

THE EFFECTS OF THE PANDEMICS ON AGRICULTURE AND RURAL AREAS DEVELOPMENT: PAST EXPERIENCES

Alina Danilowska¹, associate professor

¹Warsaw University of Life Sciences-SGGW

Abstract. The paper aims to identify the economic effects of the pandemics on agriculture and rural areas' development in the past. Recognition of different aspects of the relationship between agriculture and the pandemic is a significant issue because it influences food security. The analysis considered three important pandemics from the past: Black Death, Spanish flu and AIDS. The literature review on the economic consequences of these pandemics was the research method in the study. From the analysed three pandemics, the most extensive and most positive results for the economy in the short and long run took place after Black Death, which was the deadliest. The economic consequences of the other two pandemics were the relatively short term and rather adverse. The reduction of human capital was a negative effect of these pandemics on an economy of a long-term nature. The response of agriculture to the pandemics depended on the size of the labour shortages and the role of agriculture in the economy. The reaction differed between countries. Aggregate agricultural production did not decline in absolute or per capita terms in many countries. However, in Africa, pandemics led to famine and malnutrition. The drop in the population increased the labour/capital and labour/land ratios. The labour shortages triggered adjustment processes in the form of wage increases and encouraged the introduction of innovations. During the pandemic, rural areas depopulated, and it took quite a long time to recover to the level before the pandemic.

Keywords: Black Death pandemic, Spanish Influenza, AIDS, pandemic effects, agriculture.

JEL code: N50, O11, O13

Introduction

In the 10 last years, the consequences of climate changes, mainly global warming, were the vital challenge agriculture faced. Many studies examined this phenomenon. Their results were published in thousands of scientific and popular publications. They became the basis for taking various actions to counteract the adverse effects. In 2020, the COVID19 pandemic reminded us of another type of threat that has to be considered in the future - pandemics. They can be of different severity, territorial range and duration.

Although pandemics with a large territorial scope occurred in the past many times (Bell C., Lewis M., 2005, Maddison A., 2006), until a few years ago, they were considered a short-lived, sporadic crisis of national or regional range. Garret T.A. (2007) points out that the most severe pandemic of today, the Spanish flu pandemic, has been forgotten in the USA. In Poland, economic history textbooks hardly mention it. The two-year COVID19 pandemic, due to its global scope and duration, has shown that the phenomenon must become the subject of systematic scientific research aimed at acquiring knowledge about the impact of the pandemic on the economy and counteracting adverse outcomes at the regional, national and global levels. The influence of this phenomenon on agriculture should be an area of comprehensive study. Recognition of various aspects of the relationship between agriculture and the pandemic is a vital task because food security (defined as the provision of an adequate amount of food for the society of a single country or on a global scale if the pandemic is global) is a crucial problem the humanity faces. The research aims to identify the economic effects of the pandemic in the past on agriculture and rural areas and to analyse them comparatively.

The chief research method used in the study is a review of the literature on the economic aspects of the past pandemics, relating to agriculture as a branch of the economy and rural areas as a place of agricultural activity. Of the many pandemics that have occurred in the past, the study included three significant

1 alina_danilowska@sggw.edu.pl

pandemics from different periods: the Black Death in the 14th century, the Spanish Flu in 1918-1920, and AIDS in the 1980s and 1990s.

Many studies are devoted to the economic aspects of the selected pandemics. However, due to the distance in time, the figures for Black Death are scarce, and the information about its course and effects mainly relates to Western Europe. For the Spanish flu, the statistics are also limited. There is also the problem of separating its outcomes from the consequences of World War I. It is probably the main reason for the lack of such analysis for European countries. There are relatively many studies on its economic effects on the USA economy and the economy of India, which was the country most affected by the pandemic. Since the AIDS pandemic was and continues to be particularly severe for the countries of Asia and Arica, the research focuses mainly on the effects on these countries' economies.

The research is to answer the following questions: (i) what were the consequences of the pandemics for the economy in the short and long term with particular emphasis on agriculture and rural areas; (ii) whether agriculture as a sector of the economy was susceptible (sensitive) to pandemics; (iii) whether any regularities in the impact of the pandemic on agriculture in the past occurred.

The article is organised as follows. In the beginning, pandemics selected for analysis were characterised. The focus was on the similarities and differences. Then, the influence of each pandemic on the economy in the short and long term was shown. The third part of the article examines the consequences of the pandemics in agriculture and rural areas.

Research results and discussion

Characteristics of the selected pandemics

The epidemic known as the Black Death was probably the most deadly epidemic that hit humanity (DeWitte S., 2014). It broke out in 1347 and lasted until 1351 (Table 1). The Mongol invasion and the siege of the city of Kaffa in Crimea was its source. The disease was used as a biological weapon against the defending citizens. The refugees from this city transferred the germs to other regions of Europe (Shipmen P.L., 2014). The epidemic spread quickly across Europe, from Sicily to Norway, North Africa and Asia via merchant ships. It affected everyone, regardless of gender, age or social position. The death occurred within days of infection, and the mortality rate was very high. It amounted to 72 to 100%. Research by DeWitte S. (2014) shows that the most susceptible to the disease (death) of elderly persons and those in worse physical condition was. This disease was a tool of natural selection, and as such, it eliminated weaker human beings on an unprecedented scale and territorial range. The number of victims was estimated at 75-200 million. As a result, the population of Europe decreased by 30 to 50% (Jedwab et al., 2019).

Table 1

The pandemics characteristics: Black Death, Spanish flu, AIDS

No	Specification	Black Death	Spanish flu	AIDS
1.	Time	1347-1351	April, 1918- April, 1920	1981-2000
2.	Number of cases	x	500 000 000	36 000 000
3.	Number of deaths	75-200 000 000	50 000 000	22 000 000
4.	Number of cases/ Number of deaths	72-100%	5-10%	100% (to development of therapy)
5.	Fall in population	30-50%	2% of world population	0,3% of world population
6.	Highest risk group	Elder and in worse physical conditions people	Health people	Men (except for Africa), drug users, sexual minorities
7.	Others	The short period between illness and death Higher mortality in cities	Extreme virulence	A period of several years between infection and symptoms leading to death

Source: author's elaboration based on Alfani, 2020; Benedictow, O.J. 2021; Erkoreka, A. 2009; Garret T.A. 2007; Rout 2022; Shipman 2014; UNAIDS/WHO 2000; UNAIDS 2000; De Witte S. 2014

The Spanish flu pandemic was the most famous and deadly in modern times due to its territorial scope and number of victims. It broke out among American soldiers stationed in France in early April 1918. Malheiro A.H. (1921) mentions that it also appeared among British and German soldiers in April. Spain was the first country where the flu spread among the civilian population and caused massive deaths. That is why this flu was called the Spanish flu. From Spain, it was "exported" to the USA, and in the second half of 2018 to France, Germany and other European countries. Very soon it occurred in Asia, Africa and Australia. It lasted two years. The number of cases during this pandemic amounted to 500 million (one-third of the world's population), with at least 50 million fatalities (Centers for Disease, 2022). Its characteristic feature was the high mortality rate of young people aged 20-40 (i.e. in productive age) in good health. The mortality of men was also higher than that of women (Garret T.A., 2007). To limit the spread and overcome the pandemic, non-pharmaceutical measures were mainly used, such as isolation, quarantine, personal hygiene, disinfection or restriction of gatherings, but they were applied unevenly. The epidemic reduced the world's population by about 2%, but the differences between countries were significant. In Kenya, the population loss was estimated at 5.8%, and in India at 5.2%. This ratio for the USA was 0.52%. In Europe, it was below 1% in most countries.

The AIDS pandemic occurred in the second half of the 1980s and 1990s. The first case of AIDS was diagnosed in the USA in June 1981, although cases of the disease had occurred many years earlier. In 2000, did the number of new cases fall for the first time (UNAIDS, 2021). According to Knight L. (2008), no one at the time suspected that these few incidents were the beginning of a pandemic. What is important, the disease has not been eliminated and continues to be a severe problem in many African countries. Its territorial range was and still is significant. Although the number of AIDS cases in many European countries was high, the pandemic mainly affected African and Asian countries. As is estimated in 2000, there were already approximately 36 million carriers and sick people, of which 25.3 million lived in Sub-Saharan Africa and almost 6 million in South and South-East Asia. Carriers and patients accounted for 8.8% of the Sub-

Saharan Africa adult population and 0.56% of South and South-East Asia (UNAIDS, 2000). The disease affected middle-aged people, mainly men (except for Africa) and people from sexual minorities. Initially, various types of restrictions on the movement of carriers and patients were the primary technique for preventing its spread. Until the development of therapy, AIDS was a disease that ended in death.

The impact of the pandemics on the economy

The main factor behind the short- and long-term economic changes that followed the Black Death was the enormous decline in the population and hence the labour force. In the short term, the plague reduced the population by half. It was a real demographic shock. The decrease in population due to disease, as opposed to the sharp reductions due to war, was not accompanied by the destruction of fixed assets or a decrease in available agricultural land. As a result of the population decline, the ratio of work to capital and labour to land increased significantly. Even during the pandemic and shortly after it, there was a significant increase in luxury consumption. Plenty of different kinds of goods was left by the deceased, so the prices of goods fell (Thompson, J.W. 1921). Quite soon, the surplus was consumed. Next, as a collapse in the production of goods took place, their prices increased rapidly. A movement of people from regions with lower mortality to those with higher mortality, and therefore more depopulated occurred (Jedwab R. et al., 2019). In some industries, the decline in the population of skilled craftsmen was an incentive for workers to reskill. The enormous labour shortage pushed up wages. It was accompanied by a significant quantitative and qualitative improvement in the population's diet. In the long term, a general increase in living standards ensued. According to Voigtländer N. and Voth H.J. (2012), the initial increase in wages due to shortages of labour, and in effect, the income surge of a majority of the population has become a permanent phenomenon.

It stemmed from the so-called "Horsemen effect"². The growth in costs because of the rise in wages, combined with the labour deficit, was an incentive to introduce technological innovations. The surge in society's incomes strengthened the pressure on the production of consumer goods, contributing to the formation of a consumer-oriented economy. Considering the economic and social effects of the pandemic, the conclusion can be drawn that the pandemic accelerated the collapse of feudal economic structures. It also had a positive impact on the dynamics of the development of the capitalist economy.

The assessment of the economic effects of the Spanish flu pandemic is difficult due to the overlapping of the effects of World War I and the diverse economic situation of countries affected by the pandemic. An attempt to separate these effects in the short term was made in the publication of Barro R.J. et al. (2020). According to the authors' estimates, the influenza pandemic during its duration caused a decrease in GDP per capita by 6% in the typical country, and consumption per capita by 8%. There was also a decline in the rate of return on investments in shares and treasury bills. Additionally, the increase in real wages in industry Garret T.A. (2007) is indicated as the immediate short-term effects of the pandemic. As in the Black Death pandemic, it was the result of a decline in labour supply. The Spanish flu was less lethal compared to the Black Death, but mostly hit people of working age. As a result, the decrease in the labour force was, in relative terms, much higher than the decrease in the population. This resulted in an increase in the marginal product of labour and capital per employee. However, as mentioned, the effects of the pandemic varied between countries. In Sweden, according to Karlsson M. et al. (2014), wages did not increase. The temporary or final loss of the primary breadwinner by households, which resulted in their impoverishment, should be considered an adverse effect of the pandemic, mainly in the short term (Garret

² Pandemics, wars and urbanization did not allow for growth of population.

T.A., 2007). It concerned a significant percentage of households in the USA as victims of the pandemic were mainly men of working age.

The assessment of the long-term effects of the pandemic varies. On the one hand, studies by Brainerd E. and Siegler M. (2003) indicate that in the United States, the influenza pandemic had a positive impact on the growth of GDP per capita during the 1920s. On the other hand, Garret T.A. (2007) based on Almond's D. (2006) research findings points out that the pandemic could have adverse effects on the economy in the long term. They resulted from the decline in human capital due to the pandemic because the flu negatively affected the physical and mental condition of children born during the pandemic. It seems that this reflection could be extended to other countries affected by the pandemic.

In general, researchers of the problem believe that the effects of the Spanish flu pandemic, at least in the USA, were short-lived (Garret T.A., 2007).

The macroeconomic effects of the AIDS pandemic are ambiguous and vary depending on the assumptions adopted by the authors of the research and the countries studied (Jonung L., Roeger W., 2006). In countries with a low percentage of patients, this impact was minimal. In the context of large surpluses of labour in countries more affected by the pandemic, AIDS-related workforce reduction cannot be treated as an economic shock. However, it did matter. Three main channels of AIDS transmission to the economy were indicated (Robalino D.A. et al., 2002). The first is premature deaths that affect the size and composition of the labour force. It is intensified by the fact that the AIDS pandemic has hit the best-educated workers more severely. The second channel is growth in morbidity, which affect total factor productivity. The third channel operates through potentially lower saving rates. The low savings rate harms investment and, as a result, the economic growth rate. Through these three channels, the AIDS pandemic was slowing economic growth. Stover J. and Bolinger L. (2006) indicated that in Sub-Saharan African countries, economic growth could be reduced by as much as 25 per cent over 20 years. According to a research review by Robalino D.A. et al. (2002), in countries with higher than 5 % prevalence rates, the reductions in per capita GDP growth rates could be 0.5% to 1.5% per year. The ILO report (2003) predicted that GDP in the hardest-hit countries has might decline by 8% by 2010. However, not all studies lead to such pessimistic conclusions. Yung A. (2004) argues that the decline in labour supply increases per capita living standards. It is in line with the findings on the economic results of the Black Death.

The effects of the pandemic on agriculture

The Black Death pandemic had a significant impact on agriculture and the rural areas. However, the pandemic outcomes did differ from country to country. In Central and Eastern Europe countries, such as Poland, with a lower level of urbanization - lower population density, the pandemic was less severe (Zientara B. et al., 1988). The pandemic resulted in a significant decline in the rural labour force, with various socio-economic effects. An important phenomenon in Western Europe was the reduction in the mobility of serfs because, in the situation of the decline of the labour force, landowners tightened the conditions for peasants to leave their manors. Landowners also made attempts to introduce laws limiting the growth of wages. The problem, however, was the enforcement of landowners' rights. Due to the higher mortality rate, cities were more affected by depopulation than rural areas. The deserted cities offered immediate housing opportunities, encouraging people to leave the village and live in the city. This possibility caused further depopulation in the rural regions (Brenner R., 1985). In Norway, due to the decline in the rural population, interest in settling decreased, rents and taxes based on them decreased, and land prices fell by half (Benedictow O.J., 2016).

In the longer term, the reduction in the number of people and an increase in incomes mentioned above resulted in a rapid increase in demand for consumer goods, including food. The demand pressure pushed

prices up. The price rise encouraged increasing production. The long-term outflow of people from the countryside to the cities stabilized the income of the rural population. Population in rural areas did not return to the pre-pandemic state until the beginning of the 17th century (Jedwab R., 2019). Depopulation of rural areas and the abandonment of marginal lands increased forest and pasture areas. From the fact that cities revived faster than the rural areas (from the perspective of the return to the scale of land use before the pandemic), Jedwab R. et al. (2019) concluded that tendency to replace peasants with animals or technology in agriculture occurred. In the long term, the economic situation of the rural population improved.

Like Black Death, the Spanish flu mainly influenced agriculture and rural areas by reducing the rural population. However, its impact varied between countries. In most countries, even those hard hit by the pandemic, such as India or Indonesia, agricultural production did not decline because the survivors had additional land to cultivate (Schultz, T.W. 1967, Donaldson D., Keniston D., 2016). However, according to Schoenbaum S.C. (2001), in many areas, the impact of the pandemic was prominent, leading to a shortage in food supply on the one hand and a rise in prices of food items and other supplies on the other hand. However, it should be noted that certain branches of agriculture, especially those based on hired labour, could have been more affected by its decline. An example is the drop in sugar production in Java in 1919 (Gallardo-Albarran D. and De Zwart P., 2021). Java aggregate food production did not decline, but sugar production, which was substantial, fell in 1919. A different situation compared to Java took place in Africa. In many of its regions, due to disease and the death of the rural population, sowing and harvesting were reduced, leading to hunger and malnutrition in large areas: Tanzania, South Africa, Nigeria. In addition, an adaptation reaction took place. Farmers switched to fast-growing varieties of maize or beans. For example, in Nigeria, they changed the cultivation of yams to cassava as a less labour-intensive plant. (Ellison J.G., 2003, Phillips H., 2017).

The AIDS pandemic primarily affected the underdeveloped countries of Sub-Saharan Africa and Asia. A considerable role of the agricultural sector in the economy was and still is the specificity of these countries' economies. It is expressed by a large share of agriculture in creating the national product and in employment. Since the number of HIV carriers and AIDS sufferers was significant in the 1980s and 1990s, the problem affected a substantial portion of households. The negative impact channels were varied. The reduction in labour supply, especially during the planting and harvesting seasons, combined with the traditional division of labour between women and men, resulted in a significant decrease in commercial agricultural production, especially on small farms, with consequences for the total supply of farm products. The burden on farms with the costs of treatment and care for the sick and funerals reduced savings and investments (Stover J., Bollinger L., 1999). The loss of skilled workers was an additional channel of adverse long-term effects of AIDS on agriculture. Unfortunately, the problem of AIDS, especially in Sub-Saharan Africa, is not overcome yet due to complex socioeconomic reasons.

Conclusions

- 1) The analysis indicates that pandemics influenced the economy in the short term, mainly due to a decrease in labour. The long term outcomes depended on the size of the demographic shock. The bigger shock, the broader scope of adjustment of the economy to it occurred.
- 2) The evaluation of the pandemic results is complex. From the analysed three pandemics, the most extensive and most positive results for the economy in the short and long term took place after Black Death, which was the deadliest. The economic consequences of the other two pandemics were the relatively short term and rather adverse.

- 3) The reduction of human capital was a negative effect of analysed pandemics on an economy of a long-term nature.
- 4) The response of agriculture to the pandemics depended on the size of the labour shortages and the role of agriculture in the economy. The reaction differed between countries. Aggregate agricultural production did not decline in absolute or per capita terms in many countries. However, in Africa, pandemics led to famine and malnutrition. The drop in the population increased the labour/capital and labour/land ratios. The labour shortages triggered adjustment processes in the form of wage increases and encouraged the introduction of innovations.
- 5) During the pandemic, rural areas depopulated, and it took quite a long time to recover to the level before the pandemic.

Acknowledgements

The publication financed from state budget under the project of the Ministry of Education and Science "Science for Society" No NdS/532598/2021/2022. Total project's value 290 950,00 PLN (Poland).

Bibliography

1. Alfani, G. (2020). The Economic Consequences of Plague: Lessons for the Age of Covid-19. History and Policy. <https://www.historyandpolicy.org/policy-papers/papers/the-economic-consequences-of-plague-lessons-for-the-age-of-covid-19> (Access 10.03.2022).
2. Almond, D. (2006). Is the 1918 Influenza Pandemic Over? Long-Term Effects of In Utero Influenza Exposures in the Post-1940 U.S. Population. *Journal of Political Economy*, Volume 114, No 4, pp. 672-712.
3. Barro, R.J., Ursua, J.F., Weng, J. (2020). The Coronavirus and the Great Influenza Pandemic: Lessons from the "Spanish Flu" for the Coronavirus's Potential Effects on Mortality and Economic Activity. NBER Working Paper. No. 26866.
4. Bell, C.L., Lewis M. (2005). The Economic Implications of Epidemics Old and New. SSRN Electronic Journal, January 2005, DOI: 10.2139/ssrn.1112799
5. Benedictow, O.J. (2016). The Black Death and Later Plague Epidemics in the Scandinavian Countries: Perspectives and Controversies. Warsaw, De Gruyter Open.
6. Benedictow, O.J. (2021). The Complete History of the Black Death. The Boydell & Brewer, Woodbridge.
7. Brainerd, E., Siegler, M. (2003). The Economic Effects of the 1918 Influenza Epidemic. CEPR Discussion Papers, No 3791, p 41.
8. Brenner, R. (1985). *Agrarian Class Structure and Economic Development in Pre-Industrial Europe*. in: Aston T.H., Philpin C.H.E. The Brenner Debate. Agrarian Class Structure and Economic Development in Pre-Industrial Europe, Cambridge University Press, pp10-63.
9. Centers for Disease Control and Prevention (n.d.). Retrieved: <https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html> (Access: 10.03.2022).
10. Donaldson, D., Keniston, D. (2016). Dynamics of a Malthusian Economy: India in the Aftermath of the 1918 Influenza. *NBER Working Paper*, No 027673.
11. Ellison, J.G. (2003). "A Fierce Hunger": Tracing the Impacts of the 1918-1919 Influenza Pandemic in Southwest Tanzania in: The Spanish Flu Pandemic of 1918: New Perspectives (Eds.) Phillips, H., Killingray, D., Routledge New York, pp. 221-229.
12. Erkoreka, A. (2009). Origins of the Spanish Influenza Pandemic (1918-1920) and its Relation to the First World War. *Journal of Molecular and Genetic Medicine: an International Journal of Biomedical Research*, Volume 3, Issue 2, pp. 190-194.
13. Garrett, T.A. (2007). *Economic Effects of the 1918 Influenza Pandemic. Implications for a Modern-day Pandemic*. Federal Reserve Bank of St. Louis, St. Louis, USA. Retrieved: https://www.stlouisfed.org/~media/files/pdfs/community-development/research-reports/pandemic_flu_report.pdf (Access: 10.03.2022).
14. Gallardo-Albarran D, De Zwart, P. (2021). A Bitter Epidemic: The Impact of the 1918 Influenza on Sugar Production in Java. *Economics and Human Biology*, Volume 42, p. 107710.
15. ILO Programme on HIV/AIDS and the World of Work (2003). Workplace Action on HIV/AIDS: Identifying and Sharing Best Practice.
16. Jedwab, R., Johnson, N.D., Koyama, M. (2019). Pandemics, Places, and Populations: Evidence from the Black Death. *CESifo Working Paper*, No. 7524.
17. Jonung, L., Roeger, W. (2006). The Macroeconomic Effects of a Pandemic in Europe - A Model-based Assessment. *Economic Papers*, No° 251, Directorate-General for Economic and Financial Affairs European Commission Directorate-General for Economic and Financial Affairs.

18. Karlsson, M., Nillson, T., Pichler, S. (2012). What Doesn't Kill You Makes You Stronger? The Impact of the 1918 Spanish Flu Epidemic on Economic Performance in Sweden, *Darmstadt Discussion Papers in Economics*, No. 211, Technische Universität Darmstadt, Department of Law and Economics, Darmstadt.
19. Knight, L. (2008). *UNAIDS: the First 10 Years, 1996-2006*. UNAIDS/07.20E/ JC1262E, Geneva, Switzerland.
20. Maddison, A. (2006). *The World Economy. A Millennial Perspective*. OECD Publishing.
21. Malheiro, A.H. (2021). *A Gripe. Estudo De Epidemiologia*. Faculdade de Medicina do Porto.
22. Phillips, H. (2017). *Influenza Pandemic (Africa)*. 1914-1918 International Encyclopaedia of the First World War, https://encyclopedia.1914-1918-online.net/pdf/1914-1918-Online-influenza_pandemic_africa-2014-10-08.pdf, (Access 12.03.2022).
23. Pineo, R. (2021). Four Flu Pandemics: Lessons that Need to Be Learned. *Journal of Developing Societies*, Volume 37, No 4, pp. 398-448.
24. Robalino, D.A., Jenkins, C., El Maroufi, K. (2002). The Risks and Macroeconomic Impact of HIV/AIDS in the Middle East and North Africa. *Policy Research Working Paper*, No 2874, The World Bank Middle East and North Africa Region, Human Development Group.
25. Routt, D. (2008). *The Economic Impact of the Black Death*. EH.Net Encyclopedia, Retrieved: <https://eh.net/encyclopedia/the-economic-impact-of-the-black-death/> (Access 10.03.2022).
26. Schoenbaum, S.C. (2001). The Impact of Pandemic Influenza with Special References to 1918. *International Congress Series*, Volume 1219, pp. 43-51.
27. Schultz, T.W. (1967). Significance of India's 1918-19 Losses of Agricultural Labour - A Reply. *The Economic Journal*, Volume 77, No. 305, pp. 161-163.
28. Shipman, P.L. (2014). The Bright Side of the Black Death. *American Scientist*, Volume 102, No 6, pp. 410-413.
29. Stover, J., Bollinger L. (2006). In: The Economic Impact of AIDS. In: Columbus, F.H., Wusu, O. (eds.) *Politics and Economics of Africa*, Volume 5, Nova Sciences Publisher Inc., New York.
30. Thompson, J.W. (1921). The Aftermath of the Black Death and the Aftermath of the Great War. *American Journal of Sociology*, Volume 26, No. 5, pp. 565-572.
31. DeWitte, S. (2014). Mortality Risk and Survival in the Aftermath of the Medieval Black Death. *PLoS ONE* 9:e96513.
32. DeWitte, S. (2015). The Anthropology of Plague: Insights from Bioarcheological Analyses of Epidemic Cemeteries. *Arc Humanities Press: The Medieval Globe*, Volume 1, Inaugural Double Issue, pp. 97-123.
33. Voigtländer N., Voth, H.J. (2013). The Three Horsemen of Riches: Plague, War, and Urbanization in Early Modern Europe. *Review of Economic Studies*, Volume 80, Issue 2, pp. 774-811.
34. UNAIDS/WHO (2000). AIDS Epidemic Update. Retrieved: https://data.unaids.org/publications/irc-pub05/aidsepidemicreport2000_en.pdf (Access: 10.03. 2022).
35. UNAIDS (2021). HIV Estimates with Uncertainty Bounds 1990-Present.
36. Young, A. (2004). The Gift of the Dying: The Tragedy of Aids and the Welfare of Future African Generations, *NBER Working Paper*, No. 10991
37. Zientara, B. Maczak, A., Ihnatowicz, I., Landau, Z. (1988). *Dzieje gospodarcze Polski do 1939 r.* (Economic History of Poland til 1939). Wiedza Powszechna, Warszawa.