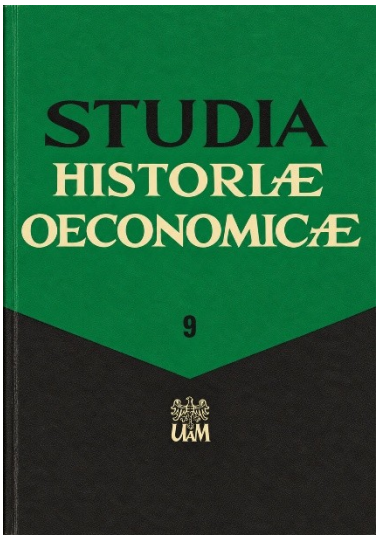



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# FACTORS AFFECTING DIFFERENCES OF AGRICULTURAL PRODUCTIVITY (IN PARTICULAR VOIVODESHIPS) IN PEOPLE'S POLAND IN THE YEARS 1945 - 1970

Differences in productivity of agriculture in particular parts of Poland appear strongly after the First and the Second World Wars. These differences were mainly determined by natural and social—economic factors.

In general terms this situation after the First World War was due to:

1. the diversity of policies of the invaders who annexed these territories for a long time before the First World War, in relation to agriculture, and different level of industrialization of this area, and differences in agrarian structure
2. unequal level of war destructions at the time of the First World War.

Those general causes have a complex character but it is necessary to indicate some more particular factors e. g. the level of education and technical equipment, which directly affected agriculture productivity, but these factors are due chiefly to those general causes of agricultural situation in each voivodeship.

For our purpose it is important to indicate, that at the period between the First and the Second World Wars we noted the process of diminishing of the differences.

This is obvious that in one state, differences between regions, which were before long time annexed by different states are diminishing but it is important to indicate also that it was not an equal process. Exceptional too were e. g. the years of best economic prosperity (1926 - 1929) when high profitability of agricultural production caused the highest progress of productivity first of all in the most productive western regions. It is important to stress also that equalization did not develop through increase of productivity of the less productive eastern regions but by decrease of productivity of the most productive ones. This last tendency was especially visible at the period of the big crisis (1929 - 1935)[1].

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[1] J. Orczyk, *Produkcja rolna Polski w latach wielkiego kryzysu gospodarczego (1929 - 1935)* (Agricultural Production in Poland in the Great Economic Crisis 1929 - 1935). Poznań 1971, p. 58, 62 - 65 and 210.

The situation after the Second World War was partially similar to that after the First World War. Differences in productivity of agriculture have been caused in general by inequality of war destruction and dissimilarities of level of economic and cultural development, but at the same time came out two, or more correctly speaking, three new factors which had a strong impact on the equality and rate of process of equalization of productivity in regions of Poland after 1945.

As the first one it is necessary to take into account the radical change of agrarian structure and more uniform structure than before as a result of reform.

As the second one it is worth to take into consideration changes of frontiers and their consequences, as the incorporation of the Recovered Territories in particular. Territories left by Germans were characterized by an agrarian structure which created conditions for higher productivity per one active worker. Some reasons decided that for a long period of time those conditions were not fully exploited. First of all incomplete utilization of those conditions were caused in first years after the war by insufficient number of people, their often low level of agricultural culture, unawareness of soil climate and other conditions in which it was necessary to operate (in peasents' farms trial and error plays an important role in improving efficiency). Of course fact that these territories were settled by colonists from different parts of Poland created conditions for better exchange of experience between neighbours, faster innovations, quicker changes of traditional habits. In the first years the negative impact on this process had the state of uncertainty of rights to property; the importance of this factor was diminishing fast after the change of the principles of collectivization.

Very important impact on this process was exerted by fast industrialization of the country and connected with it decrease of employment in agriculture.

Those three factors have a structural character but the process of equalization of productivity was under strong impact of current economic policy which e. g. created preferencies or difficulties for farms of different size, by supporting some types of production. This kind of policy occurred in Poland but was very changeable at particular periods. It is necessary to add that in general the respective kind of policy had an impact on the process of equalization of the level of economic development in regions of Poland and especially upon agricultural productivity.

Agrarian reform after the Second World War created a situation in which long and strong demand of the peasants for land was satisfied in some parts of Poland. It created conditions for the use of more labour for the development of production but did not solve problems of over-population of agriculture in general. At the same time in the Recovered Territories was observable

a strong demand for workers in agriculture. This period of changes of agrarian structure and settling peoples in the Recovered Territories ended after the three years' Economic Plan, it means in 1949. As a result there were created in Poland 817,900 new farms and 254,500 were increased in size[2].

It is worth to add that not all manor farms were parcelled out, some of them, usually the best ones and mainly not in overpopulated areas remained as centres of agricultural culture and industry. Because of agrarian structure and difficulties to find a sufficient number of people the biggest cohorts of those farms remain in the Recovered Territories. All these large farms (over 50 ha) which were not parcelled out were taken over by the state. These state farms occupied over 50 per cent of arable land in Koszalin and Szczecin voivodeships. To them belongs a large percentage of arable land in other western and northern voivodeships, but they did not play practically any role in the overpopulated south-eastern voivodeships.

It is possible to say that after 1946 the agrarian structure in Poland did not change substantially until today[3]. It does not mean that the agrarian structure was stable all the time, some changes were taking place all time but they did not have a character of radical transformation, but of a slow evolution process[4]. Some exception was the period after 1950, when there was realized the intensification in the process of creating collective farms[5]. This campaign was ended in 1956 and a plenty of collective farms established n the foregoing period were dissolved. In general the characteristic eature of changes of agrarian structure after 1957 is a systematic diminishing

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[2] A. Jezierski, *Historia gospodarcza Polski Ludowej* (The Economic History of People's Poland). Warszawa 1971, p. 98.

[3] Rocznik Statystyczny (Statistical Yearbook) 1957, p. 124, 129. Operations of settling on Recovered Territories of Poland were continuing in this period of time but with some stabilization. In the years 1950 - 1956 there were settled 14 thousand of families on the average. Increasing percentage of those families were settled in state and co-operative farms, e. g. in 1953 about 63 percent of settlers were placed in state farms.

[4] All indexes in this paper are related to arable land only, in case of whole area proportions are different; in hands of the state is a large majority of forests and inusable land.

[5] Rocznik Statystyczny 1957, p. 127; Some changes in structure are illustrated in the below presented table.

The percentage of arable land which belongs to individual, state and co-operative farms.

| Years | Total | Individual | Co-operatives | State |
|---|---|---|---|---|
| 1946 | 100 | 91.4 | - | 8.6 |
| 1950 | 100 | 89.6 | 0.8 | 9.6 |
| 1951 | 100 | 84.9 | 3.2 | 11.9 |
| 1952 | 100 | 83.9 | 3.4 | 12.7 |
| 1953 | 100 | 80.4 | 6.7 | 12.9 |
| 1954 | 100 | 78.7 | 8.2 | 13.1 |
| 1955 | 100 | 77.3 | 9.2 | 13.5 |
| 1956 | 100 | 76.6 | 9.6 | 13.8 |

of the participation of individual, private farms and simultaneous process of slow increase of significance of the state farms, the latter increase their size mainly by joining lands of individual farms when the owners are too old for operating the farms themselves (the younger generation moved in majority to the cities) and give up their farms to the state for pension. This kind of

Table No. 1

Agrarian Structure of Farms in Poland (arable land only)

| Years | Total in thousands ha 100 | Private | Co-operative | State-owned |
|---|---|---|---|---|
| | | in percentage | | |
| 1955 | 20,402.8 | 77.3 | 9.2 | 13.5 |
| 1960 | 20,402.8 | 86,9 | 1.2 | 11.9 |
| 1965 | 19,946.0 | 85.0 | 1.1 | 13.3 |
| 1970 | 19,543.2 | 83.4 | 1.3 | 14.8 |

Source: Rocznik Statystyczny (Statistical Yearbook) 1960 p. 191; 1961 p. 177; 1966 p. 229; 1971 p. 273.

Table No. 2

Indexes changes value of production in comparative prices

| Years | Total production | Final production net[a] | Market production net[a] |
|---|---|---|---|
| | years 1950—1952=100 | | |
| 1950 | 104.6 | 101.8 | 102.5 |
| 1951 | 96.8 | 100.2 | 101.0 |
| 1952 | 98.6 | 98.0 | 96.5 |
| 1953 | 101.3 | 100.3 | 102.3 |
| 1954 | 107.2 | 102.3 | 103.9 |
| 1955 | 109.9 | 106.4 | 115.3 |
| 1956 | 118.0 | 110.2 | 119.2 |
| 1957 | 122.9 | 117.3 | 129.4 |
| 1958 | 126.5 | 122.4 | 141.4 |
| 1959 | 125.4 | 118.9 | 136.2 |
| 1960 | 132.1 | 121.9 | 141.6 |
| 1961 | 145.8 | 137.3 | 158.3 |
| 1962 | 133.7 | 116.8 | 151.7 |
| 1963 | 139.1 | 128.2 | 147.6 |
| 1964 | 140.8 | 125.4 | 150.2 |
| 1965 | 151.7 | 136.4 | 158.5 |
| 1966 | 159.6 | 142.2 | 173.5 |
| 1967 | 163.4 | 142.4 | 176.1 |
| 1968 | 170.6 | 152.6 | 182.6 |
| 1969 | 162.6 | 132.4 | 172.1 |
| 1970 | 166.1 | 139.9 | 175.5 |

[a] diminished about value of products agriculture origin purchased by agriculture.
Source: Rocznik Statystyczny 1971 p. 266.

change is slow and depends mainly on demographic factors. It is necessary to add that these farms which are ceded to the state are usually in poor conditions and need investment and create some other problems for state farms.

Changes in agrarian structure after the Second World War which were expressed by the creation of selfsufficient types of farms and generally poor equipment of agriculture in technical resources, caused that market production increased in similar ratio as total production, particularly until 1957[6]. In the period of the six-year plan (years 1950 - 1955) the government tried to attain an increase of agricultural (market production especially without) investment. Possibilities of this were detected in changes of agrarian structure, in collectivization, in extension of obligatory deliveries of some agricultural products. Investment in agriculture was small and located mainly in state and co-operative farms. The results were noted diminishing value of capital in private farms and decrease of production. In terms of inability to create sufficient technical resources and improving qualification of man-power for state and co-operative farms, substantial reserves of production growth were to be found in private farms, in which existed not fully exploited reserves of manpower resources. Fuller utilization of this was possible in terms of some changes of agricultural policy of the government.

The government did not give up long term transformation of agrarian structure but it implies that this process must be combined with continuous growth of agricultural production and productivity. It means that state and co-operative farms must give evidence of their superiority in production in comparison with individual farms.

It is worth to add that after 1957 when taxes and other liabilities were diminished, changed ratio of prices between industrial and agricultural products, higher profitability of production induced individual farmers to the intensification of production. It is necessary to stress that increase of production appeared without changes in technology of production this was mainly due to a better utilization of resources possessed.

Increase of investment was demonstrated by the best farms only but it led to better utilization of resources and increase of production in general.

In 1960 ensued next change of agricultural policy which was based on assumptions that further reduction of liabilities and changes of the ratio of prices favourable to agriculture were needless because in the consequence led to a change of structure of national income. It was stressed that growth of income in agriculture ought depend first of all on increase of production. The latter is usually strictly associated with investment. Assumed that 77% of outlay ought to be directly or indirectly associated with peasants' farms. These assumptions were not achieved mainly in consideration of drop of the

[6] A. Jezierski, *Historia gospodarcza...*, p. 101 and 102.

Table No. 3

Participation of individual, state and co-operatives farms in total, final and market production (General = 100)

| Production | 1950 | | | 1960 | | | 1970 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Indiv. | State | Co-operat. | Indiv. | State | Co-operat. | Indiv. | State | Co-operat. |
| Total | 92.0 | 7.5 | 0.5 | 89.2 | 9.6 | 1.2 | 85.7 | 12.9 | 1.3 |
| Final | 93.4 | 6.1 | 0.5 | 88.7 | 10.1 | 1.2 | 83.5 | 14.8 | 1.5 |
| Market | 91.8 | 7.8 | 0.4 | 85.9 | 12.8 | 1.3 | 85.7 | 12.8 | 1.3 |

Source: Rocznik Statystyczny 1971 p. 267.

ratio of accumulation and investment in individual farms. In 1964 policy makers came to a conclusion that modification of agricultural policy was necessary again. Growth of production was insufficient and looking for possibilities of increased production determined the concentration of resources on developing these factors of production which directly and cheaply stimulated production growth, mainly fertilizers and better seeds. It was decided to use price policy for stimulating farmers too, as in period 1957 - 1960. In general after those changes investments in agriculture were profitable. Production started to grow faster but bad climate conditions of the years 1969 and 1970 stopped this tendency.

Generally speaking Polish agricultural policy tried to combine structure transformations of agriculture with sufficient production growth. This last reason determined current modifications of those policies. That policy was favourable to state and co-operative farms which achieved production per ha lower than individual ones for a long period, but a higher one when we compare market production and productivity per worker[7].

It is important to stress that in the sixties increased substantially the basis of agriculture, that at this period progress was made in transformation of individual farms by extended activities of farmers clubs, contractions and so on[8].

It is worth to say that each type of farms which existed in Poland indicated large differences in productivity and market production, and different ratio of development; this relative difference existed independently from size, types of farms and regions. These ones and differences in agrarian structures and level of economic development appeared in general differences in productiv-

[7] When computed per one worker we find in state farms much more arable land and more technical resources than in individual farms. We find a completely opposite picture when those variables are computed per ha of arable land.

[8] Compare F. Tomczak, *Rolnictwo Polski Ludowej. Zarys ekonomiki* (Agriculture in People's Poland. Outline of economics). 2nd ed. Warszawa 1972, p. 50 - 63.

Table No. 4

Investment outlays* total and participation of agriculture in percentages

| Years | Investment outlays in current prices in millions zł. | Participation of total agriculture in percentages | Total agriculture = 100 within state and co-oper. farms investm. |
|---|---|---|---|
| 1950 | 28,564 | 11.50 | 63.80 |
| 1951 | 32,329 | 6.49 | 85.07 |
| 1952 | 38,337 | 7.49 | 72.30 |
| 1953 | 44,353 | 7.56 | 79.06 |
| 1954 | 46,981 | 8.77 | 77.63 |
| 1955 | 48,518 | 11.97 | 72.92 |
| 1956 | 50,478 | 12.08 | 74.11 |
| 1957 | 62,844 | 13.67 | 54.58 |
| 1958 | 70,028 | 13.11 | 50.95 |
| 1959 | 84,815 | 11.76 | 52.56 |
| 1960 | 95,033 | 12.59 | 58.44 |
| 1961 | 107,776 | 12.31 | 58.97 |
| 1962 | 118,265 | 12.29 | 64.68 |
| 1963 | 121,241 | 13.27 | 65.96 |
| 1964 | 126,807 | 15.07 | 68.69 |
| 1965 | 139,237 | 16.11 | 69.27 |
| 1966 | 150,317 | 16.42 | 58.74 |
| 1967 | 167,205 | 16.16 | 67.00 |
| 1968 | 181,839 | 16.22 | 66.85 |
| 1969 | 197,707 | 16.25 | 66.27 |
| 1970 | 207,093 | 16.13 | 63.58 |

* Investment outlays to 1956 computed in prices from 1956.
Source: Rocznik Statystyczny 1960 p. 75; 1966 p. 94; 1971 p. 126, 151.

ity between voivodeships computed by unit of land or manpower. The impact of government economic policy on agriculture was in Poland very important all the time, but it is difficult to estimate and weigh the influence of particular move up on the process of equalization agriculture of productivity in voivodeships. This impact was different and depended not only on social and political factors but on differences in soil, capital resources of production, as well as on factors which are more changeable and have more direct impact on production such as: fertilizers, seeds and horse-power.

For measuring the differences of productivity between voivodeships are rendered in following relations:

1) difference in value of production per 1 ha of arable land in particular voivodeships

2) difference in value of production per 1 active worker in agriculture in particular voivodeships.

These relations in opposition to total value of production in particular voivodeships give better possibilities for full analysis of productivity and manpower capital and technical resources. The above mentioned variables have in case of agriculture partially substitutional and partially complementary character. The aim of this paper is an explanation of the impact of particular variables on the level of productivity in the voivodeships in Poland.

Indicators of total value, final and market production, and value of purchase of agricultural products by state, which are rendered in analysis, computed per unit of arable land and manpower present a picture of synthetic impact of all factors and variables.

In consideration of sources as a basis for a better investigation and calculation it was necessary to take into account only the years 1960 and 1970. Those years are chosen because of national censuses which in Poland are conducted each ten years. Those censuses are the main source of more accurate and full data about manpower in agriculture, and especially in peasants' farms. For better reliability and control of investigation and findings different types of production from different years close to the years of national censuses were taken into consideration. In case of total production we operated average data from two or three years. Selecting indicators of production was decided by the possibilities of finding data and their representativeness. Sometimes it was difficult to compare statistical materials and it was necessary to give up average figure and render data from one year only.

As dependent variables the total, final and market production and to make the findings of market production more reliable in 1970, value of purchase of agricultural products in 1971 were taken into consideration. These variables were selected because of the necessity to take into consideration aggregate indicators, and because of a need of mutual verification of findings.

The ratio of total production which presents the picture of value of all vegetable and animal production in relations per unit of arable land or manpower informed us in this way about the technical efficiency of labour. Final production is a part of total production diminished by value of products produced in agriculture which are utilized for production aims in the farms. This production informed us about the value of production which is delivered by agriculture for social needs. In relation to one active worker this production indicates the value of production socially useful, which is provided by one active worker, in particular voivodeships or gives possibilities to compare changes of this ratio in a long period of time[9].

[9] W. Ziętara, *Poziom i dynamika wydajności pracy w rolnictwie (1959 - 1968)* (The Level and Dynamics of Changes of Labour Efficiency in Agriculture 1959 - 1968) in: Dynamika wydajności pracy w świetle prakseologii. Warszawa 1972, p. 307 - 309 and 320 - 324; Y. Hayami, *Sources of Agricultural Productivity Gap Among Selected Countries.* American Journal of Agriculture Economics 1969, p. 565 - 575.

Agriculture must secure victuals for people who work in other sectors of economy and live outside villages, for this reason market production is an important indicator which informs us what volume and value of production is delivered for sale. This indicator has some other important aspects.

In general the volume of production per one active worker depends on the size of land (apart from differences in quality of land), technical resources of production and professional qualifications of operators, their motives and possibilities. At the time when this paper was under preparation not all data from the 1970 census were available. For this reason into consideration were taken only those variables which have direct impact on production, such as size of arable land and technical resources of production.

As independent variable the following relations were selected: arable land to active workers in agriculture and its reciprocal (A.L./A.W. and A.W./A.L.), fixed resources per unit arable land (F.R./A.L.) and manpower (F.R./A.W.), investment outlays (I/A.L. and I/A.W.), and total horse-power and separately mechanical horse-power per ha and one active worker (H./A.L. and H./A.W. and respectively M.H./A.L. and M.H./A.W.). In case of productivity by unit of land as independent variable was taken into consideration the consumption of fertilizers per ha (F./A.L.) too.

These variables including those which are representative for the productivity of land: for a longer period and those which it directly stimulated (fertilizers) and also those which increased efficiency of labour and have an indirect impact on productivity growth (investment outlays). This selection of variables may arouse some doubts: particularly some explanations of items of fixed resources are needed. These ones are referring to the total value of buildings, installations, equipment and machinery. From production point of view it is important to take into consideration the value of farm buildings, but they are included in some statistics together with residential houses only. The separation of the value of machines and technical equipment, which is easy in case of state farms, presents difficulties with reference to peasants' farms.

Furthermore insertion of horse-power as an independent variable allows to grasp the most important aspect of fixed resources, it is the possibilities of substitution of human labour.

In this paper we did not take as independent variable the agrarian structure in particular parts of Poland because the ratio of number of active people per ha reflects the significance of individual farms, it means the more active people per ha, the more important is the role of individual farms in these voivodeships.

Because of the lack of general data it was not possible to include elements of cost analysis. The cost of production in agriculture is very difficult for calculation and especially the cost of labour. In addition some farms are assisted by the state and apart from that the prices of many products have been rather

diversified. Without cost it is difficult to estimate the reasonableness of farming but in conditions when demand of farmers for fertilizers and tractors and other equipment was higher than supply, the rationality of farming appeared in the utilization of resources.

These independent and dependent variables were correlated without intent to estimate their mutual relations. Combined association effects of all independent variables on particular dependent variables were examined (multiple correlation) and also separate net effect and importance of each independent variable on dependent variable with the elimination of the other independent variables (partial correlation). In addition, in some cases rank correlation were used. It happened in those cases when it was necessary for better explanation and checking relations between features which are difficult to compute in absolute figures including further variable.

The correlations informed us about existing relations and their importance at different periods of time.

For a better explanation and analysis it is important to study both the changes in particular dependent as well as independent variables. The best measure for this is the coefficient of variation. This measure makes possible comparisons between variables which are computed in different units and in different periods of time.

The calculations were done by voivodeships for the sake of available sources and the substance of the matter as well as of different growth trends in each voivodeship in consequence of industrial development, which in turn created a different situation in the field of migration to towns. Different agricultural policies in each particular voivodeship and above all different land productivity per working man had to be taken into consideration. Voivodeships as administrative units, however, do not correspond strictly to economic regions.

The present article is an attempt to define what factors influenced productivity. The problem is complex and hard to measure and therefore these findings should be treated as an introduction and presentation of the first results. The value of the findings would be higher if each farm category i.e. state, co-operative and private farms had been singled out in the analysis, if their role in each particular voivodeship had been determined, if the prevailing farm size in a given region had been specified in each category and if the capital equipment of the farms had been presented. These elements and their analysis would make the research more precise, but the aim of this article is to present general differences in agricultural productivity in Poland in the present conditions in large administrative regions and the variables that affect the differences. On the other hand it should be taken into account that too small regions do not allow to reveal fully their essential features[10].

[10] Compare F. Welch, *Education in Production*. Journal of Political Economy 1970

On the basis of the calculations it may be assumed that the applied independent variables of productivity per ha of arable land as well as per working man explain fundamentally changes in productivity although the significance of each particular variable is different. The obtained results should be treated with caution because of the comparatively small number of examined units (17 voivodeships). The applied variables have, however, a great effect and therefore in spite of the small number of examined units the results obtained may be accepted as significant.

Before more detailed calculations have been presented it is worth pointing to the basic relations obtained with help of a relatively simple coefficient of rank correlation. The use of the coefficient is not very difficult and it made possible to study relations of some characteristics which were left out in more detailed calculations. It turned out that the relation between the share of private farms in the total agricultural acreage and the amount of investment outlays per ha was negative in 1960 i.e. increase in the share of private farms was connected with decline in average investment outlays per ha, but the relation did not come into play in 1970, although on average investment outlays in state and co-operative farms continued to be much higher throughout Poland. It indicates that it was determined by investments made mostly in voivodeships with considerable outlays. The picture would probably undergo some changes if more detailed analysis of the agrarian structure of private farms were made.

When fixed resources in private farms or rather their share in the total value of fixed resources and correlation with investments per ha of arable land in a voivodeship were taken into account it was proved that in 1960 there was a weak negative correlation (—0.227) and in 1970 it was of no significance (0.022). The correlations were different when the share of fixed resources in private farms in each voivodeship and the amount of investments per working man were considered. They were strong and negative. In 1960 the correlation was —0.67 and in 1970 as much as —0.88. It proves clearly that the amount of investments in a given voivodeship was not related to the agricultural acreage belonging to a particular farm category but to the amount of manpower resources i.e. the higher percentage of fixed resources in a voivodeship was owned by individual farmers the lower were investment outlays per man working in agriculture. The correlation is fully understandable because in private farms which have great manpower resources at their disposal the effected investments were smaller than in state and co-operative farms or in private farms with few labour hands in relation to the acreage but with means assigned for that purpose by the State. Therefore the highest investments were made in regions with large farms and thin population, chiefly in those voivodeships in which pri-

No 1, p. 45; Changes in productivity in different types of farms were lately taken into consideration by S. Felbur in his publication, *Problemy wzrostu produkcji rolniczej w Polsce* (Problems of Agricultural Production Growth in Poland), Warszawa 1972, p. 300.

Table No 5

Consumption of fertilizers per ha sowed land in kg

| Years | Total | Individual and co-operative farms | State farms |
|---|---|---|---|
| 1954/55 | 35.3 | 31.0 | 62.7 |
| 1955/56 | 38.1 | 33.9 | 63.9 |
| 1956/57 | 40.4 | 36.4 | 65.6 |
| 1957/58 | 37.7 | 32.6 | 72.7 |
| 1958/59 | 42.3 | 39.6 | 62.4 |
| 1959/60 | 48.6 | 43.2 | 88.1 |
| 1960/61 | 51.9 | 44.8 | 103.4 |
| 1961/62 | 58.6 | 51.6 | 108.0 |
| 1962/63 | 59.9 | 52.9 | 108.8 |
| 1963/64 | 64.3 | 56.1 | 120.4 |
| 1964/65 | 73.1 | 64.9 | 127.1 |
| 1965/66 | 86.2 | 74.7 | 161.1 |
| 1966/67 | 104.7 | 90.1 | 198.4 |
| 1967/68 | 121.2 | 104.6 | 226.5 |
| 1968/69 | 142.5 | 124.1 | 256.3 |
| 1969/70 | 161.5 | 142.0 | 279.3 |

Source: Rocznik Statystyczny 1965 p. 278; 1971 p. 319.

vate farms played the least important role in respect of fixed resources value. The share of private farms in the total acreage of farm land or in fixed resources value showed also substantial correlations between the value of the total output or commodity production computed either per ha of arable land or per man working in agriculture.

According to these calculations the correlation occurred essentially when total output and market production were taken into account per working man and not per ha of arable land. While production results per working man show a fall, when the role of private farms is growing, production results per ha show no substantial effect and what is more important it is decreasing.

The argument can be put forward that production results become differentiated primarily because of number of employed persons, and when intensity of the levelling process in this field is growing, productivity per ha of arable land is being levelled in each particular farm category. In this instance the significance of private farms does not affect any longer the differentiation of production results per ha in each particular voivodeship although the effect appeares in correlation with other production factors. Information about some changes in correlations between production factors is given in the tables. Correlation changes between capital outlays and fixed resources should be especially noticed. In 1960 the correlation per ha of arable land was +0.72 and in 1970 only +0.28. Correlation between investment outlays and fixed

resources per working man in each particular voivodeship was weakened to a lesser degree.

It is evident that differentiation of capital outlays per ha has diminished, which is also a sign that their amount was determined to a lesser and lesser extent by the former base. The base, however, still plays an important part, especially with reference to economically active population i.e. in those voivodeships in which there are biggest fixed resources per working man relatively most investments are undertaken. Those are the regions where state farms play a significant role and where there is relatively most arable land per working man. The argument may be put forward that in Poland the amount of investments in each particular voivodeship was not determined by value of resources per ha but by relation between fixed resources value and number of persons active in agriculture. It should be, however, noted that the process of productivity levelling is very complex and cannot be thoroughly analysed on the basis of simple correlations only. Before, hover results of more accurate calculations have been presented, it is worth noting how some simple correlations between results i.e. between total output or market production and each particular production factor were developing. It is distinctly seen that there are strong correlations when production and its qualificatory factors are computed per working man, but weaker correlations occur when computed per ha of arable land.

Table No 6

Correlation of ranks between the role of private farms and indices of different kind of production or investment outlays

| Years | per 1 ha | | per 1 active worker | |
|---|---|---|---|---|
| | Participation of ind. farms | | Participation of ind. farms | |
| | in total arable land | in total value of fixed resources | in total arable land | in total value of fixed resources |
| | Total production | | | |
| 1960 | 0.431 | 0.539 | −0.537 | −0.499 |
| 1970 | 0.322 | 0.765 | −0.765 | −0.842 |
| | Market production | | | |
| 1960 | −0.010 | 0.044 | −0.510 | −0.574 |
| 1970 | −0.175 | −0.205 | −0.760 | −0.561 |
| | Investment outlays | | | |
| 1960 | −0.374 | −0.227 | −0.780 | −0.670 |
| 1970 | 0.000 | 0.022 | −0.880 | −0.880 |

Source: Rocznik Statystyczny 1962 p. 184; 1971 p. 273, 88, 11.

A detailed analysis is needed to find out which factor played a really essential part and which one was only relevant to the problem. The information is given in the table of partial correlations of each particular variable. It is shown here that although there were frequently essential correlations when only two variables were taken into consideration, they usually reflected also changes in other strongly correlated variables.

Table No 7

Simple correlation between variables in relations per ha of arable land

| Variables | TP/ /AL | FP/ /AL | MP/ /AL | PP/ /AL | AW/ /AL | FR/ /AL | F/ /AL | I/ /AL | H/ /AL | MH/ /AL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1960 | | | | | |
| Total P/AL | 1 | | | | 0.40 | 0.54 | 0.51 | 0.44 | 0.73 | −0.16 |
| Final P/AL | | 1 | | | 0.23 | 0.62 | 0.53 | 0.50 | 0.50 | −0.00 |
| Market P/AL | | | 1 | | −0.08 | 0.35 | 0.86 | 0.67 | 0.48 | 0.40 |
| Value P. Purchased from Agric/ /AL | | | | 1 | −0.11 | 0.39 | 0.74 | 0.50 | 0.47 | 0.51 |
| AW/AL | | | | | 1 | −0.18 | −0.34 | −0.23 | 0.65 | −0.57 |
| FR/AL | | | | | | 1 | 0.76 | 0.72 | 0.13 | 0.47 |
| F/AL | | | | | | | 1 | 0.82 | 0.08 | 0.68 |
| I/AL | | | | | | | | 1 | 0.14 | 0.59 |
| H/AL | | | | | | | | | 1 | −0.27 |
| MH/AL | | | | | | | | | | 1 |
| | | | | | 1970 | | | | | |
| Total P/AL | 1 | | | | 0.51 | 0.40 | −0.02 | 0.51 | 0.69 | 0.07 |
| Final P/AL | | 1 | | | 0.23 | 0.71 | 0.32 | 0.59 | 0.70 | 0.35 |
| Market P/ /AL | | | 1 | | −0.21 | 0.64 | 0.62 | 0.49 | 0.66 | 0.65 |
| Value P. Purchased from Agric/ /AL | | | | 1 | −0.41 | 0.26 | 0.64 | 0.27 | 0.78 | 0.75 |
| AW/AL | | | | | 1 | −0.07 | −0.73 | 0.16 | 0.03 | −0.75 |
| FR/AL | | | | | | 1 | 0.58 | 0.28 | 0.42 | 0.52 |
| F/AL | | | | | | | 1 | 0.12 | 0.44 | 0.96 |
| I/AL | | | | | | | | 1 | 0.41 | 0.21 |
| H/AL | | | | | | | | | 1 | 0.53 |
| MH/AL | | | | | | | | | | 1 |

Source: Rocznik Statystyczny 1961 p. 174, 176; 1962 p. 181, 183, 184, 191, 228, 231; 1963 p. 205; 1968 p. 276; 1970 p. 219; 1971 p. 270, 273, 319; 1972 p. 88, 112, 253, 299, 310; *Inwestycje i środki trwałe w rolnictwie* (Investment and fixed resources in agriculture) 1946 - 1967 p. 13, 14, 18, 40; *Inwestycje i środki trwałe w rolnictwie* (Investment and fixed resources in agriculture) Warszawa 1972 p. 31, 46.

Table No 8

Simple correlation between variables in relations per active worker in agriculture

| Variables | TP/ /AW | FP/ /AW | MP/ /AW | PP/ /AW | AL/AW | FR/ /AW | I/AW | H/ /AW | MH/AW |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | | | | | | | | | |
| Total P/AW | 1 | | | | 0.86 | 0.92 | 0.96 | 0.93 | 0.88 |
| Final P/AW | | 1 | | | 0.81 | 0.94 | 0.94 | 0.90 | 0.67 |
| Market P/AW | | | 1 | | 0.84 | 0.90 | 0.84 | 0.93 | 0.76 |
| Purchased Products from Agric/AW | | | | 1 | 0.84 | 0.76 | 0.85 | 0.91 | 0.85 |
| AL/AW | | | | | 1 | 0.78 | 0.93 | 0.97 | 0.88 |
| FR/AW | | | | | | 1 | 0.92 | 0.84 | 0.66 |
| I/AW | | | | | | | 1 | 0.96 | 0.81 |
| H/AW | | | | | | | | 1 | 0.85 |
| MH/AW | | | | | | | | | 1 |
| 1970 | | | | | | | | | |
| Total P/AW | 1 | | | | 0.88 | 0.83 | 0.88 | 0.97 | 0.96 |
| Final P/AW | | 1 | | | 0.80 | 0.90 | 0.86 | 0.93 | 0.94 |
| Market P/AW | | | 1 | | 0.81 | 0.84 | 0.84 | 0.93 | 0.93 |
| Purchased Products from Agric/AW | | | | 1 | 0.88 | 0.74 | 0.88 | 0.98 | 0.96 |
| AL/AW | | | | | 1 | 0.68 | 0.89 | 0.94 | 0.91 |
| FR/AW | | | | | | 1 | 0.69 | 0.79 | 0.84 |
| I/AW | | | | | | | 1 | 0.91 | 0.92 |
| H/AW | | | | | | | | 1 | 0.98 |
| MH/AW | | | | | | | | | 1 |

Source: See table No 7 and Rocznik Statystyczny 1965 p. 35, 40, 41; 1971 p. 88, 112.

It turned also out that the multiple correlation between most of the said factors and production results is very strong, which is a proof that the choice of variables was right[11].

There were, however, essential differences in the sphere of the significance and even direction of correlation where each particular factor was concerned.

It turned out that when production and the factors were computed per ha of arable land such a factor as number of economically active persons per ha of arable land fell in value. Artificial fertilizers which were substantially correlated with production results per ha in 1960 did not play an important part

[11] It is necessary to add that in general coefficients of determination were very high (0.9 and more). There are two exceptions in 1960 in case of final production (0.668) and in case of market production in 1970 (0.686).

Table No 9

Coefficients of multiple and partial correlation of production results

| Production | Years | Correlation | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Multiple | Partial | | | | | |
| | | | AW/AL | FR/AL | F/AL | I/AL | H/AL | MH/AL |
| TP/AL | 1960 | 0.97* | 0.14 | 0.52 | 0.83* | −0.10 | 0.78* | −0.86* |
| | 1970 | 0.90* | 0.33 | 0.42 | −0.24 | 0.21 | 0.45 | 0.16 |
| FP/AL | 1960 | 0.82* | 0.09 | 0.37 | 0.39 | 0.05 | 0.24 | −0.46 |
| | 1970 | 0.91* | 0.11 | 0.58* | −0.01 | 0.45 | 0.42 | −0.02 |
| MP/AL | 1960 | 0.96* | −0.29 | −0.15 | 0.87* | −0.37 | 0.79* | −0.13 |
| | 1970 | 0.83* | −0.07 | 0.34 | 0.02 | 0.33 | 0.28 | 0.03 |
| PP/AL | 1960 | 0.96* | −0.41 | −0.62* | 0.85* | −0.61* | 0.85* | 0.54 |
| | 1970 | 0.91* | −0.08 | −0.31 | −0.10 | −0.03 | 0.59* | 0.24 |
| | | | AL/AW | FR/AW | . | I/AW | H/AW | MH/AW |
| TP/AW | 1960 | 0.98* | −0.51 | 0.26 | . | 0.46 | 0.70* | −0.40 |
| | 1970 | 0.98* | −0.46 | 0.49 | . | 0.32 | 0.76* | −0.28 |
| FP/AW | 1960 | 0.98* | −0.68* | 0.41 | . | 0.58* | 0.70* | −0.23 |
| | 1970 | 0.98* | −0.63* | 0.70* | . | 0.47 | 0.63* | −0.18 |
| MP/AW | 1960 | 0.98* | −0.75* | 0.14 | . | 0.44 | 0.78* | −0.40 |
| | 1970 | 0.96* | −0.49 | 0.38 | . | 0.18 | 0.53 | −0.07 |
| PP/AW | 1960 | 0.97* | −0.75* | 0.19 | . | −0.01 | 0.82* | 0.75* |
| | 1970 | 0.99* | −0.71* | −0.41 | . | 0.12 | 0.84* | −0.02 |

* = essential from statistical point of view when degree of confidence $\alpha = 0{\cdot}05$.
Source: See table No 7.

any longer in 1970, from the view point of affecting differentiation of production results per ha. As it is well known, partial correlation provides information what role is played by each particular factor but it does not comprise the effect of co-operating variables, the effect being reflected in multiple correlation, and therefore e.g. fixed resources per ha or other coefficients suggest decline in production value per ha while the given factor increases (the fact of close mutual complementarity of some factors reflected in high gross correlation being disregarded). Horse-power as a whole proved to be the relatively most stable factor affecting production results.

This factor played a more substantial role when computed per man employed in agriculture. In this case, when the effect of other factor is excluded, rise in acreage per working man is strongly correlated with decline in production results, which denotes that not an area but rise in value of resources and horse-power pertinent to the area determined productivity per man[12].

[12] W. Ziętara, *Poziom...*, p. 326. He represents a notion that when size of arable land of farm enlargement and other factors are unchangeable per ha, 1) the productivity of land diminishes, 2) employment diminishes, 3) the level of labour productivity increases.

After calculations which were made for this paper we may say that the increase of

On the whole it may be noted that correlations are stronger when we consider relations per man, which point out closer dependence of the applied variables than in the case of arable land, and denotes that the effect of each particular factor is more considerable. It should be remembered that the number of factors taken into consideration was smaller than in the analysis of relation of results per ha of arable land but they explain the range of production variation to a higher degree.

It seems interesting that correlations between the applied variables proved to be weaker in 1970 than in 1960 (final production being an exception) when relations per ha of arable land were under consideration. This is probably linked with a diminished role of artificial fertilizers as a factor strongly correlated with production results per ha. It seems that the correlation coefficient in 1970 would be higher if such variables as certified seeds, plant protecting chemicals, fodder concentrates, in short other factors affecting directly production growth were applied. Increasing use of artificial fertilizers, their propagation (Minimum Fertilization Act of 1967) and availability caused that their use was not in substantial relation with production results per ha, although they showed negative relation with the share of private farms in agricultural acreage (simple relation between one variable and another)[13].

The differences were probably caused also by the fact that manure which played important role in private farms with considerably more livestock was disregarded in the calculations. This would partly explain why in 1970 the share of private farms in a given voivodeship did not show any longer essential correlation with production results per ha of arable land. The effect of each particular variable on multiple correlation coefficient is well illustrated by table 10 which shows how increasing of the variables affects the total coefficient. An analysis of this table helps to state that in fact the first two variables allow to fix the strength of the relation. Only in the instance of market production and purchase computed per ha of arable land the adoption of an additional variable (i.e. artificial fertilizers) affected substantially the correlation coefficient. Horse-power especially when computed per ha of arable land affected considerably the rise of coefficient of production correlation with selected va-

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labour productivity did not appear when we eliminated the influence of other variables which strongly correlated with increasing size of land. This calculation was made not per farms but size of arable land per one active worker in particular region; Compare J. Zalewa, *Relacje i produkcyjność czynników wytwórczych w indywidualnych gospodarstwach rolnych* (Relations and productivity factors of production in individual farms). Ekonomista 1970 No 5 p. 953.

[13] S. Felbur, *Problemy wzrostu...*, p. 284 and 285. Studying growth of agricultural production in Poland S. Felbur computed that in the years 1961 - 1964 fertilizers participated in 51% in total growth of production. In the years 1965 - 1968 this share diminished to 42% in spite that consumption of fertilizers increased about 65%. It is probably because of diminished marginal efficiency additional outlay of fertilizers.

Table No 10

Rising correlation coefficients of production factors relation per ha of arable land and per working man

| Correlated variables | Total production | | Final production | | Market production | | Purchase | |
|---|---|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1960 | 1970 | 1960 | 1970 | 1960 | 1970 |
| per ha of arable land | | | | | | | | |
| AW/AL | 0.396 | 0.508 | 0.231 | 0.235 | −0.076 | −0.213 | −0.105 | −0.415 |
| +FR/AL | 0.738 | 0.728 | 0.697 | 0.762 | 0.373 | 0.665 | 0.392 | 0.473 |
| +F/AL | 0.810 | 0.767 | 0.736 | 0.800 | 0.889 | 0.725 | 0.812 | 0.691 |
| +I/AL | 0.811 | 0.808 | 0.736 | 0.862 | 0.894 | 0.787 | 0.827 | 0.717 |
| +H/AL | 0.888 | 0.898 | 0.760 | 0.906 | 0.964 | 0.828 | 0.941 | 0.902 |
| +MH/AL | 0.972 | 0.901 | 0.817 | 0.906 | 0.965 | 0.828 | 0.958 | 0.908 |
| per man economically active | | | | | | | | |
| AL/AW | 0.862 | 0.879 | 0.812 | 0.803 | 0.844 | 0.805 | 0.844 | 0.882 |
| +FR/AW | 0.949 | 0.935 | 0.950 | 0.933 | 0.932 | 0.899 | 0.860 | 0.904 |
| +I/AW | 0.962 | 0.946 | 0.968 | 0.954 | 0.948 | 0.914 | 0.865 | 0.919 |
| +H/AW | 0.979 | 0.982 | 0.983 | 0.980 | 0.977 | 0.958 | 0.928 | 0.991 |
| +HM/ /AW | 0.983 | 0.984 | 0.984 | 0.981 | 0.981 | 0.958 | 0.969 | 0.991 |

Source see table No 7

riables. Such variables as investments and mechanical tractive force per ha and per working man did not play a great role; they were not essentially correlated with production results per ha of arable land and per working man and after they were excluded, the results did not virtually change. It may be generally said that the differentiation of agricultural productivity in each particular voivodeship of Poland is dependent principally on the following factors:

(1) agricultural acreage, especially per working man,
(2) value of fixed resources per ha,
(3) horse-power per working man,[14]
(4) in the instance of market production and purchase per ha of arable land a considerable role is played also by the use of artificial fertilizers.

It is essential that the first and third factors are relatively most stable and it is worth noting that their influence is not subject to changes. Therefore it is useful to examine coefficients of variation of each particular variable per ha of arable land as well as per working man. It is well known that variational coeffi-

[14] This independent variable is very important. In regression equations for calculations productivity per active worker is only one variable which is substantial in all equations in 1960 and 1970.

cient permits estimation of differentiation degree of the examined variables in various aggregations. The coefficients of 1970 as compared with the coefficients of 1960 are much lower in the case of all the variables (only the coefficient of horse-power per ha of arable land was a little higher, although it was the lowest of all).

Table No 11

Variation coefficients of each particular variable per ha of arable land and per man active in agriculture in the years 1960 and 1970

| Years | TP/ /AL | FP/ /AL | MP/ /AL | PP/ /AL | AW/ /AL | FR/ /AL | F/ /AL | I/ /AL | H/ /AL | MH/ /AL |
|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | 17.29 | 19.56 | 24.57 | 26.75 | 43.91 | 47.15 | 32.03 | 18.13 | 10.91 | 53.84 |
| 1970 | 14.34 | 18.66 | 22.61 | 21.39 | 37.04 | 37.55 | 18.64 | 14.32 | 11.69 | 41.92 |
| | TP/ /AW | FP/ /AW | MP/ /AW | PP/ /AW | AL/ /AW | AR/ /AW | · | I/ /AW | H/ /AW | MH/ /AW |
| 1960 | 47.91 | 52.09 | 53.91 | 47.62 | 48.54 | 80.73 | . | 59.64 | 39.28 | 78.67 |
| 1970 | 27.39 | 31.20 | 38.20 | 41.80 | 35.57 | 46.09 | . | 35.93 | 34.14 | 63.72 |

Source: See Table No 7.

At the same time it turned out that there are still considerable differences in production results achieved in each voivodeship, especially in market production. The differences are, however, not considerable when the results are estimated separately, which proves with regard to the fact that the initial data are derived from different years, that the differences were essential and not casual. The earlier argument is also confirmed that differences in productivity per ha have become relatively small and can hardly be expected to grow still smaller as they depend to a great extent upon natural conditions such as the quality of soil and atmospheric conditions, and man's influence on them has been small so far. On the other hand differences in output per man seem too great although they have decreased. Productivity levelling per man in Polish conditions would entail change of agrarian structure (although little would be gained with enlargement of acreage per man) creating better facilities for possession and use of production means and especially for rise in horse-power resources, chiefly in mechanical force, and other forms of power replacing human labour and above all making it much more efficient. Expansion of industry and urbanization of the country as well as migration to towns and retirement from active participation in production because of advanced age (disproportions in this age group of economically active persons are relatively the highest between the voivodeships) help to level relation of arable land and number of working persons. As growth of this relation is inevitable, technical equipment of farmers will become more and more important. It must bring about not only a rise in output per man but also in productivity per ha in market production mainly,

to counterbalance the shrinking acreage of arable land and to secure increase in the total volume of market production. The analysis of the effect of each particular variable on the increase in production is a separate problem. It can be said that one stage of development and agricultural transformation in Poland is over. It brought relative levelling of agricultural productivity per ha of arable land in spite of the existent various agrarian structure and mutual substitutability of some production factors.

The existing differences in productivity and in growth trends are linked with different output of each particular farm and with the competence and possibilities of its owner and manager, but these differences are no longer interregional and are not conditioned by interregional differences (e.g. fixed resources, roads network, centres of purchasing farm products, etc.). Further levelling of differences in productivity per working man and rapid growth of output are to take place in the next stage.