

Grain Yields and the Causes of the Russian Revolution

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In the study of the causes of the Russian Revolution, the problem of the standard of living of the population plays an important role. This problem, in turn, is linked to the question of agricultural productivity. In modern historiography, both domestic and foreign, the thesis of the growing productivity of Russian agriculture in the post-reform period is considered proven - and in particular the increase in grain yields. This thesis is based on the well-known works of V.G. Mikhailovsky, V.M. Obukhov and A.S. Nifontov, in which time series of grain yields in European Russia were constructed on the basis of official statistics. Meanwhile, the opinion of the experts of the 1901 Commission is well known, who believed that the increase in yields recorded in official statistics was explained by the improvement in the system of collecting harvest data. Reforms to improve the survey system were carried out in 1870, 1883 and 1893. The author examines the dynamics of 4-year averages and shows that when 4-year periods containing the years indicated are excluded from consideration, the yield in the remaining time intervals does not increase. In other words, the increase in yield in the time series shown was explained by more detailed accounting.

The period 1893-1914 is considered separately, when it is assumed that the yield data were quite accurate and no new reforms were made in the field of their collection. Previously it was assumed that the yield, calculated by the regression coefficient of the linear model, increased by 12% during this period. The author conducts a more detailed analysis and shows that the regression coefficient used previously is statistically insignificant. Thus, the claim of an increase in returns over this period cannot be statistically substantiated. Perhaps the return was a random variable independent of time.

The paper also examines the dynamics of gross cereal yields per capita and shows that average per capita yields did not increase between 1893 and 1914.

Thus, the prevailing opinion about the growth of agricultural productivity in Russia in the post-reform period needs to be revised.

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The question of the causes of the Great Russian Revolution is still one of the most important questions determining the world view of the Russian population. Until the end of the 20th century, most experts believed that the main cause of the social crisis was overpopulation, which led to a decline in the population's standard of living. This view was in line with the provisions of the later demographic-structural theory - i.e. the processes taking place in Russia reflected the general patterns of development of pre-industrial societies (Goldstone, 1991; Turchin, Nefedov, 2009).

However, at the end of the nineteenth century, first in foreign and then in Russian historiography, the opinion gained popularity that in the last decades of the Russian Empire the processes of modernisation began to influence the development of traditional society. Modernisation gradually raised the standard of living, and there were no economic reasons for the revolution; the revolution was caused by a confluence of political circumstances. The proponents of this view were called "optimists", while the traditionalists began to be called "pessimists". A debate between "pessimists" and "optimists" developed, which has an important place in modern Russian historiography.

The main argument of the "optimists" was the increase in grain productivity recorded in documents in the period after 1861. The question of whether grain yields increased in post-reform Russia remained controversial for a long time. In 1901, by imperial order, the "Commission for the Study of the Question of the Movement from 1861 to 1900 of the Welfare of the Rural Population of the Average Agricultural Provinces in Comparison with Other Localities in European Russia" was created. The commission was headed by Deputy Finance Minister V. N. Kokovtsov. More than one hundred economists and statisticians were involved in the work. A great deal of work was done to collect and process crop data in 50 provinces of European Russia, the result of which was a well-known statistical collection that serves as a valuable source for characterizing the socio-economic development of these territories (Materials, 1906). The statisticians used, to a large extent, unpublished materials from ministries and departments that have not survived to this day, so their findings are of particular value.

The Commission noted the increase in crop yields recorded in the documents, but its conclusion was rather sceptical: "A steady increase in crop yields from decade to decade... would suggest that agricultural production is gradually improving. This conclusion, however, seems doubtful when one considers... the ploughed and exhausted state of the peasants' allotments... A more probable explanation... seems to be... the improvement of the data on the grain harvest in the last decade compared with the previous period, when the harvest statistics were in such a disorderly state that the data on the grain harvest were extremely unreliable' (ibid., Part 3: 198-199).

It should be noted that we are talking about the improvement of crop statistics in the "last decade" of the 19th century. As for the previous period, according to the statisticians who collected the harvest data at that time, the data were characterised by "extreme unreliability". The data for this period were taken from the governors' reports, which measured the harvest in "sams" (the ratio of harvest to sowing). In addition, the Commission noted the unreliability of the material from the 1860s and 1870s in particular (*ibid.*, Part 3: 198-266). In 1866, the director of the newly created Central Statistical Committee (CSC), P.P. Semenov, wrote in the first issue of the Statistical Timeline of the Russian Empire that the editors had decided not to publish the available harvest data "because they did not find in it any guarantees of even approximate accuracy". "All our information on grain harvests amounts to complete guesswork" (*Statistical Timeline*, 1866: 22). At Semenov's insistence, a new, more detailed form for harvest data was included in the governor's reports in 1870, after which harvest data began to be published (*Collection of Information*, 1879: 1-3).

However, the accuracy of this data remained questionable, so in 1883 the CSC organised a collection of material independent of the Governor's reports by surveying local producers. At the same time, the Department of Agriculture and Rural Industry began to collect sample harvest data. The well-known agricultural expert A. F. Fortunatov calculated that the rye yield for 1883-1889 according to the governors' reports was 6.9% lower than according to the CSC, while the figures provided by the Department of Agriculture exceeded the CSC data by 20% (Fortunatov, 1893: 46-48). It was thus recognised that the governors' reports were underestimated, but the Central Statistical Committee's data were also called into question. Finally, in 1893, another reform was carried out in the area of collection and recording of harvest data (Nefedov, Ellman, 2024). Although sceptical judgements were sometimes expressed even after this reform (Ivantsov, 1915), in the 1920s an expert from the Soviet Central Statistical Administration, N. Vinogradova, following a detailed statistical analysis, finally concluded that since the late 1890s 'the data of the Central Statistical Committee have determined the level of the harvest very close to reality' (emphasis added by N. Vinogradova) (Vinogradova, 1926: 90).

The 1901 Commission, despite its extreme scepticism, nevertheless published ten-year averages for the 1860s and 1870s (along with more precise data for the 1880s and 1890s). In 1921, the head of the statistical department of the Moscow City Council, V. G. Mikhailovsky, stated that 'the data collected in Russia by administrative bodies... since 1802 are closer to the truth than statisticians usually think' (Mikhailovsky, 1921: 2-8). Using data from governors' reports up to 1883 and subsequent data from the Central Statistical Committee, he produced a year-by-year series of rye yields in 'sams' for 1801-1912. Mikhailovsky concluded that

"since 1863 the average yield has increased rapidly" (ibid: 2). Based on Mikhailovsky's series, V. G. Vainshtein constructed a linear regression equation which showed that in the second half of the 19th century rye yields increased by an average of 1% per year (relative to the average yield for the whole period) (Vainshtein, 1927: 89-90).

In 1973, A. S. Nifontov constructed a similar series for the yield of all cereals in 1851-1900, which also indicated a rapid increase in yields (Nifontov, 1973). Nifontov's reliance on data from governors' reports has been criticised by some historians (Litvak, 1979: 142-186), but Nifontov's series has been widely used to demonstrate the progress of imperial Russian agriculture (Mironov, 1912: 236-237; Kuznetsov, 2020: 53-83; Leonard, 2019: 472-475; Wheatcroft, 1991: 135). Since then, the thesis of rising crop yields has been supported by both domestic and Western historians (Sinitsyn, 2023: 249-250; Leonard, 2019: 471).

However, Nifontov's data deserve more detailed analysis. Crop yields fluctuate according to weather conditions, and averages over several years are usually used to analyse the dynamics. We will analyse 4-year averages because they capture yield fluctuations better than the more commonly used 5 or 10-year averages. Figure 1 shows a scatter plot of the yield data and a 4-year moving average curve.

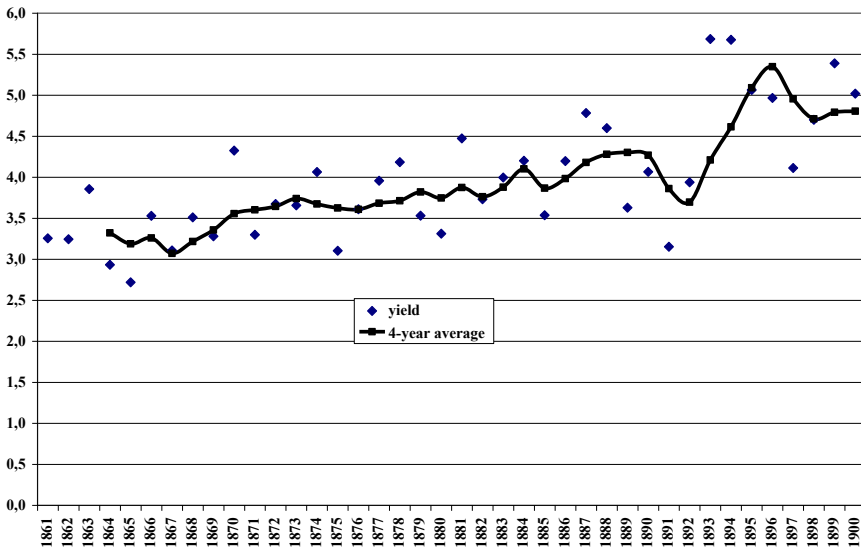


Figure 1. Grain yield in "sams" and a 4-year average for the years preceding the corresponding date. Compiled from: (Nifontov, 1973: 155, 183, 225, 237).

A striking combination of small periods of growth in the moving average and more extended periods when yields remained virtually unchanged or declined. The

first period of growth ends in 1870; the second is around 1883; the third is around 1893. These are all years when the system of collecting and recording yield data changed, and this change should be reflected in the transition from 1869 to 1870, from 1882 to 1883 and from 1892 to 1893. It would be logical to exclude from consideration the four-year intervals containing these transitions, i.e. containing both 1869 and 1870, then the intervals containing both 1882 and 1883 and, accordingly, 1892 and 1893. This gives us the picture shown in Figure 2

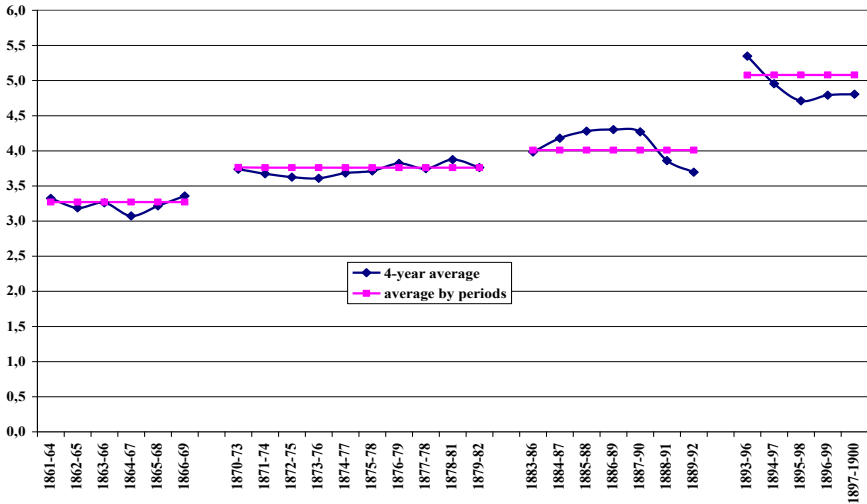


Figure 2. Four-year averages not including years of change in the harvest data collection system. Compiled after: (Nifontov, 1973: 155, 183, 225, 237).

Thus, excluding the effect of the change in the collection system leads to the disappearance of the areas of yield growth. During the years of a constant system of collecting and recording harvest data, the average yield did not increase. It only fluctuated around the average line (asymptote), which was different for different periods of constancy of the collection system. This means that the growth in yield shown by Nifontov's series was fictitious. The change in the collection and recording system led to an abrupt formal increase in the average yield, then the average remained approximately the same for a long time, and then with the next reform it grew again abruptly. The only exception was the situation of the catastrophic crop failure of 1891; this natural disaster, unique in its scale, was reflected in the graph by a significant drop in the moving average, after which the 1893 crop reform led to a greater formal jump in yield than in previous cases.

The Mikhailovsky and Nifontov series show the average Russian yield in "sams", which does not quite correspond to the true dynamics of yield. "Sam" is the ratio of harvest to sowing, but sowing was different in different provinces. In the southern provinces, sowing was less than in the central provinces, and accordingly the yield in "sams" was significantly higher, although the real yield (in poods per dessiatine) did not show such a difference. Meanwhile, in the post-reform period, the area under cultivation in the southern provinces grew rapidly, leading to a fictitious increase in the yield of "sams". Mikhailovsky found that 2/3 of the increase in yield found in his calculations could be explained by the shift of sown area to the south (Mikhailovsky, 1921: 2).

After the reform of 1883, more detailed yield data appeared, making it possible to determine the yield in poods per dessiatine. In 1927, V. M. Obukhov, Director of the Institute of Experimental Statistics, published a series of crop yields (y) for 1883-1914 for all cereal crops in 50 provinces of European Russia, using data from the Central Statistical Centre. Obukhov calculated the Pearson correlation between the series of crop yields and the series of natural numbers (x), $r = 0.612$, and also obtained the regression equation $y = 34.6 + 0.49x$ (Obukhov, 1927: 1-160). According to the Chaddock scale, the correlation was rated as 'strong' and the regression coefficient showed that crop yields increased by an average of 0.49 poods per dessiatine per year. Obukhov concluded that 'a significant increase in crop yields in European Russia for the period 1883-1914 was an undeniable phenomenon' (ibid: 8).

The most authoritative Western specialist, S. Wheatcroft, relied on these results and found that the growth in crop yields was 2.1% per year and the population grew by 1.5%, so that per capita production grew by 0.6% per year (Wheatcroft, 1999: 133).

However, as has recently been shown (Nefedov, Ellman, 2024), the reform of crop yield accounting in 1893 led to a fictitious jump in crop yields, both in sams and in poods per dessiatine. Therefore, the dynamics of crop yields can only be considered for the period 1893-1914.

An attempt to estimate the growth of crop yields during this period was made by N. O. Voskresenskaya in 1980. After constructing a linear trend, calculating the regression coefficient and the average yield, N. O. Voskresenskaya concluded that the yield increased by 12% during this period (Voskresenskaya, 1980: 83). However, the question of the statistical significance of the regression coefficient obtained was not considered. Figure 3 shows a scatter plot of the yield for the period 1893-1914 and a 4-year moving average curve.

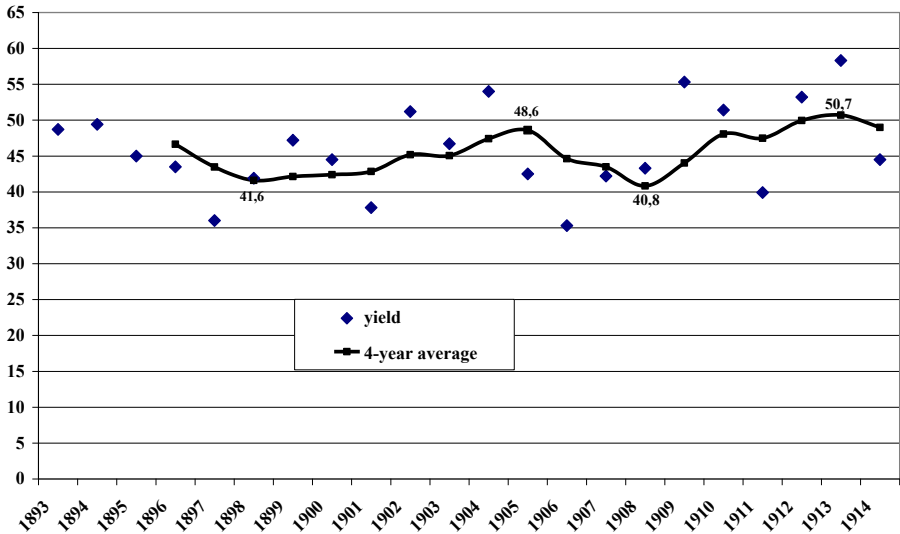


Figure 3. Yield (in poods per dessiatine) and 4-year moving average. Compiled by: (Obukhov, 1927: 1-160).

It is impossible to draw any conclusions about yield growth from the graph. If we calculate the Pearson correlation between the yield series and the time series, it is equal to 0.25, according to Chaddock, such a correlation is considered weak, and the question of its statistical significance arises: after all, we only have an estimate for the correlation coefficient, can we say that the real coefficient is different from zero? The Student's t-statistic in our case is 1.176, while the critical value for 80% confidence is 1.33. In other words, it is impossible to say with 80% probability that the correlation is different from zero (it can be said with 60% probability, but such a result is of little value). The same situation is observed when constructing the regression equation: the regression coefficient (0.24) is also insignificant.

It is therefore possible that the return is a random variable that does not depend on time. The only conclusion that can be drawn from the 4-year moving average graph is that the average yield fluctuated and the amplitude of the fluctuations increased. The minimum of 1905-1908 is lower than the minimum of 1895-1898 and the maximum of 1910-1913 is higher than the maximum of 1902-1905. A similar conclusion was reached earlier by A.S. Nifontov (Nifontov, 1974: 287)

V. M. Obukhov also provides a series for the gross harvest per capita in 1883-1914 (Obukhov, 1927: 12). The sample coefficient of correlation of the per capita harvest with the time series calculated by the statistician was 0.303. The Student's t-statistic in this case is 1.56, which guarantees 80 per cent confidence, but is not sufficient to guarantee 90 per cent confidence in the existence of a non-zero correlation, which is considered necessary in most studies. The linear regression coefficient calculated by Obukhov (0.13) is also insignificant. Nevertheless, the researcher concludes that "among the weather fluctuations in gross per capita output caused by harvest surges, we can quite clearly detect their increase in the period 1883-1914" (ibid: 13). In fact, as shown earlier, it is correct to consider the dynamics of the indicators only in the period 1893-1914. The scatter plot for per capita cereal production and the 4-year average is shown in Figure 4.

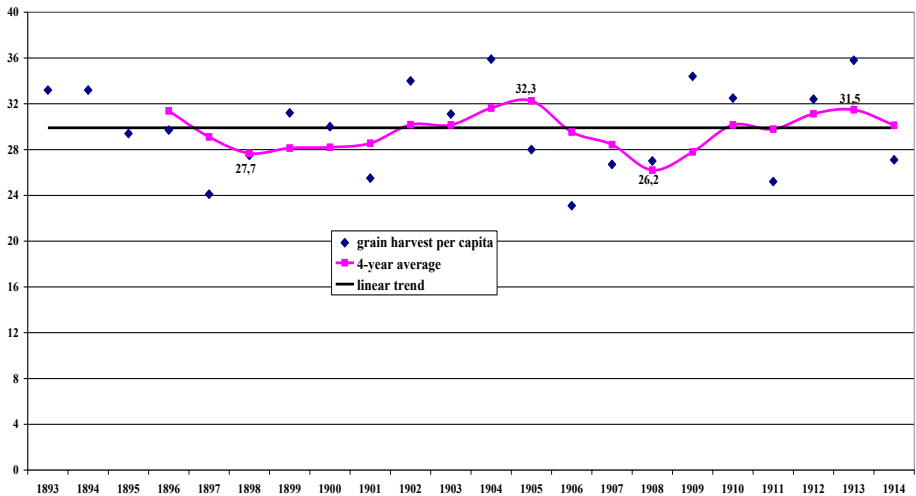


Figure 4. Gross grain harvest per capita (in poods) and 4-year moving average. Compiled by: (Obukhov, 1927: 13)

The Pearson correlation coefficient with the time series in this case is 0.004, the regression coefficient is 0.002. Both coefficients are close to zero and insignificant. It is clear that the average per capita harvest has not tended to increase over time.

Like the crop yield, the average per capita harvest fluctuated, with the minimum in 1905-1908 being lower than the minimum in 1895-1898, and the maximum in 1910-1913 being lower than the maximum in 1902-1905. In other words, there was a real decline in per capita yields. Thus, the arguments of A.S. Nifontov, V.M. Obukhov and other authors quoted above prove to be untenable. The generally accepted opinion about the increase in productivity of grain farming in European

Russia does not correspond to reality. Accordingly, the view of the "optimists" on the progress of grain production in Russia in 1861-1914 proves to be insufficiently substantiated

References

- Collection of Information on the Ministry of Agriculture and Rural Industry*. 1879. Issue 1. St. Petersburg. (In Russian)
- Fortunatov, A.F. 1893. *Rye harvests in European Russia*. Moscow: M.G. Volchaninov. (In Russian)
- Goldstone, J. 1991. *Revolution and Rebellion in the Early Modern World*. London: University of California Press.
- Ivantsov, D.N. 1915. 'On the criticism of Russian harvest statistics'. *Notes of the Imperial Russian Geographical Society* 24: 1-178. (In Russian)
- Kuznetsov, I. A. 2020. 'Production of grains and potatoes per capita in European Russia in 1883–1913: regional dynamics'. *Peasant studies* 5 (1): 53-83 (In Russian)
- Leonard, K. 2019. *Agrarian reforms in Russia: the road out of slavery*. Moscow: Delo. (In Russian)
- Litvak, B.G. 1979. *Essays on the source study of mass documentation of the 19th – early 20th centuries*. Moscow: Nauka. (In Russian)
- Materials of the Commission for the Study of the Question of the Movement of the Rural Population of the Middle Agricultural Provinces from 1861 to 1900 in Comparison with Other Localities in European Russia, approved by the Supreme Council on 16 November 1901*. 1903. In 3 parts. St. Petersburg. (In Russian)
- Mikhailovsky, V. G. 1921. 'Harvests in Russia in 1801–1912'. *Bulletin of the Central Statistical Bureau of the RSFSR* 50: 2-8. (In Russian)
- Mironov, B. N. 2012. *Welfare of the population and revolution in imperial Russia*. Moscow: Novyi khronograf. (In Russian)
- Nefedov, S., Ellman, M. 2024. 'A re-examination of russian harvest statistics for the end of the nineteenth century'. *Revolutionary Russia* 1: 1-15.
- Nifontov, A. S. 1973. *Grain production in Russia in the second half of the 19th century*. Moscow: Nauka. (In Russian)
- Obukhov, V. M. 1927. "Movement of grain harvests in European Russia in the period 1883–1915". In *The influence of crop failures on the national economy of Russia*. Part 1, edited V.G. Groman, 1-160. Moscow-Leningrad. (In Russian)
- Sinitsyn, R.V. 2023. "Dynamics of grain yields in European Russia in the 19th – early 20th centuries: the degree of study of the issue". *Bulletin of the Ural Federal University. Series 2: Humanities* 25(1): 239-256. (In Russian)
- Statistical timeline of the Russian Empire*. 1866. Series I. Issue I. (In Russian)

- Turchin, P., Nefedov, S. 2009. *Secular cycles*. Princeton: Princeton University Press.
- Vainshtein, A.L. 1927. 'Evolution of grain yield in Russia before the war and prospects for its development in the future'. *Planned economy* 7: 81-100. (In Russian)
- Vinogradova, N. 1926. 'Russian harvest statistics'. *Bulletin of statistics* 24: 51-104 (In Russian)
- Voskresenskaya, N. O. 1980. *Dynamics and structure of productive forces in grain production in European Russia at the end of the 19th – beginning of the 20th centuries*. Moscow. (In Russian)
- Wheatcroft, S. 1991. "Crises and the Condition of the Peasantry in Late Imperial Russia". In *Peasant Economy, Culture and Politics of European Russia*, edited E. Kingston-Mann and T. Mixter, 128-172. Princeton: Princeton University Press.
- Wheatcroft, S. 1999. 'The Great Leap Upwards: Anthropometric Data and Indicators of Crises and Secular Change in Soviet Welfare Levels, 1880–1960'. *Slavic Review* 58: 27-60.