1990–2017 рр. та оцінка його впливу на динаміку таких показників людського розвитку, як рівень народжуваності, рівень смертності, очікувана тривалість життя при народженні, рівень смертності немовлят і коефіцієнт фертильності жінок. Під час дослідження було встановлено, що споживання основних аграрних продуктів не відповідало рекомендованим нормам харчування. Спостерігається тенденція низького споживання «дорогих» білковмісних і вітамінних продуктів (м'яса, молока, риби та фруктів). Одночасно актуальною була тенденція споживання «дешевих»

продовольчих товарів. Таким чином, рівень споживання хліба, картоплі та овочів перевищував рекомендовані норми харчування. Дані свідчать про те, що погіршення споживання аграрно-продовольчої продукції відповідало змінам рівнів народжуваності, смертності, очікуваної тривалості життя при народженні та фертильності в Україні. Кореляційний аналіз виявив, що основними тригерами негативної соціально-демографічної ситуації в Україні було низьке споживання м'яса, молока, овочів і фруктів. У той же час споживання таких аграрно-продовольчих продуктів, як хліб, картопля, цукор, яйця і рослинні олії, не справили істотного впливу на результати дослідження.

**Ключові слова:** аграрно-продовольча продукція; споживання; соціально-демографічні індикатори; кореляційний аналіз.

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**Потребление аграрно-продовольственных товаров и его взаимосвязь с социально-демографическими индикаторами человеческого развития**

**Аннотация.** Целью данного исследования является анализ уровня обеспечения населения Украины основными аграрно-продовольственными товарами в период 1990–2017 гг., а также оценка его влияния на динамику таких показателей человеческого развития, как уровень рождаемости, уровень смертности, ожидаемая длительность жизни при рождении, уровень смертности младенцев и коэффициент фертильности женщин. В ходе исследования было установлено, что потребление основных аграрно-продовольственных продуктов не соответствовало рекомендуемым нормам питания. Наблюдается тенденция низкого потребления «дорогих» белоксодержащих и витаминных продуктов (мяса, молока, рыбы и фруктов). Одновременно актуальной является тенденция потребления «дешевых» аграрно-продовольственных товаров, следствием чего уровень потребления хлеба, картофеля и овощей превысил рекомендуемые нормы питания. Данные свидетельствуют о том, что ухудшение потребления аграрно-продовольственных продуктов соответствовало изменению уровней рождаемости, смертности, ожидаемой продолжительности жизни при рождении и фертильности женщин в Украине. Корреляционный анализ выявил, что основным триггером негативной социально-демографической ситуации в Украине было низкое потребление мяса, молока, овощей и фруктов. В то же время потребление таких аграрно-продовольственных продуктов, как хлеб, картофель, сахар, яйца и растительные масла, существенно не повлияли на результаты исследования.

**Ключевые слова:** аграрно-продовольственная продукция; потребление; социально-демографические индикаторы; корреляционный анализ.

## 1. Introduction

One of the important benchmarks of the national economic policy is a significant improvement of the living standards of the population. Nowadays Ukrainian policies require the accession of socially focused market economy according to the main European standards. Consequently, this may lead to a remarkable improvement of the population's food provision, especially in the field of basic agrarian food consumption with regard to the healthy eating norms. That is why per capita food consumption trends, food safety and nutrition quality are in the field of the agrarian food market analysing.

Currently, the main problems of humanity are the growing food demand within the conditions of world's population increasing, the support of rational food consumption and elimination of dietary shifts and, as a result, deterioration of the health status [1]. According to the data of the Global Burden of Disease, there were 270,000 deaths (95% UI 249,000-295,000) from nutritional deficiencies in 2017, representing 2.60% (2.37-2.86) of all deaths from communicable, maternal, neonatal, and nutritional (CMNN) causes in that year [2]. Most of the United Nations' 2030 Sustainable Development Goals (SDGs) are linked with global food systems performance [3]. From the medical point of view, both low consumption and overconsumption, depending on the level of economic development, are able to cause negative outcomes of human health. Overconsumption is typical for highly developed countries (EU, the USA, Japan and others), while low-consumption of basic agrarian food is the characteristic of low developed and developing countries. Therefore, the problem of food safety and providing the population with access to rational food consumption is one of the prior tasks not only for the countries with low economic standards.

An association between the demographic and economic indicators of human development is obvious and mutual. In general, we are confident that providing the population with access to rational agrarian food consumption can impact the basic indicators of human development, such as the birth rate, the death rate, life expectancy and others. The outcome of the conducted researches indicates a possibility to decrease the mortality of the population by providing access to rational food consumption [4]. For example, it was identified that the most remarkable triggers of life expectancy in Turkey during 1965-2005 were the availability of food products and the level of their consumption [5]. An analysis of scientific literature proves that providing the population with adequate and rational food products contributes to extended life expectancy and improved quality [6]. According to Ro-Ting Lin et al., nutrition contributes 2.79%-5.14% to life expectancy gains in less developed countries [7]. That is why the extent to which the population is provided with agrarian food may be a universal marker that can display both economic and socio-demographic progress of society.

## 2. Brief Literature Review

In publications by foreign authors, issues relating to the impact of agrarian food consumption on social and demographic indicators of human development have drawn significant attention. The following scholars devoted their studies to relevant issues: R. C. Casper (1995) [8], A. Chaudhary, D. Gustafson and A. Mathys (2018) [1], S. E. Chen (2012) [9], H. Ferda (2011) [5], J. Fledderjohann (2016) [10], M. Ilic (2016) [11], D. T. Jamison (2006) [12], V. Kosulwat (2002) [13], H. H. Lee (2016) [14], R. T. Lin (2012) [7], W. D. Mosher and C. A. Bachrach (1996) [15], V. Rao (1988) [16], A. Robson and T. Woutersen (2007) [17], E. Rogot (1992) [18], G. A. Roth (GBD 2017 Causes of Death Collaborators, 2019) [2],

L. Schwighackl (2017) [4], F. N. Uchendu (2018, 2015) [19-20], D. R. Vogli (2005) [21], R. G. Wilkinson (1992) [22], X. Y. Zheng (2014) [6].

In Ukraine, there is a very small number of publications that include studies on the impact of the agrarian food consumption on the state of socio-demographic indicators of human development. Most publications relate either to socio-demographic or socio-medical components. Regarding the Ukrainian expert environment, the problem of the impact of agrarian food consumption on the state of socio-demographic indicators of human development was in the focus of researchers such as N. M. Levchuk (2017) [23], E. M. Libanova (2006) [24], S. V. Polyakova and T. V. Novosilcka (2015) [25], S. Sehedra (2018, 2017, 2012) [26-28], V. A. Shlykova and O. M. Levanda (2018) [29] and D. G. Shushpanov (2016) [30].

### 3. The purpose

The purpose of this study is to analyse to what extent the population of Ukraine is provided with basic agrarian food products and assess its impact on the dynamics of social and demographic indicators of human development such as the birth rate (per 1,000 people), the death rate (per 1,000 people), life expectancy at birth, the mortality rate of infants (under the age of 1 year) and the fertility rate (number of newborns per one woman).

### 4. Material and methods

This research contains an analysis of change in food supply trends in Ukraine, based on statistics data across a period of 28 years. Thus, a comparative analysis to evaluate food consumption of meat, milk, fish, bread, eggs, fruits, vegetables, potatoes, vegetable oil, sugar per capita/per year and the relevant data by the National Dietary Guidelines was conducted with regard to the population of Ukraine during the 1990-2017 period. Consumption funds were determined by using the balance sheet method. Data sources for the calculations are summarized data of the state statistical surveys on the activities of agricultural enterprises and households, industrial enterprises, wholesale and retail trade, foreign trade of food products, as well as the results of sample surveys on living conditions of households and agricultural activities of households in rural areas. Also, the trends in basic socio-demographic indicators such as the birth rate, the death rate, life expectancy at birth, the mortality rate of infants and the fertility rate were evaluated in view of the 1990-2016 period.

The correlation analysis was conducted to estimate associative interactions between food consumption of main products and the basic social and demographic indicators. The relationship between the two variables was estimated by taking into account Pearson's correlation coefficient and according to the correlation analysis with the use of linear regression [31]:

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\left[ \sum_{i=1}^n (x_i - \bar{x})^2 \right] \left[ \sum_{i=1}^n (y_i - \bar{y})^2 \right]}}, \quad (1)$$

where:

- $r$  - Pearson's correlation coefficient;
- $y$  - per capita food consumption of main products;
- $x$  - the basic social-demographic indicators of Ukraine;
- $n$  - total number of values.

The strength of the relationship between the independent variables (per capita/per year food consumption) and the dependent variables (social and demographic indicators of human development) was assessed based on a multivariate linear regression analysis. In trying to disentangle the relationships involved in a set of independent variables, collinearity diagnostic was done which resulted in omitting variables that showed significant mutual correlation ( $r > 0.85$ ). Total statistical analysis was conducted with the use of Microsoft Excel software and the StatPlusLE statistic package. The State Statistics Committee of Ukraine ([www.ukrstat.gov.ua](http://www.ukrstat.gov.ua)), the National Dietary Guidelines ([www.me.gov.ua](http://www.me.gov.ua)), and figures by the World

Data Bank ([www.data.worldbank.org](http://www.data.worldbank.org)) were used to compose the informational database for collecting outgoing data for the research. Data for 2014-2017 did not concern the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and parts of the temporarily occupied territory in Donetsk and Luhansk regions.

### 5. Results

The economic transformation in Ukraine during 1990-2017 affected the agrarian food market. Thus, the consumption of basic agrarian foods during the analysed period underwent significant changes and was marked by periods of upsurge and recessions, as well as significant deviations from the recommended medical amount. Our research has started from the «first-point» 1990, the year prior to the Ukrainian independence. The consumption of basic agrarian food in 1990 can be divided into three groups. *The first group* includes foods, the consumption of which per capita/per year was corresponding and even exceeded the minimal recommended norms implemented by the Ministry of Health of Ukraine:

- bread and bakery goods - 141 kg/per capita/per year (139.6% of the minimal recommended norm),
- sugar - 50 kg/per capita/per year (131.6% of the minimal recommended norm),
- potato - 131 kg/per capita/per year (105.6% of the minimal recommended norm) (Figure 1).

*The second group* contains products, the consumption of which was average, yet it didn't meet the minimal recommended amounts:

- milk and dairy products - 373.2 kg/per capita/per year (98.2% of the norm),
- eggs - 272 points/per capita/per year (93.8% of the norm),
- vegetables oil - 11.6 kg/per capita/per year (89.2% of the minimal recommended norm),
- fish and fish products - 17.5 kg/per capita/per year (87.5% of the minimal recommended norm),
- meat - 68.2 kg/per capita/per year (85.3% of the minimal recommended norm).

*The third group* included products, which had been used noticeably lower than minimal recommended norms of healthy nutrition:

- vegetables - 102.5 kg/per capita/per year (67.9% of the minimal recommended norm),
- fruits - 47.4 kg/per capita/per year (52.7% of the minimal recommended norm).

A significant and, to some extent, critical recession of food consumption started in 1991 and continued until 2000. The period is characterised by the following records: the fruit consumption varied in the range 32.5% - 37.1% of the minimal recommended norm; the meat consumption - 41.0% - 48.6%; the fish consumption - 18% - 42.0%; the milk consumption - 52.4% - 64.1%; the eggs consumption - 57.2% - 58.9%; the vegetables consumption - 63.9% - 67.4%; the vegetable oil consumption - 63.1% - 72.3%. The consumption of sugar was not affected so much (83.2% - 96.8% of the minimal recommended norm), and the consumption of potatoes and bread even exceeded the recommended norms during the analysed period (99.7% - 109.2% and 127.1% - 123.7%, respectively). It is shown that the consumption of basic protein and vitamin containing products (meat, fish, milk and eggs and fruit) significantly decreased in comparison with 1990 almost two-fold and is characterised by overconsumption of bread, potato and sugar.

The economic recovery of 2000-2013 was marked by an increase in the basic agrarian food consumption. However, the level of basic agrarian food consumption has not reached the records of the early 1990. The group structure of agrarian food consumption changed in comparison to the year 1990 and its subdivision into groups was also transformed.

For example, *the first group* was composed of:

- potatoes - 135.4 kg/per capita/per year (109.2% of the minimal recommended norm),
- vegetables - 163.3 kg/per capita/per year (108.1% of the minimal recommended norm),
- bread and bakery products - 108.4 kg/per capita/per year (107.3% of the minimal recommended norm),

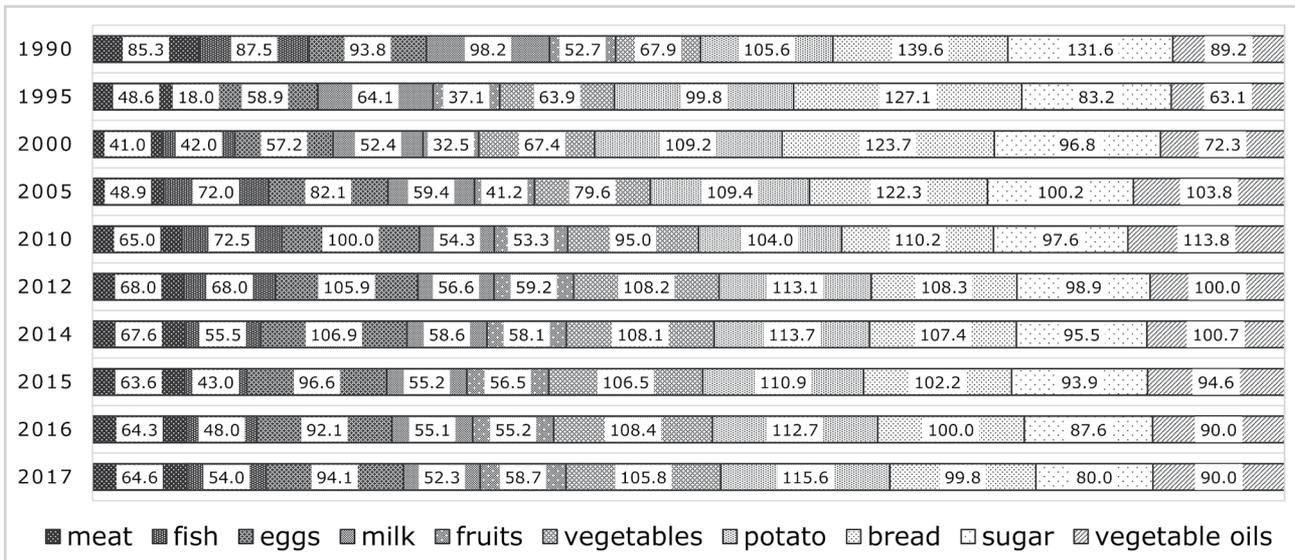


Fig. 1: The dynamics of agrarian food consumption in Ukraine during 1990-2017 (displayed in % of minimal recommended norm\*)

Note \* - Rational norm of consumption per 1 person a year, kg: meat and meat products - 80; fish and fish products - 20; eggs - 290 items.; milk and dairy products - 380; fruits - 90; vegetables - 151; potato - 124; bread and bakery products - 101; sugar - 38; vegetable oils - 13.

Source: Authors' calculation according to data of State Statistics Service of Ukraine

- eggs - 309 points/per capita/per year (106.6% of the minimal recommended norm),
- vegetable oil - 13.3 kg/per capita/per year (102.3% of the minimal recommended norm).

The second group included only sugar - 37.1 kg/per capita/per year (97.6% of the norm).

The third group was consisted of all important protein and vitamin containing foods:

- milk - 220.9 kg/per capita/per year (58.1% of the minimal recommended norm),
- fruit - 56.3 kg/per capita/per year (62.6% of the minimal recommended norm),
- meat - 56.1 kg/per capita/per year (70.1% of the minimal recommended norm),
- fish - 14 kg/per capita/per year (73.0% of the minimal recommended norm).

The deterioration of economic situation in 2014-2017 due to the antiterrorist operation in Donetsk and Luhansk regions and the annexation of the Crimea, affected the agrarian food market in Ukraine. In 2017, the consumption of «cheap» food has met the recommended norms, namely:

- potatoes - 143.4 kg/per capita/per year, or 115.6% of the minimal recommended norm,
- vegetables - 159.7 kg/per capita/per year, or 105.8% of the norm,
- bread - 100.8 kg/per capita/per year, or 99.8% of the minimal recommended norm.

The consumption of the so-called «expensive» products traditionally did not correspond to the recommended norm:

- meat and meat products - 51.7 kg/per capita/per year (64.6% of the minimal recommended norm),
- fruit - 52.8 kg/per capita/per year (58.7% of the minimal recommended norm),
- milk and dairy products - 200.0 kg/per capita/per year (52.3% of the minimal recommended norm),
- fish and fish products - 10.8 kg/per capita/per year (48% of the minimal recommended norm).

The level of other food consumption was close to the minimal recommended norm.

Therefore, the study has proved that during a long period Ukrainian people have been experiencing with the lack of food consumption, important for the human development (meat, milk, fish and fruit) and overconsumption of foods such as potato, vegetables, bread, eggs and vegetable oil.

Furthermore, we may conclude that such nutrition can have influenced the demographic situation in the country.

Consequently, the next step of our investigation was to analyse the dynamics of the main social and demographic indicators of human development during 1990-2017. It has been estimated that one of the principal demographic problems in Ukraine was a high level of population mortality, which was the major factor of Ukrainian depopulation. The overall death rate was potentially growing from 12.1‰ in the early 1990 up to 16.6‰ in 2005 (Figure 2). During the following decade (2005-2015), the death rate was reduced to 11%, and it decreased to 14.5‰ in 2017. According to the overall death rate, Ukraine was the leader among European countries. Thus, during the studied period, the death rate in Ukraine was 1.13-1.88 times higher than in the EU member states. In 2017, the death rate in Ukraine was higher than the corresponding indexes in Hungary (7.4%), Germany (28.3%), Poland (36.8%) and Switzerland (83.5%).

According to data from scientific literature, life expectancy at birth is considered to be an indicator of sufficient nutrition [8; 19; 20]. Thus the next step of our study was to evaluate life expectancy in Ukraine. In 1990, the life expectancy

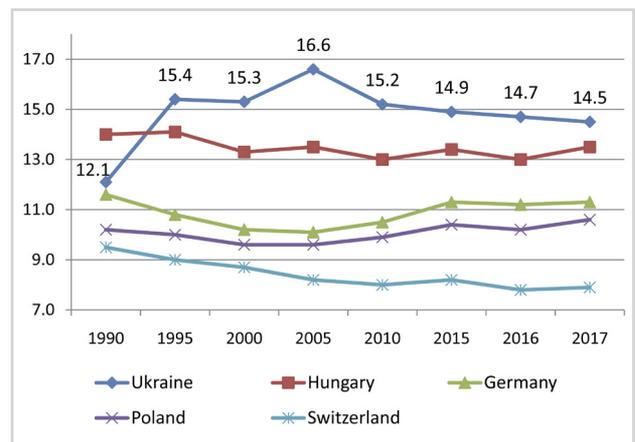


Fig. 2: The dynamics of the death rate in Ukraine and in some EU member states, per 1,000 of population

Source: Compiled by the authors based on State Statistics Service of Ukraine [32] and The World Bank Data [33]

at birth in Ukraine was 70.1 years, and was almost similar to the identical indexes in Poland and Hungary (Figure 3).

Although, while the life expectancy in most European countries was increasing annually, the life expectancy at birth in Ukraine had diminished from 70.1 to 68.0 by 2005 or by approximately 2 years. Since 2006, we have observed an upward trend in extending the life expectancy. The figures of early 1990 were renovated only in 2010 (70.3 years). In 2017, the life expectancy at birth in Ukraine was 71.8 years, however it didn't reach the indicators of the EU. The life expectancy at birth in 2017 was higher by 4.3 years in Hungary, 6.1 years in Poland, 9.2 years in Germany and 11.8 years in Switzerland than in our country.

The level of infant mortality is also one of the major indicators of the population mortality, which corresponds to the living standards and nutrition quality [23; 24]. The infant mortality rate was 16.6 children per 1,000 newborns in early 1990, which is by 9-10% higher than the relevant indexes in Hungary and Poland. Furthermore, it exceeds the relevant indexes in Germany and Switzerland by 2.4-2.5 times (Figure 4).

During 1990-1995, Ukraine experienced an increase in infant mortality rate, whereas our nearest neighbours, Poland and Hungary, have managed to diminish the level of infant mortality almost 1.2-1.4 times during the abovementioned period. After the crucial 1995 (17.4‰) the mortality rate of infants extensively decreased and reached the level of 7.5 children per 1,000 live births in 2017, which was lower by 2.2 times if compared with the year 1990. Despite the positive dynamics, the mortality rate of infants in Ukraine is still very high. In 2017, it exceeded the similar indexes of Poland by 1.88 times, Hungary - 1.97 times, Switzerland - 2.03 times and Germany - 2.42 times.

It has been proven that the deficiency of sustainable nutrition is closely connected with birth rate and infant morbidity and mortality [10; 14-15]. The significant reduction of birth rate recorded in Ukraine was from 12.7 per 1000 persons in 1990 to 9.40 in 2017, which indicates a decrease by 26.0% (Figure 5). The critical downfall of the birth rate continued until the year 2000. A gradually increasing birth rate was observed during 2001-2010. In 2017, the relevant indicator reached 9.4%. This even exceeded the corresponding data of Poland, Hungary and Germany.

One of the important indicators of the human development is the fertility rate (births per woman). Alike the prior index, the fertility rate in Ukraine during 1990-2000 underwent a decline from 1.84 to 1.11 children per 1 woman, or 39.7% (Figure 6). Nevertheless, a trend in women's negative attitude to birth during the underlined period was registered in Europe as well.

Since 2000, there has been a growth of the fertility rate in Ukraine, which extended to 1.37 children per 1 woman in 2017. In such terms, It is worth mentioning that Ukraine has reached Poland.

Consequently, the study has revealed the synchronism of alterations in the main social and demographic indicators of human development and changes in the basic agrarian food consumption in Ukraine during 1990-2017. Therefore, we need to estimate an interconnection between the emphasised demographic indexes and the consumption of basic agrarian foods (meat, milk, fish, eggs, bread and bakery products, fruit, vegetables, potato, sugar and vegetable oils) by statistic calculation.

Based on the conducted correlation analysis, it was estimated that the unsustainable level of meat and milk consumption was directly associated with demographic indicators such as the birth rate ( $r=+0.9471$  and  $+0.5699$  respectively,  $p<0.01$ ); the fertility rate ( $r=+0.9296$  and  $+0.6941$  respectively,  $p<0.01$ ), life expectancy at birth (meat  $r=+0.6732$ ,  $p<0.01$ ) and the mortality rate of infants (milk  $r=+0.4555$ ,  $0.01<p<0.05$ ). A reverse (negative) association was recorded between the meat and dairy products consumption and the death rate in Ukraine ( $r=-0.6023$  and  $-0.6830$  respectively,  $p<0.01$ ) (Table 1).

The absence of a direct impact of meat consumption on the indicators of depopulation (the death rate) can be

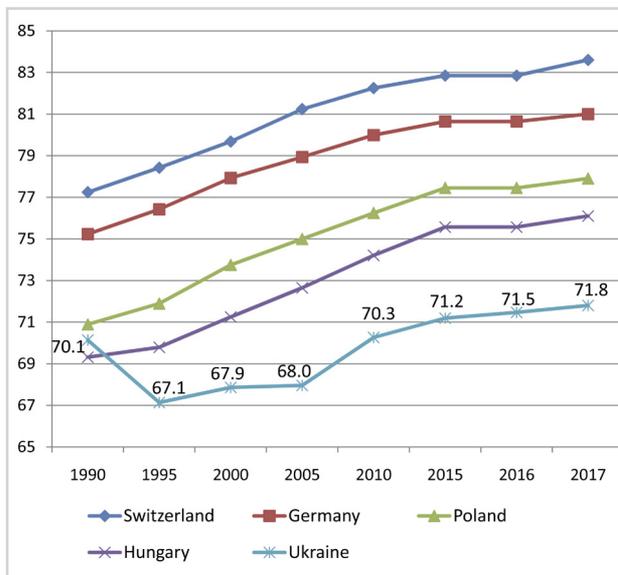


Fig. 3: The dynamics of life expectancy at birth in Ukraine and in some EU member states, total (years)  
Source: Compiled by the authors based on [32-33]

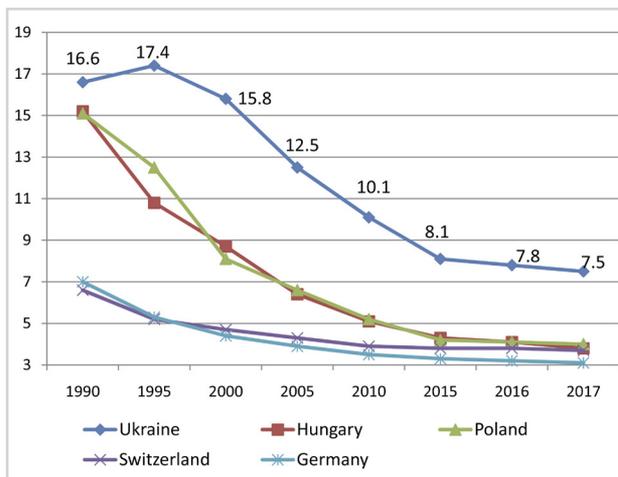


Fig. 4: The dynamics of mortality rate of infants in Ukraine and in some EU member states (per 1,000 live births)  
Source: Compiled by the authors based on [32-33]

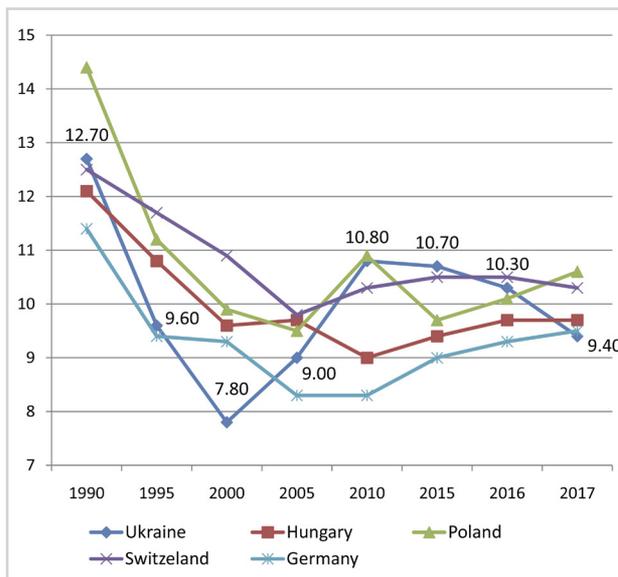


Fig. 5: The dynamics of birth rate in Ukraine and in some countries of EU, (per 1000 people)  
Source: Compiled by the authors based on [32-33]

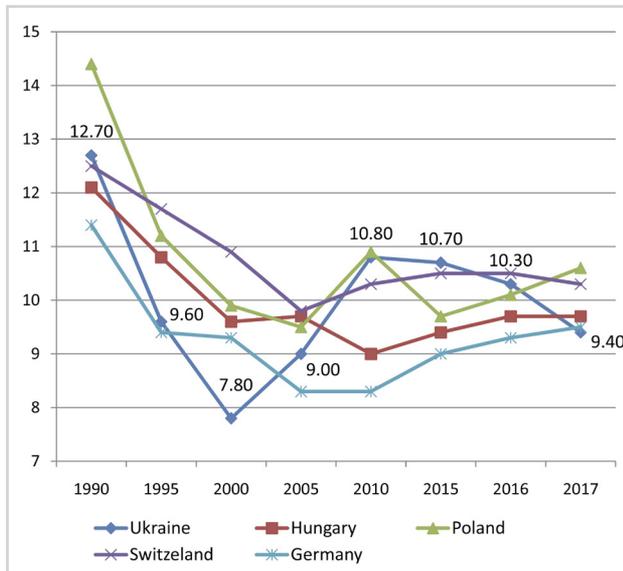


Fig. 6: The dynamics of fertility rate in Ukraine and in some EU member states, total (births per woman)  
Source: Compiled by the authors based on [32-33]

Tab. 1: The link between per capita/per year food consumption and the main demographic indicators of human development in Ukraine during 1990-2017 (Pearson's correlation coefficient (r))

| Food groups and beverages (units) | Indicators of human development of the Ukrainian population |   |                                      |  |  |
|-----------------------------------|---|---|--------------------------------------|--|--|
|                                   | Birth rate, crude (per 1,000 people)                        | Life expectancy at birth, total (years) | Death rate, crude (per 1,000 people) | Mortality rate, infant (per 1,000 live births) | Fertility rate, total (births per woman) |
| Meat (kg)                         | +0.9471**   | +0.6732**                               | -0.6023**                            | -0.3919  | +0.9296**                                |
| Milk (kg)                         | +0.5699**   | -0.0653                                 | -0.6830**                            | +0.4555*                                       | +0.6941**                                |
| Eggs (pieces)                     | +0.7348**   | +0.8285**                               | -0.1383                              | -0.8283**                                      | +0.5595**                                |
| Bread (kg)                        | +0.0244   | -0.6245**                               | -0.3565                              | +0.8849**                                      | +0.1273                                  |
| Potato (kg)                       | -0.0421   | +0.3766*                                | -0.1443                              | -0.4174*                                       | -0.0857                                  |
| Vegetables (kg)                   | -0.3657   | +0.8530**                               | +0.0999                              | -0.9729**                                      | +0.1923                                  |
| Fruits (kg)                       | +0.6912**   | +0.8309**                               | -0.2119                              | -0.7743**                                      | +0.5862**                                |
| Fish (kg)                         | +0.4091*  | +0.3801*                                | +0.1440                              | -0.5575**                                      | +0.1798                                  |
| Sugar (kg)                        | +0.6218**   | +0.0851                                 | -0.4136*                             | +0.1019  | +0.5890**                                |
| Vegetable oil (kg)                | +0.5065**   | +0.4791*                                | +0.2925                              | -0.7581**                                      | +0.2526                                  |

Note: \*\* $p < 0.01$ , \* $0.01 < p < 0.05$

Source: Compiled by the authors

interpreted as low consumption of this product in Ukraine throughout a long period of time. This fact is also supported by the data of medical studies which prove that the overconsumption of meat can result in an increase in the death rate due to higher frequency of cardiovascular diseases and cancer. Another reason for the weak association between unsustainable consumption of protein products and basic demographic factors of human development is the possibility of mutual substitute of protein containing food. In spite of the ambivalent (dual) effect of meat consumption on social and demographic indicators, the outcome of the study proves that there exists an association between the insufficient meat and milk consumption and the indicators of depopulation in Ukraine. It also concerns the consumption of milk and dairy products.

According to our data, the fish and fish products consumption had a moderate negative association with the mortality rate of infants ( $r = -0.5575$ ,  $p < 0.01$ ) and a positive association with the birth rate and life expectancy at birth ( $r = +0.4091$  and  $+0.3801$  respectively,  $0.01 < p < 0.05$ ). It can be explained by a continuous lack of fish consumption in Ukraine between 1990 and 2016 (18%-54% of the minimal recommended norm).

The consumption of eggs was directly linked to the life expectancy at birth, the birth rate and the fertility rate ( $r = +0.8285$ ,  $+0.7348$  and  $+0.5595$  respectively,  $p < 0.01$ ). There was a negative association between the eggs

consumption and the mortality rate of infants ( $r = -0.8283$ ,  $p < 0.01$ ). Therefore, the level of eggs consumption was also an important factor to increase the life expectancy and the birth rate in Ukraine. The cost and availability of eggs (the consumption rate in 2017 was 94.1% of the minimal recommended norm) triggered a high level of consumption and substitution of eggs with other health crucial protein containing products (meat, milk and fish), which finally resulted in the poor socio-economic state of the population in Ukraine.

The unsustainable level of fruit consumption in Ukraine corresponded directly with the life expectancy, the birth rate and the fertility rate ( $r = +0.8309$ ,  $+0.6912$  and  $+0.5862$  respectively,  $p < 0.01$ ). A negative association was recorded between the consumption of fruit and mortality rate of infants ( $r = -0.7743$ ,  $p < 0.01$ ). According to these data, the research indicates that the level of fruit consumption in Ukraine also triggered the extension of life expectancy.

Oppositely to the factors mentioned above, it should be stated that the overconsumption of «cheap» food products (bread, potato, vegetables, sugar and vegetable oils) could be a reason why the demographic situation in the country is negative. The study proves that the overconsumption of bread was positively correlated with the mortality rate of infants ( $r = +0.8849$ ,  $p < 0.01$ ) and negatively correlated with the life expectancy at birth ( $r = -0.6245$ ,  $p < 0.01$ ). It means that the exceeding consumption of bread and bakery products was one of the main triggers of a low life expectancy of the Ukrainian population.

The exceeding consumption of potatoes had a moderate positive association with the life expectancy at birth ( $r = +0.3766$ ,  $0.01 < p < 0.05$ ) and a negative association with the mortality rate of infants ( $r = -0.4174$ ,  $0.01 < p < 0.05$ ). The consumption of vegetables beneficially corresponds with the life expectancy at birth ( $r = +0.8530$ ,  $p < 0.01$ ) and negatively with the mortality rate of infants ( $r = -0.9729$ ,  $p < 0.01$ ). Such an outcome proves that there exists a significant association between the vegetable consumption and social and demographic indicators of human development. It should be mentioned that a low cost of vegetables in combination with a high level of self-provision with vegetables in Ukraine was a powerful reason of mutual substitution of fruit consumption.

The consumption of sugar and sugar-containing products had a positive association with the birth rate and the fertility rate ( $r = +0.6073$  and  $+0.5857$  respectively,  $p < 0.01$ ). A negative interconnection between the consumption of sugar and the death rate per 1,000 persons was registered ( $r = -0.4236$ ,  $0.01 < p < 0.05$ ). It means that the overconsumption of sugar could be a notable reason for the increasing death rate in Ukraine. The consumption of vegetable oils had a positive association with the birth rate ( $r = +0.5002$ ,  $p < 0.01$ ) and the life expectancy ( $r = +0.4791$ ,  $0.01 < p < 0.05$ ). A negative association was observed between the consumption of vegetable oils and the mortality rate of infants ( $r = -0.7153$ ,  $p < 0.01$ ).

A multivariate linear regression was applied to estimate the impact of consumption of all agrarian foods and the main social and demographic indicators of human development. According to the applied method, the level of interconnection between independent unchangeable data (the consumption of agrarian foods) and the variability of dependable changeable data (social and demographic indicators of human development) was identified. The results are shown in Table 2.

The multivariate linear regression has revealed a positive association between the consumption of meat and the life expectancy at birth ( $\beta = +0.359$ ; 95% CI 0.02 to 0.08;  $p < 0.001$ ),

**Tab. 2: The interconnection between the level of basic agrarian food consumption and main socio-demographic indicators of human development in Ukraine during 1990-2017; multivariate linear regression analysis**

| Items  | Positive    |         |                  |            | Negative       |         |                   |            |
|--|-------------|---------|------------------|------------|----------------|---------|-------------------|------------|
|  | Food groups | $\beta$ | 95% CI           | $p$ -Value | Food groups    | $\beta$ | 95% CI            | $p$ -Value |
| Life expectancy at birth, total (years)        | Meat        | +0.359  | (0.02 to 0.08)   | <0.001     |                |         |                   |            |
|  | Vegetables  | +0.689  | (0.03 to 0.05)   | <0/001     |                |         |                   |            |
| Death rate, crude (per 1,000 people)           |             |         |                  |            | Meat           | -0.358  | (-0.07 to -0.003) | 0.03       |
|  |             |         |                  |            | Milk           | -0.487  | (-0.02 to -0.004) | 0.006      |
| Mortality rate, infant (per 1,000 live births) |             |         |                  |            | Vegetables     | -0.860  | (-0.12 to -0.09)  | <0.001     |
|  |             |         |                  |            | Vegetable oils | -0.164  | (-0.44 to -0.09)  | 0.007      |
| Birth rate, crude (per 1,000 people)           | Meat        | +0.947  | (0.11 to 0.14)   | <0.001     |                |         |                   |            |
|  |             |         |                  |            |                |         |                   |            |
| Fertility rate, total (births per woman)       | Meat        | +0.789  | (0.012 to 0.018) | <0.001     |                |         |                   |            |
|  | Milk        | +0.250  | (0.001 to 0.002) | 0.002      |                |         |                   |            |

Source: Compiled by the authors

the birth rate ( $\beta = +0.948$ ; 95% CI 0.11 to 0.14;  $p < 0.001$ ) and the fertility rate ( $\beta = +0.789$ ; 95% CI 0.012 to 0.018;  $p < 0.001$ ). The observed negative impact was mostly associated with the death rate ( $\beta = -0.358$ ; 95% CI -0.07 to -0.003;  $p = 0.03$ ). Therefore, either sufficient or insufficient levels of the consumption of meat and meat products resulted in an essential impact on all demographic indicators of the Ukrainian population. Consequently, this aspect requires a detailed analysis from the point of view of its production capacity and people's financial ability to purchase it.

The consumption of milk and dairy products had a positive association with the fertility rate ( $\beta = +0.250$ ; 95% CI 0.001 to 0.002;  $p = 0.002$ ) and a negative association with the death rate ( $\beta = -0.487$ ; 95% CI -0.02 to -0.004;  $p = 0.006$ ). The consumption of vegetables had a remarkably positive association with the life expectancy at birth ( $\beta = +0.689$ ; 95% CI 0.03 to 0.05;  $p < 0.001$ ) and a negative association with mortality rate of infants ( $\beta = -0.860$ ; 95% CI -0.12 to -0.09;  $p < 0.001$ ). The consumption of vegetable oils has also resulted in a harmful impact on the mortality rate of infants ( $\beta = -0.164$ ; 95% CI -0.44 to -0.09;  $p < 0.001$ ).

In order to examine the meaningful portion of the impact of each of the factors on the variability of the resultative characteristics, we have conducted the decomposition of the general variability of food products into corresponding features (Table 3).

It has been discovered that food products create a variability of the mortality rate of infants of 96.1%; the fertility rate - 90.70%; the birth rate - in 89.92%; the life expectancy - 82.94% and the death rate - in 56.08%.

Thus, we can confirm the existence of a strong association between the consumption of the main agrarian foods and social and demographic indicators.

**6. Conclusions**

The current research is one of the first attempts to examine the impact of the consumption of basic agrarian foods on social and demographic indicators of human development in Ukraine during 1990-2017. It has been determined that the consumption of basic agrarian foods did not meet the minimal recommended norms during the period under research. We have identified a trend leading to significantly low consumption of «expensive» protein and vitamin-containing products (meat, milk, fish and fruit). Simultaneously, the tendency of «cheap» food consumption (bread, potato and vegetables) is topical. The misbalance of nutrition in Ukraine was estimated, due to insufficient protein consumption and overconsumption of fats and carbohydrates. As a result, the human body received not enough vitamins important for life, including protein and other nourishing elements. Our data suggest that the degrading nutrition of the consumption of agrarian foods corresponds to changes in the birth rate, the death rate, the life expectancy at birth and the

**Tab. 3: Decomposition of the general variability of the consumption of food products in Ukraine into features**

| Indicators  | Feature        | Pearson's correlation coefficient ( $r_{yx}$ ) | $\beta$ -coefficient ( $\beta_x$ ) | % ( $r_{yx} \times \beta_x \times 100\%$ ) |
|---|----------------|--|------------------------------------|--|
| Life expectancy at birth, total                   | Meat           | +0.6732  | +0.359                             | 24.17                                      |
|   | Vegetables     | +0.8530  | +0.689                             | 58.77                                      |
| Death rate, crude (per 1000 people)               | Meat           | -0.6311  | -0.358                             | 22.59                                      |
|   | Milk           | -0.6877  | -0.487                             | 33.49                                      |
| Mortality rate of infants, (per 1000 live births) | Vegetables     | -0.9729  | -0.860                             | 83.67                                      |
|   | Vegetable oils | -0.7581  | -0.164                             | 12.43                                      |
| Birth rate crude (per 1000 people)                | Meat           | +0.9471  | +0.947                             | 89.69                                      |
| Fertility rate, total (births per woman)          | Meat           | +0.9296  | +0.789                             | 73.35                                      |
|   | Milk           | +0.6941  | +0.250                             | 17.35                                      |

Source: Compiled by the authors

fertility rate in Ukraine. The correlation analysis was done to estimate associations between the extent to which the population of Ukraine is provided with agrarian food, as well as the relevant social and demographic indicators of human development. It has been identified that the basic triggers of all social and demographic indicators of human development in Ukraine were meat, milk, vegetables and fruit consumption. The other foods did not have a significant impact on the outcome of the research.

We presume that the extent to which the population of Ukraine is provided with basic agrarian foods has a considerable value for both maintaining health and wellness of the nation. Besides, it significantly impacts the demographic situation in Ukraine. The misbalance of nutrition is a reason for substantial disorders in human development - the high mortality, the low life expectancy and the high mortality rate of infants. This consequently highlights the importance of the expansion of the Ukrainian agrarian food market because such a market is responsible for food production, which is crucial for human beings. Our further investigations will be dedicated to the issues of interconnection between the production of agrarian foods and consumption of the latter, examining the association between the level of income and the purchasing capacity of the population in Ukraine.

**7. Limitations of the study**

The data sources of food consumption are summarised in the state statistical surveys, basing on of agricultural enterprises and household activities, industrial enterprises, wholesale and retail trade, foreign trade, as well as on the results of sample surveys considering living conditions of households and agricultural activities of households in rural areas [32]. The sectors of both the natural and shadow economies of Ukraine may affect the level of food consumption. This was not taken into account in the present study. Also, the results of this study have some limitations and weaknesses associated with a variety of objective and subjective factors. For example, our calculations do not take into account other food intakes (salt, spices or biological additives) which can affect social and demographic indicators.

Besides, the low life expectancy and high mortality rates may be attributed not only to nutritional factors, but also to a number of other factors (smoking, consumption of alcohol, physical activity, obesity, level of education, level of medical care, etc.).

This study has examined a relationship between the outcome and the exposure at the level of the population. At the same time, this association may not occur at the level of in-

dividuals. Also, in this study, we have evaluated the relationship between food consumption and social and demographic indicators in the same time period (same year). However, it is known that insufficiency of macro and microelements has a time-lag effect on the human body.

In conclusion, further research is needed to single out more accurate causative associations by using different statistical methods and models.

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