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## THE VALUE OF OCCUPATIONAL SAFETY – ESTIMATION OF LOST PRODUCTIVITY IN THE POLISH AGRICULTURAL INDUSTRY

Key words: lost productivity, occupational safety, agricultural sector

**ABSTRACT.** The study was to assess the level of lost productivity of human resources in the Polish agricultural industry determined by working conditions. The assumed analysis was conducted in a time frame by assessing the accident ratio and its economic consequences in Polish agriculture. The estimation of costs of lost productivity is based on the adoption of the so-called human capital approach. A comparison of the lost product value in the A section – “Agriculture, Forestry, Fishing”, with average results recorded in the economy indicates high divergence resulting both from existing differences in the scale of burden with consequences of incapacity for work and from the conducted valuation of working time against mean values in economy. Depending on the adopted criterion for valuation of the unit of working day, estimated values of lost productivity in the A section per one injured fluctuate between 22 and 150% of mean values obtained for economy in total, and between 30 and 212% per 1,000 persons working in the given section (year 2016). The obtained results, apart from indicating an economic aspect of relations between occupational safety and productivity, constitute the basis for discussion on the profitability of health “interventions”.

### INTRODUCTION

The growth trend concerning the burden of the labour force with long-term consequences of poor health has been observed in highly-developed market economies. It makes the physical aspect of human capital more and more important in economic sciences. A healthy and safe working environment is desired not only from the staff’s point of view, but it also significantly favours improved labour productivity, consequently determining the production capacity of the economy. An improvement of OHS conditions increases the competitiveness and performance of enterprises, reducing costs resulting from accidents at work and work-related health issues, simultaneously inspiring the motivation of employees. Research conducted within this scope confirms a positive correlation between healthy working conditions and the wealth and competitiveness of a region. [Elsler et al. 2017].

In 2019, the European Agency for Safety and Health at Work published the results of an assessment of the economic burden of accidents at work and occupational diseases

based on an analysis of a number of lost healthy life years (DALY). Results have indicated that in the Polish agricultural industry this burden is relatively high in comparison with such countries as Germany, Finland, or the Netherlands [Tomba et al. 2019]. The authors assumed that although a part of that phenomenon might be explained by industry structure (the percentage of persons working in agriculture in Poland is much higher than the EU mean value), the level of burden with consequences of accidents at work and occupational diseases in Polish agriculture also results from a high level of lung cancer risk caused by occupational factors and a large number of lost healthy life years due to so-called “unintentional injuries” and “transport injuries”. Statistics maintained at a national and international level, considering the sectoral differentiation of the accident ratio related to performed professional work indicate that agriculture is one of the most dangerous industries [McCurdy, Carroll 2000].

The study aims to assess the level of lost productivity of human resources in the Polish agricultural industry determined by working conditions. The obtained results, apart from indicating an economic aspect of relations between occupational safety and productivity, constitute the basis for discussion on profitability and performance of health “interventions” from the perspective of an employer and the entire health care industry.

## MATERIAL AND RESEARCH METHODS

Long-term consequences of poor health generate high costs resulting both from a loss of work productivity and the burden of social protection systems. Poor health and a low safety level of employees also generate costs for the organisation itself. The most frequent costs are related to absence resulting from disease or care for sick family members, individual losses in the performance of a sick employee, necessity for staff retraining, high insurance costs, pension costs or other indirect costs, such as the employment of substitutes, payment for overtime, commissioning of tasks to subcontractors, etc. However, from a methodological point of view, it is not easy to estimate the value of the product lost due to poor health of employees. Limitations in this area, indicated in the literature, are determined both by the existing consent to high diversity of applied parameters describing human factor productivity in production processes [Matzke et al. 2007, Mitchell, Bates 2011], and the heterogeneous impact of the disease itself on a scale of reduced productivity of employees [Galama, Van Kippersluis 2013]. A lack of unambiguous guidelines in the issue of scope and method of estimating the costs of productivity lost as a consequence of disease means that there are large discrepancies among estimates made. These assessments are mostly based on one in two approaches indicated in the literature to research this phenomenon: the human capital approach (HCA), resulting in a valuation of a maximum level of loss as a consequence of an employed person’s disease (value of potentially lost productivity or potentially lost earnings, with the assumption that an ill employee cannot be replaced), or the friction cost method (FCM), assuming that the value of productivity lost due to disease depends on time needed to restore the original level of productivity in a plant.

Regardless of indicated difficulties in the accurate estimation of health impact on work productivity, the research on cost reducibility, as a result of the introduction of health programmes oriented towards employees, has become a subject of multiple studies [Chap-

man 2012]. Despite the diversity of applied terms and adopted assessment criteria, the presented results suggest that well-planned and regularly conducted activities within the scope of improved occupational health and safety may often generate economic profits several times higher than those resulting from alternative capital investment.

The assumed analysis of the level of lost productivity of human resources in the agricultural sector in Poland was conducted in a time frame by assessing the accident ratio and its economic consequences. The estimation of costs of lost productivity is based on the adoption of the so-called human capital approach, which – with some methodological limitations – enables to estimate the loss in the global product value suffered as a result of an employee's ill health<sup>1</sup>. The analysis applies statistical data of the Central Statistical Office aggregated at the level of A section of the Polish Classification of Activities – "Agriculture, Forestry, Fishing". Due to the availability of data to estimate the value of the working day, the analysis of the level of lost productivity was based on data from 2016.

## OCCUPATIONAL SAFETY IN AGRICULTURE – SELECTED CHARACTERISTICS

Agriculture is one of the most dangerous industries with regard to the number of accidents at work. In the EU-28, agricultural workers are subject to accidents at work 1.3 times more often than the average, while fatal accidents happen over three times as frequently as in other sectors [Eurostat 2016]. Despite the activities undertaken in order to improve occupational safety, still more than 63% of the employed in the agricultural industry report their exposure to risk factors that may adversely affect their physical health, while almost 10% constitute persons reporting work-related health issues [Eurostat 2013].

The specificity of running one's own activity in the agricultural industry determines both the application of unusual employment forms and working conditions. Employees on farms must often work in limited spaces during operations, inspections, cleaning, maintenance, and repair works. Lack of oxygen and the presence of toxic gases may constitute a source of hazards. The most common causes of deaths in this sector include: transportation accidents (being run over or vehicles overturning), falls, being struck by falling or moving objects (machinery, buildings, bales, tree trunks), drowning (in water reservoirs, slurry tanks, grain silos), handling livestock (attacked or crushed by animals), contact with machinery (unguarded moving parts), entrapments (under collapsed structures) and electricity (electrocutions) [EC 2012]. The main factors causing accidents at work in agricultural activities also include: the work performance by one person; no appropriate protective equipment; financial constraints, time pressure and fatigue; lack of awareness, training and information and subcontracting [Martínez-Casariago et al. 2011].

In the case of the EU agricultural industry, the prevalent form of activity is constituted by family farms and own business activity. In 2016, nine in every ten (89.5 %) people who worked regularly in agriculture were farm owners or family members. The only Member

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<sup>1</sup> The proposed methodology was also used by the authors to assess the value of production lost as a result of incapacity for work of workers injured in accidents in the Polish tourism sector [Jakubowska 2018].

States where this proportion was much lower were Czechia (37.4 %) and Slovakia (50.9 %). From an OHS point of view, running one's own business activity and the fact that agriculture is often a family project constitute the largest challenges in agriculture. An additional methodological issue of estimation of the accident ratio in the agricultural industry was constituted by the employment of persons with various occupations and the performance of work related to various activity areas, not only agriculture [Martínez-Casariago et al. 2011]. For these reasons, it is hard to obtain sectoral statistical data concerning occupational health and safety maintenance. This problem is additionally aggravated by the specificity of work of persons running their own business activity, where being “irreplaceable” and the pressure of time defined by seasonal demands and weather conditions make work continuation necessary despite disease. It means that occurred accidents are often not reported, thus official statistics should be treated as significantly understated<sup>2</sup>.

An analysis of the Central Statistical Office data concerning the accident ratio in the A section in Poland indicates that the previously mentioned intensity of specific risk sources results in a higher level of risk of a potential accident than on average in other economic sectors. In the period of 2010-2017, an average number of victims of accidents connected with work performed, per 100 thousand of the A section employed, fluctuated between 999 and 1,301 persons, with mean values for all sections from 700 to 835 (Figure 1). The number of victims of accidents at work in the A section ranged from 1,283 (year 2013) to 1,507 (year 2011) in the studied period.

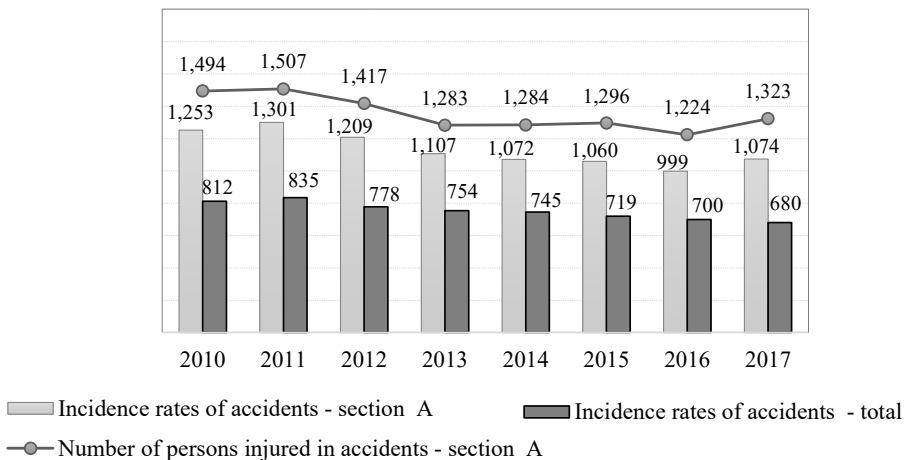


Figure 1. Persons injured in accidents at work and incidence rates of accidents: number of accidents per 100,000 workers, A section – “Agriculture, forestry and fishing” and “Total”, in 2010-2017

Source: own study based on Central Statistical Office data [GUS 2019]

<sup>2</sup> An analysis of data on the accident ratio in the A section, available at a Eurostat level, confirms significant differences in this area among particular Member States. A number of reported accidents at work in the agricultural industry in the EU-28 fluctuates between 43.72 (Bulgaria) and 5,360.95 (France) per 100 thousand working persons. Such a high divergence may suggest a lack of comparable methodology of conducted estimates, additionally determined by the size of the “grey market” in the functioning of the agricultural industry at a level of particular EU-28 countries.

An analysis of characteristics of victims of accidents at work in the section “Agriculture, Forestry and Fishery” indicates that, in comparison with mean values observed in the economy in the A section, older people (55+) with professional experience lasting more than 20 years have accidents more often. Statistically, accidents happen more often in small and medium enterprises, while the duration of the absence period caused by accidents is on average longer than the mean values observed in all sections (Figure 2).

The conducted assessment of reasons of accidents at work in the A section indicates that their structure is not significantly different than those observed in other industries. “Incorrect employee action”, constituting the main determinant of accidents (63% of all events), is the prevalent risk source. The identified health consequences of accidents are dominated by wounds and superficial wounds (38%), dislocations, sprains and strains (22%), and bone fractures (23%).

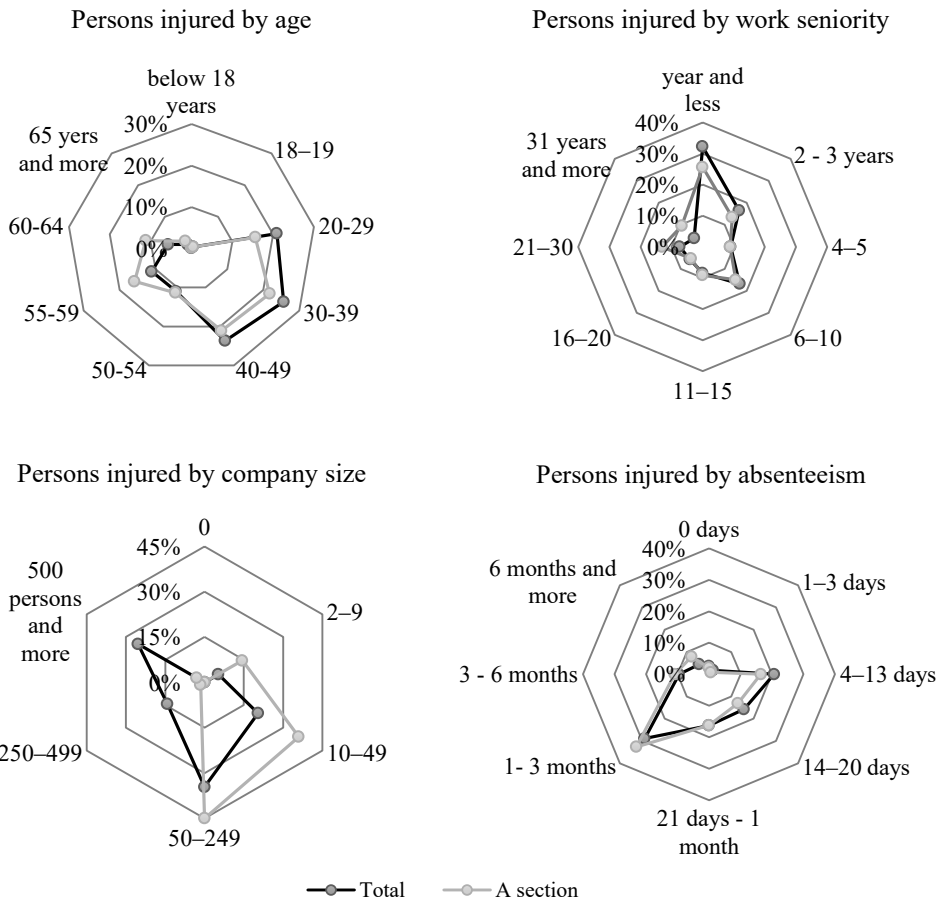


Figure 2. Persons injured in accidents at work by selected criteria, A section – “Agriculture, Forestry and Fishery” and “Total”, in 2017

Source: see Figure 1

## ESTIMATE OF LOST PRODUCTIVITY – RESEARCH RESULTS

Estimation of the value of productivity lost as a result of incapacity for work due to accidents at work, proposed in this approach, has been based on the “human capital approach”, offered in the literature. This approach enables to estimate the loss level from the point of view of industry or economy. Despite indicated limitations, this approach has been observed in the majority of research on the valuation of lost productivity of human resources presented in the literature [Steel et al. 2018]. It is indicated as the most accurate method to calculate costs of bad OHS practices [Weerd et al. 2014]. An approach based on the “human capital method” enables to determine the value of potentially lost productivity or potentially lost income, assuming that a sick employee may not be substituted due to a lack of potentially free labour force (no unemployment and full productivity of all labour forces). The application of the “human capital approach” requires estimating the duration of staff absence and adopting a contractual valuation of lost production converted into a specific unit of working time [Heuvel et al. 2017]. For the assumed analysis, the yearly value of production lost due to staff absence (*VPL*) was estimated according to the formula:

$$VPL = L_d * V_{wd}$$

where:  $L_d$  – aggregated number of days of incapacity for work (days lost) due to accidents at work on a yearly basis,  $V_{wd}$  – contractual value of the working day.

The variables adopted in the analysis were selected based on a review of staff productivity assessments proposed in the literature, with the simultaneous consideration of availability of aggregated data at a level of the PCA section. The contractual value of the working day ( $V_{wd}$ ) significantly determining the estimated lost product value was specified with the use of three alternative aggregates: (1) gross added value per one employed, (2) labour cost level per one employee, and (3) average level of gross wages and salaries in a given PCA section. The scale of absence due to accidents at work (number of days of incapacity for work) was assessed based on the estimates of the Central Statistical Office available at a level of particular PCA sections. The value of the lost product in the A section – “Agriculture, Forestry and Fishery” was estimated on a yearly basis, with reference to several analysis levels. The value of production loss occurred was determined on a global basis for the entire section, per one victim of accident, as well as per 1,000 persons employed in the given section.

Depending on the adopted criterion for the valuation of the working day, the value of production lost in 2016 as a result of accidents at work on a global basis in the “Agriculture, Forestry and Fishery” section fluctuated between PLN 5.13 and 20.69 million. That value per one injured amounted to PLN 4.22-17.01 thousand, while per 1,000 of working persons in the A section – PLN 41.87-168.85 thousand. Table 1 presents the detailed results of the conducted estimate for events noted in the A section in 2016.

A comparison of the lost product value in the A section with other economic sectors indicates high divergence resulting both from existing differences in the scale of burden with consequences of incapacity for work and the conducted valuation of the working day

Table 1. Estimation of the value of the lost product as a result of accidents at work in the A section – “Agriculture, Forestry and Fishery”, in 2016

Lp.	Specification	Value of the working day – $V_{wd}$ [PLN]	Number of days of incapacity for work on a yearly basis – $L_d$	The yearly value of production lost – $VPL$ [PLN]
<b>A section “Agriculture, Forestry and Fishery” – total</b>				
1.	Gross value added per employed	78.4	65,444	5,130,810
2.	Labour costs per employee	316.2		20,693,393
3.	Gross wages and salaries	244.9		16,027,236
<b>Per 1 person injured</b>				
1.	Gross value added per employed	78.4	53.8	4,218
2.	Labour costs per employee	316.2		17,012
3.	Gross wages and salaries	244.9		13,176
<b>Per 1,000 persons employed</b>				
1.	Gross value added per employed	78.4	534	41,866
2.	Labour costs per employee	316.2		168,851
3.	Gross wages and salaries	244.9		130,777

Source: own study based on the data from the Central Statistical Office (CSO) [<https://bdl.stat.gov.pl>]

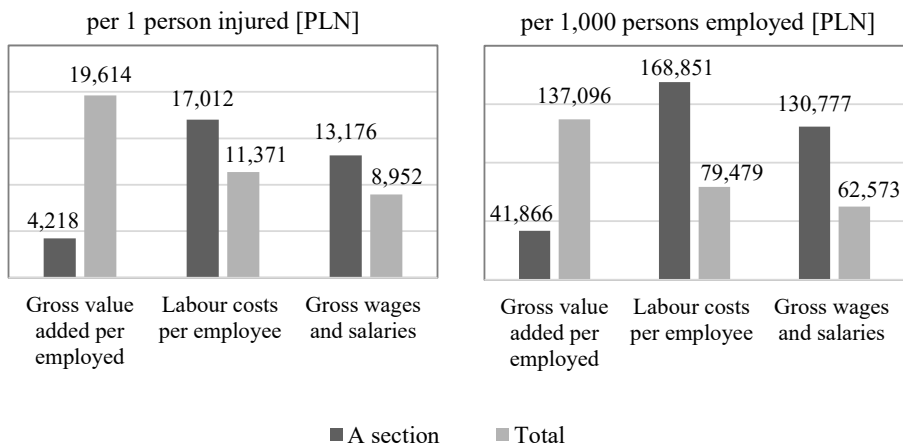


Figure 3. Estimation of the value of the lost product – selected indicators, A section – “Agriculture, Forestry and Fishery” and “Total”, in 2016

Source: see Table 1

against mean values in the economy. The statistical value of the working day, measured with gross added value developed in the A section, comes just to 17.4% of the average level in the economy in total, with average employment costs more than 21% higher than mean values in the economy. As a consequence, depending on the adopted criterion for valuation of the unit of working time, estimated values of lost productivity in the A section per one injured fluctuate between 22 and 150% of mean value obtained for the economy in total, and between 30 and 212% per 1,000 persons working in the given section (Figure 3).

## SUMMARY

The human capital approach proposed herein, despite noticeable methodological limitations, has enabled to assess the loss on the global value of the created product, suffered as a result of the studied process. This provides arguments in a discussion on the profitability of activities within the scope of limitation of the accident ratio and improvement of employee health, as well as justifies the necessity for adoption in the health programme assessment of a perspective going beyond the so-called direct costs of disease. Simultaneously, it should be emphasised that the perspective of assessing the phenomenon of effectiveness of human resources being affected by a lack of health, presented from an enterprise level, corresponds with the latest concept of market valuation of business projects conducted through the prism of assessment of the so-called relation capital of the business organisation, which is based on the “quality” of relations with a broadly understood group of stakeholders, including employees.

The attempted estimate of the value of productivity of agricultural activity lost due to accidents at work confirmed the initially adopted assumptions of existing limitations in the possibility of unambiguous quantification and economic valuation of consequences of specific events not beneficial from the point of view of employee health. This process is hampered i.a., by a lack of possibility to obtain credible information aggregated at the level of an enterprise and in reference to the entire industry or economy. Unreliability indicated in the literature or stated lack of data in international sources concerning accidents at work raises questions about the value of comparisons in the international arena, as well as makes it impossible to estimate the economic value of good practice applied within the scope of occupational safety throughout the EU.

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## WARTOŚĆ BEZPIECZEŃSTWA PRACY – OCENA UTRACONEJ PRODUKTYWNOŚCI W POLSKIM SEKTORZE ROLNYM

Słowa kluczowe: utracona produktywność, bezpieczeństwo pracy, sektor rolny

### ABSTRAKT

Celem badań była próba oceny utraty produktywności zasobów ludzkich w wyniku złych warunków bezpieczeństwa pracy w polskim sektorze rolnym. Analizę przeprowadzono na podstawie badań zmian wskaźnika natężenia poziomu wypadkowości w okresie 2010-2017 oraz na podstawie oceny konsekwencji ekonomicznych tego zjawiska w sektorze rolnym w Polsce. Szacunek kosztów utraconej produktywności oparto na przyjęciu tzw. perspektywy kapitału ludzkiego (ang. *human capital approach* – HCA). Porównanie wartości utraconego produktu w sekcji A „Rolnictwo, leśnictwo, łowiectwo i rybactwo” na tle przeciętnych wyników obserwowanych w gospodarce wykazało występowanie dużych rozbieżności w tym obszarze, wynikających zarówno z różnic widocznych między sektorami w skali obciążenia konsekwencjami niezdolności do pracy, jak i w wartości jednostki pracy w stosunku do średnich wartości w gospodarce. W zależności od zastosowanego podejścia w wycenie wartości statystycznego dnia pracy, szacunkowa wartość utraconej produkcji w sekcji A na jednego poszkodowanego wahała się między 22 a 150% średnich wartości uzyskanych dla całej gospodarki oraz między 30 a 212% w przeliczeniu na 1 tys. osób pracujących w danej sekcji (2016 rok). Osiągnięte wyniki pozwoliły na ukazanie ekonomicznego aspektu relacji między bezpieczeństwem pracy a produktywnością, dając jednocześnie argumenty w ocenie rentowności działań z zakresu poprawy warunków pracy.

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