INSTITUTE OF AGRICULTURAL AND FOOD ECONOMICS
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From the research on socially-sustainable agriculture [14]

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COMPETITIVENESS OF THE POLISH FOOD ECONOMY UNDER THE CONDITIONS OF GLOBALIZATION AND EUROPEAN INTEGRATION

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Edited by
prof. dr hab. Józef St. Zegar

Authors:
dr Zbigniew Floriańczyk
dr Mariola Kwasek
dr Wioletta Wrzaszcz
prof. dr hab. Józef St. Zegar

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The authors are the researchers
of the Institute of Agricultural and Food Economics
– National Research Institute (IAFE-NRI)

This publication has been prepared under the Multi-Annual Programme within the subject ***The Competitiveness of Sustainable Agriculture***, which involves three research tasks, as follows:
(1) *Alternative forms of agriculture in the strategy for the development of the agri-food sector and rural areas,*
(2) *The productivity of different forms of sustainable agriculture,*
(3) *Sustainable agriculture and safe food and health.*

Reviewer
Dr. Andrew Fieldsend, Research Institute of Agricultural Economics in Budapest

Translated by
AGIT Centrum Tłumaczeń

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Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej
– Państwowy Instytut Badawczy
00-950 Warszawa, ul. Świętokrzyska 20, skr. poczt. nr 984
tel.: (22) 50 54 444
faks: (22) 50 54 636
e-mail: dw@ierigz.waw.pl
http://www.ierigz.waw.pl

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FOREWORD

The Multi-Annual Programme entitled "*The Competitiveness of the Polish Food Economy in the Era of Globalisation and European Integration",* established pursuant to the Resolution of the Council of Ministers of 1 February 2011, implemented by the Institute of Agricultural and Food Economics, National Research Institute (IAFE-NRI) in Poland in the years 2011-2014, covers, among 8 research topics, the issue of **"The Competitiveness of Sustainable Agriculture"**. Within this topic, three research tasks have been distinguished, namely 1) Alternative forms of agriculture in the strategy for the development of the agri-food sector and rural areas, 2) The productivity of various forms of sustainable agriculture, 3) Sustainable agriculture and food safety and health.

The issues connected with sustainable agriculture have been studied within the framework of the multiannual programme "The economic and social conditions of the development of the Polish food economy after accession to the European Union" (task: socially-sustainable agriculture), implemented by IERiGŻ-PIB in the years 2005-2009. The research results concerning this form of agriculture have been presented in 10 books published jointly as *"From the research on socially sustainable agriculture"*.

The research on sustainable agriculture in the current Multiannual Programme focuses on the issues connected with the competitiveness of this form of agriculture. It especially concerns new challenges and conditions with regards to the development of agriculture, technological and economic factors enabling increasing competitiveness, and competitiveness in the field of food quality.

The competitiveness of agriculture and the entire agri-food sector is more and more determined by ecological (environmental) conditions and food quality. It may result in a discrepancy between economical competitiveness, defined by the market as the result of choices made by independent sellers and purchasers, and social competitiveness, including negative externalities and public goods accompanying agricultural activity. The first constitutes a fundamental aim of the Lisbon Strategy, and the latter constitutes the message of a sustainable agriculture strategy. With reference to agriculture, these strategies are reflected in the European Agricultural Model, which marks the direction of development for Polish agriculture through Common Agricultural Policy solutions: *cross-compliance*, animal welfare requirements, the rural development programme, including the agricultural-environmental programme, and the gradual transfer of means to the second pillar of the CAP. Also there is an increase

in need to use agriculture to a greater extent for the substitution of fossil fuels (production of renewable energy) and countermeasures against climate change.

The European Agricultural Model, and European agriculture in general, including Polish, is subject to increasing pressure from globalisation. Globalisation is moving toward the standardisation of the production of the agri-food sector, based on economic competitiveness. At the same time, the need for the protection of public and common goods (global, regional, local) is continuing to increase. The discrepancies between the main players on the global agricultural and food products market are escalating in this respect, as do those between the forms of agriculture varying in the level of environmental and social sustainability.

The conditions caused by the processes of globalisation and European integration are additionally overlapping with the conditions resulting from the structure of Polish agriculture and the limited opportunities of changing it in the next few years. A number of factors shape this phenomenon, including demographic factors (the age of land users, the presence of successors), economic (the demand for work, the availability of capital for the restructuring and modernising of agriculture), social (the education of farmers' children, the family's source of income, the location of households' domiciles within the area of a particular farm) and environmental (sustaining rural viability, protection of agricultural landscape assets, biodiversity protection, and the increasing in water scarcity and climate change).

In the transformations of agriculture reconciling the requirements of competitiveness and environmental protection, an important role falls to alternative forms of agriculture, which cover, respectively, sustainable environmental; sustainable in terms of the environment, economy and society at the same time; and integrated, organic, ecological, and socially sustainable households. Apart from the importance of alternative forms of agriculture to the competitiveness of the agri-food sector and environmental protection, they also play a significant role in the productivity of agriculture, the effectiveness of the agricultural structure, the food quality, the sustainable development of agriculture and rural areas, and therefore of the entire country. A whole range of factors have an influence on the development of these forms, including the requirements of the global and local (niche) markets, ecological policy, the CAP, macroeconomic policy, agricultural structures, innovations (technological and biological progress), and consumers' preferences. A strategic question that is frequently asked nowadays occurs: is whether sustainable agriculture only a certain alternative to conventional (industrial) agriculture or is it also a necessity?

Within this issue, the interactions between agriculture and environment from the economic perspective will be also examined, resulting, *i.a.,* from ac-

tions undertaken in the area of the climate package, water management (balance) development, biological diversity and their influence on the agriculture sector. Therefore, the economic aspect of the impacts of agriculture and the environment will be taken into account in the research. The environment, especially including climate change, freshwater resources, biodiversity, and exploitable minerals resources, naturally imposes limits or even barriers on agricultural production. Agriculture, depending on specific agricultural practices (production methods) may on the one hand weaken those barriers, but on the other enrich the environment.

For instance, the importance of agriculture keeps growing, with regards to limiting the emission of greenhouse gases, including carbon dioxide. Similarly, the results of the climate package may constitute a barrier, but at the same time they may provide an opportunity for agriculture. Therefore, these environmental factors have to be taken into account when studying social competitiveness, and, to an increasingly greater extent, also the economic competitiveness. However, the issues of climate change, water, and biodiversity as such, cannot constitute an object of the research, since they fall within the ambit of other scientific disciplines.

The research will particularly focus on determining the productivity of various forms of agriculture, since this has a strong influence on competitiveness. Traditional measures of the productivity of production factors (*Total Factor Productivity* – TFP) will be complemented by social and economic measures, which reflect the external effects accompanying agricultural production. After all, the aim is to establish the correlation between the level of sustainability, productivity, and both the economic and social competitiveness of various forms of agriculture.

Nowadays, the assessment of food quality and safety are gaining in importance on account of their influence on health. The significance of food quality and proper nutrition to human health is not to be underestimated. The food quality is determined both in the post-agricultural elements of the food chain and in agriculture. The commonness of the industrial methods of delivering agricultural products has unspecified effects in terms of the wholesomeness quality of these products. The research should demonstrate the correlation between various forms of agriculture, especially conventional and ecological agriculture and the food quality.

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The results of the research on the competitiveness of sustainable agriculture will be published in subsequent books of the Multi-Annual Research Programme in the series ***From the research on socially-sustainable agriculture***.

In 2011, three books from this series were published. This one, which is the fourth, is in English and it includes an outline of research problems in the area of the competitiveness of sustainable agriculture (Chapter I), a summary of the kind of previous research on sustainable agriculture (Chapter II), an outline of research problems in the area of the food quality and safety and human health (Chapter III) and an outline of research problems in the area of the productivity and sustainability of agriculture from the development strategies perspective (Chapter IV).

I

THE COMPETITIVENESS OF SUSTAINABLE AGRICULTURE
An outline of research problems

1. Introduction

The Multi-Annual Programme **The Competitiveness of the Polish Food Economy in the Era of Globalisation and European Integration** includes the subject of THE COMPETITIVENESS OF SUSTAINABLE AGRICULTURE[1]. The importance of this problem lies, above all, in the role of competitiveness in the real economy and in the growing relevance of the form of sustainable agriculture. In a market economy, the *sine qua non* condition of agricultural holdings development is to meet the requirements of competitiveness. This obviously also concerns the holdings satisfying the criteria of sustainability and a larger whole – sustainable agriculture. Regardless of more or less approving assessments of an ethical character, if this form does not fulfil the competitiveness requirement it will have no chance for development. This is because the very foundation of a market economy is the competition mechanism – achieving an advantage on the market by agricultural holdings in order to increase the economic profits necessary for development or just staying in the area of economic. Lack of competitiveness leads to displacement from the market and therefore the loss of the benefits of the social division of labour. In such a situation the holding is forced into liquidation or, if the farming family possesses alternative sources of income, its restructuring into a self-subsistence farm.

Competitiveness constitutes the *credo* of modern economic and social thought. Competitiveness has become the mantra of public discourse in many fields: economic (maximise profit), political (win elections), social (gain material status, wealth, higher prestige than others have), and even the media (fame, viewer ratings as the basic criterion in television). Also in the environmental system (Nature) live organisms fight (compete) for habitat, food, water. In competitive-

[1] The Multi-Annual Programme "The Competitiveness of the Polish Food Economy in the Era of Globalisation and European Integration", set up pursuant to the Resolution of the Council of Ministers of 1 February 2011, realised by IERiGŻ-PIB (Institute of Agricultural and Food Economics – National Research Institute) in the years 2011-2014.

The subject THE COMPETITIVENESS OF SUSTAINABLE AGRICULTURE involves three research tasks, as follows: (1) *Alternative forms of agriculture in the strategy for the development of the agri-food sector and rural areas*, (2) *The productivity of different forms of sustainable agriculture* and (3) *Sustainable agriculture and safe food and health*.

ness many see the *panaceum* for all problems connected with socio-economic life. In competitive struggles the economic criterion seems to come first.

The phenomenon of competitiveness in the field of the economy − given a tremendous importance in the era of industrialisation − presently takes up new, fiercer, and even sinister forms, as the result of, above all else, exceeding capacity of the biosphere, "shallowing" the value system, and globalisation processes. This creates huge challenges for market participants and actors in socio-economic life. Forced competitiveness tempts the use of every opportunity, including unfair practices and gaining profits at the expense of others. Business entities (agricultural holdings) may achieve short-term (medium-term) competitive advantages at the expense of the future of the natural environment, or other subjects – the participants in socio-economic life. In fact, the main goal is to gain a competitive advantage by avoiding negative externalities, whose costs are borne by other business entities or "mute" market participants, i.e. nature (ecosystems) and future generations. The temptation and chance to avoid the results (costs) of externalities, *ergo* to offload them on others, and thus increase one's competitive advantage, escalate in parallel with the growing openness of economies and the growing dominance of transnational corporations.

The competitiveness of business entities – microeconomic competitiveness – does not translate into the competitiveness of collectivity of business entities and non-economic social entities. The goals and interests of this collectivity, as a whole, may only be achieved in the superior system – a social system. Given that the pressure of competitiveness *ceteris paribus* remains in opposition to the pressure of environmental protection and the protection of other social values, there emerges the question of extending the category of competitiveness, till now formulated in clearly discretionary terms as a monetary economic category, integral with the market, by including non-monetary and non-market issues. Therefore, the term microeconomic competitiveness has to be supplemented by social competitiveness. The main objective is to supplement the market, an independent pillar, with a political pillar, thus creating a mechanism controlling the development of the socio-economic system.

Different dimensions of social competitiveness are observed in the case of national economies and when it comes to the global economy. In the first case there exists a (declining) political factor, whilst in the second case such a factor cannot yet be observed. In the case of nation states, political institutions have certain powers to establish the rules of market functioning (boundary conditions) and the internalisation of externalities in the prices of products introduced onto the market. However, when it comes to globalisation, with the dominance of corporations, the possibilities of offloading external costs onto others grow,

whilst the political institutions' power to impose boundary conditions for market operating decline.

The peculiarity of agriculture is expressed, apart from the negative externalities, in positive effects. This mainly results from the integral bond between agriculture and the natural environment – land management – and the form of family agriculture. In the first case the main point is to protect natural resources – soil renewal, maintaining biodiversity and preserving the qualities of the agricultural landscape. In the second case the focus is on tradition, culture and, not long ago discarded older methods (technologies) of producing food, medicinal and other-purpose products. The observed a growing interest in traditional and regional (local) products – this is not a fashion, as the "discovery" of the commercial value of knowledge accumulated through the ages.

The transition from national economies to the global economy puts humankind in a householding situation, or, using Kenneth Boulding's metaphor, to a spaceship called Earth. This brings new light to the terms of understanding competitiveness and the connections between politics and competition. So, in the case of the national economy, it is recommended for politicians to make use of the competition mechanism, whilst taking action to achieve social goals. In order to do this, politicians encounter many dilemmas, including especially the choice of the field of competition (in which it can use competitive advantages most effectively and minimise lost benefits) as well as the available instruments.

As far as the global economy is concerned, the destructive effects of competition on global common and public goods and for the integrity of the world community substantiate the need for replacing competition with cooperation in order to most effectively achieve the necessary, optimal (not maximal) objectives within the available, limited resources. Replacing the growth imperative with development – the survival imperative, and the economic criterion, with the sustainability criterion – is becoming the necessity. However, there is emerging a crucial problem as how to achieve this goal under the conditions of the dominance of corporations competing against one another, driven only by economic, often short-term, interest.

In the case of agri-food systems, policy choices related to the two main models of agriculture: industrial and sustainable, and trade-off between the autonomy of the market and the state (the political factor). One must consider the agri-food system part of a primary system (higher order) and its connections with other secondary systems. In other words, there is a need for the holistic approach, not the reductionist approach, as mostly occurs.

Polish agriculture is undergoing significant transformations in pursuit of the more developed countries, adapting to market requirements. Under European integration and globalisation it is exposed to international competition and the competitiveness requirement to work with all the ruthlessness. The holistic approach, driven by social competitiveness, and therefore allowing for externalities, may significantly change the mode of agricultural development, which in the common opinion is outlined by the developed countries. Considering the social calculus (using the production potential and lost alternative benefits/costs), the choice may turn out to be far from obvious. Acting on social competitiveness, *ergo* bringing agriculture within the primary system (a higher-order system) changes the relationships as regards the competitiveness between the basic models of agriculture: industrial (conventional) and sustainable. The ability to manage economic competitiveness with no harm to social interests is a huge challenge standing before Polish agribusiness.

2. The concept of competitiveness

Competitiveness has not been unambiguously and strictly defined despite being the object of economic interest since the mid 18th Century[2] and becoming one of the cornerstones of economic theory, a status it retains up to the present day. The concept of competitiveness, as the concept of sustainable agriculture[3], is subject to different interpretations, which seem to be well grounded in light of their mutual interactions and connections with other elements of the socio-economic and environmental system. Generally the term "competitiveness" is understood as gaining advantage on the goods and services market. The advantage derived from competitiveness is concerned with selling these products. This advantage, under the conditions of perfect market, which is a general assumption of classical (neoclassical) economics, is larger or smaller depending on the relationship between supply and demand. Competitiveness in the economic sense is the competition for access to limited goods, being the subject of market transactions.

Generally speaking, competitiveness takes place when at least two subjects compete for the same good. As far as the economy is concerned, these subjects

[2] Note that the term competitiveness was introduced into economic theory by Thomas Malthus, whilst Adam Smith used the competition mechanism in his concept of the invisible hand, leading to the optimal allocation of resources, i.e. giving the same marginal income growth (later Pareto efficiency).

[3] The definition and interpretation of the concept of sustainable agriculture can be found in the series "From the research on socially-sustainable agriculture", especially in the synthesis [J.St. Zegar (2009a), *Z badań nad rolnictwem społecznie zrównoważonym [10]. Raport końcowy: synteza i rekomendacje*, seria „Program Wieloletni 2005-2009", nr 175, IERiGŻ-PIB, Warszawa.

participate on the market and compete against each other either in selling as much product as possible (salesmen' competition) or in purchasing commodities (goods) on the best possible terms (purchasers' competition). These conditions usually concern price, quality, delivery time, payment form, delivery form, etc. To win the competition, sellers make use of different activities enhancing the strength of their package (advertising, marketing). Competition can be ethical or unethical. As in sport. Ethical competition is based on the principle "may the better one win". It involves cooperation and corresponds to the added-value game (non-zero), whereas unethical competition is based on the principle: "the winner takes all" and corresponds to the zero-value game. The advantage of the first one is obvious, as it leads to development – increasing welfare by seeking the best – most effective – solutions. The second type only shares profits between the competitors and wastes strength and resources to eliminate the rival.

Classical economic theory assumed the existence of perfect competition conditions. In general, one assumes the following perfect economic conditions: 1) the number of sellers and buyers on a given product market which is large enough to exclude both groups from influencing the market price, 2) the uniformity of the product (commodity) offered by the sellers, 3) perfect market information available to all participants in the market, 4) no intervention of political factors on the market (the total independence of the market), 5) no transactional costs for market operations, 6) no barriers to market entry and exit, 7) perfect mobility of production factors enabling the adjustment to changing market conditions, 8) producers being guided by profit and consumers (purchasers) by usefulness (advantages), 9) non-increasing economies of scale. If the conditions of perfect competition are not met we are dealing with the situation called imperfect competition. The particular forms of imperfect competition are monopoly (only one seller of a given product), oligopoly (a few sellers of a given product), monopsony (only one purchaser of a given commodity), and oligopsony (a few purchasers of a given commodity).

Perfect competition is beneficial, as it secures the most effective allocation of resources in the Pareto sense. It so happens because *ex definitione* competition stimulates progress in the form of new technologies (innovations), and new products and services and eliminates less effective producers. The results are beneficial for purchasers, who are given a wider range of choice in line with better products and lower prices. This generally occurs when there are no deformations (defects) in the market. Thus, it is important that state policy applies in this regard. Even orthodox liberal accept state interference in order to provide

the conditions for perfect competition[4]. Supporting competitiveness by the state is also perfectly understandable, which is of present importance as well, especially regarding the role of innovation as a competitiveness factor, but also the role of knowledge. One should consider that in parallel with socio-economic development the field of competitiveness is in the state of transition from costs/prices (less-developed countries) to the quality of products (developed countries) and innovations (highly-developed countries).

3. Economic competitiveness *versus* social competitiveness

We are normally used to understanding competitiveness - indeed in terms of classical theory – as the competitiveness of businesses in their struggle on the market. Competitiveness in such a sense is based on microeconomic criteria. It is described as economic competitiveness, which, following market efficiency criteria exclusively, is defined by the equilibrium price indicated by the supply and demand mechanism. However, the equilibrium price does not involve externalities accompanying the production of market goods. It thus ignores social cost (lost benefits) and public goods, which are connected with the production of market goods. Including externalities in the process of competition gives it a social character. Whilst in the first case competition leads to maximising microeconomic effects, the second case favours maximising social welfare.

Economic competition theory was described most exhaustively by the guru of competitiveness, Michael E. Porter[5]. This theory assumes the existence of perfect competition and ignores the occurrence of externalities.

Competitiveness theory focuses on the issues of providing the conditions for perfect competition – eliminating any constraints on free competition, assuming that the perfect market will ensure the optimum of welfare in the Pareto sense. However, this approach has been put under question. For example the so-called The Lisbon Group on this issue stated: *The ideology of competitiveness does not observe that the market is not the only relevant element which counts and which defines the economic and social welfare of people and countries*[6].

The classical theory of competitiveness is subject to contestation on primarily due to the skipping of externalities. Generally speaking, an externality

[4] The law to secure competition dates back to Roman times: for instance, the law protecting the freedom of the grain trade (Lex Julia of 50 B.C.) or establishing the death penalty for profiteering on the common goods market (Diocletian's edict of 301 A.D.). Modern competition law is dated from the US Antitrust Law (so-called Sherman Act of 1890 year and Clayton Act of 1914 year).

[5] M.E. Porter (1992), *Strategia konkurencji. Metody analizy sektorów i konkurencji*, PWE, Warszawa.

[6] *Granice konkurencji. Raport Grupy Lizbońskiej* (1996), Poltext, Warszawa, p. 142-143.

emerges when a decision concerning the production or consumption of one object directly influences decisions concerning the production or consumption of other objects in ways other than market-related. In such cases the production or consumption capabilities of one group of subjects depend on the choices made by other subjects (other companies or consumers). The fundamental feature of externalities is their not being factors in market transactions. Yet, they can be desired or, quite contrary, undesired. The first case concerns positive externalities, whereas the other one negative externalities (anti-goods). The occurrence of externalities may lead to ineffective goods allocation – inefficient in terms of the primary system (in this case, the social system). The market itself triggers the production of the excess of negative externalities and the shortage of positive externalities. Therefore, it is necessary to internalise these externalities by adjusting the functioning of the market. For this purpose we could use concept of Cecil Pigou's tax, Ronald Coase's theorem or legal and administrative instruments.

Ignoring the costs of negative externalities, for instance the costs of environmental degradation, leads to a decline in welfare. The criticism, which only limits itself to (micro)economic competition is therefore justifiable. This way we have a place and justification for making relevant adjustments by an institutional (political) body. Regarding this problem, Professor Augustyn Woś stated: *Expansive competition leads to the destruction of the natural environment and the cost of its restoration is borne by whole societies* (…) *The total-competition hypothesis, everyone with everyone, gives advantage to the narrowly-understood "economism" at the expense of social structures and goals. We must look for a reasonable balance between these two systems*[7].

Including externalities is of key importance to the sustainable development concept and therefore for achieving important social and ecological goals. For this reason we are going to elaborate on this issue with possibly the simplest example referring to the case of a producer of good Y with input X, where certain negative externalities are connected with this transformation[8].

The price of a manufactured product should cover the marginal cost of production, i.e. in simplification to satisfy the condition:

$p \geq K_p'$,

where K_p' – producer's marginal cost (microeconomic),

with $K_p' = f(X)$,

where X – input volume, f – function symbol (transformation).

[7] A. Woś (2003), *Konkurencyjność polskiego sektora żywnościowego*, IERiGŻ, Warszawa, p. 10.
[8] References are made here to the work [J.St. Zegar (2009), *Konkurencyjność rolnictwa w dobie globalizacji*, Roczniki Naukowe SERiA, t. X, zeszyt 1].

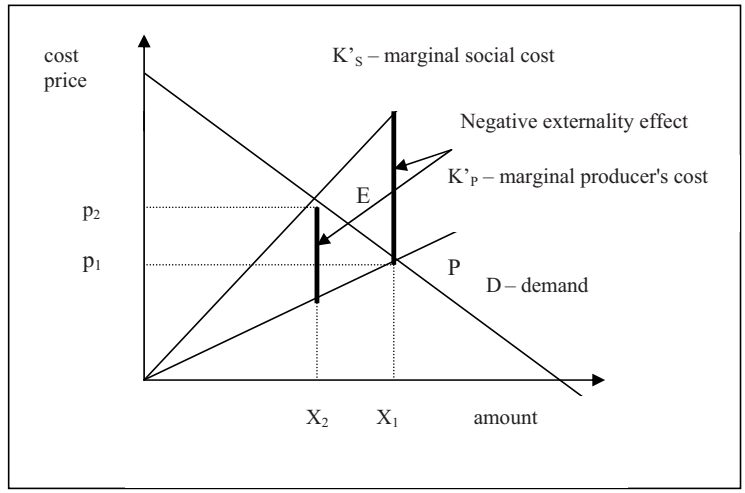
Price p (market) stands is the utility (benefit) for this product for consumer (buyer), whilst cost K_p' expresses the marginal cost incurred by the producer to manufacture this unit of the product. This cost is the result of a valuation of the input by the market. This is the microeconomic cost. In the case all the other cost and alternative cost entries, expressing negative externalities, thus in other words social costs, are left out. Taking into account the social costs requires that the price of the product produced to cover the marginal social cost of the production, i.e.

$p \geq K_s'$,

where $K_s' = f(X) + g(X)$, where g(X) expresses the negative externality cost.

If $K_p' < p < K_s'$, then we are dealing with the situation where price p of a given product covers the marginal cost of the given producer (thus being competitive), although it does not cover the marginal social cost. In the second case it can be the result of either high production costs or high externalities. Here, the implementation of a product at price p makes inroads on social good – for instance in the form of unpaid natural resources, environmental degradation or losing advantage in other applications of input X. Such situation is a typical academic example (see e.g. [Samuelson, Nordhaus, 1996; Tietenberg, 2004][9]. Let us illustrate this graphically in Figure. I.1.

Figure I.1. Supply and demand in the occurrence of externalities



Source: [Zegar, 2009].

[9] P.A. Samuelson, W.D. Nordhaus (1996), *Ekonomia*, tom 2, PWN, Warszawa; T. Tietenberg (2004), *Environmental Economics and Policy*, Pearson Education Inc., (ed. 4), Boston, New York, London.

Assuming that price p_1 meets the microeconomic competitiveness condition, the producer, to produce the market good, uses input in the amount of X_1, accompanied by a negative marginal externality amounting to $K'_s - K'_p$. Including the disadvantage resulting from the excess of this externality requires a reduction in the input for good (X) to the level X_2, thus *de facto* to a limitation of the production. A new balance is achieved with a lower production rate, satisfying the demand thanks to a higher price of the market equilibrium, but at the same time covering social cost.

The presented approach is of exceptional importance in agriculture, whose externalities are considerable due to numerous ecological and socio-cultural functions[10]. Ignoring these effects leads to discrepancies of the microeconomic and social optimum (the fallacy of composition), as these agricultural externalities are not *ex definitione* taken into account in the case of the microeconomic criteria of farmers' decision-making. They create inefficiency in the Pareto sense of goods (resources) allocation and constitute a relevant cause of state intervention. The state can, for the purposes of the internalisation of these externalities, make use of (apart from direct market instruments) legal and administrative instruments, either in the form of norms (standards) or financial transfers. Political instruments are first of all used to achieve the microeconomic (private) optimum value, established in the farmers' decision-making process, as close as possible to the social optimum's value. Similarly, the total activity of economic entities can extend the use of environment (natural resources, capacity) beyond the permissible limits. This also justifies the need for state intervention.

The state, obviously a democratic one, can serve the common good better than a market which is driven by consumers' (purchasers') actual needs or those imputed to them by advertising. This hypothesis is supported by the following arguments. Firstly, market institutions are not capable of listing environmental assets, as these are not subjects of market transactions. Secondly, market institutions are not capable of providing social preferences if these also involve intangible assets (which is actually the case). Thirdly, the market differentiates access to resources (money is the decisive factor), ignoring the social effects of the distribution, and violating the principle of social justice. Only the state has the power to change this[11]. In any case, one must assume that the state has the potential to realise objectives in accordance with social rationality. Otherwise, interventionism remains only wishful thinking. This is why the state, via politi-

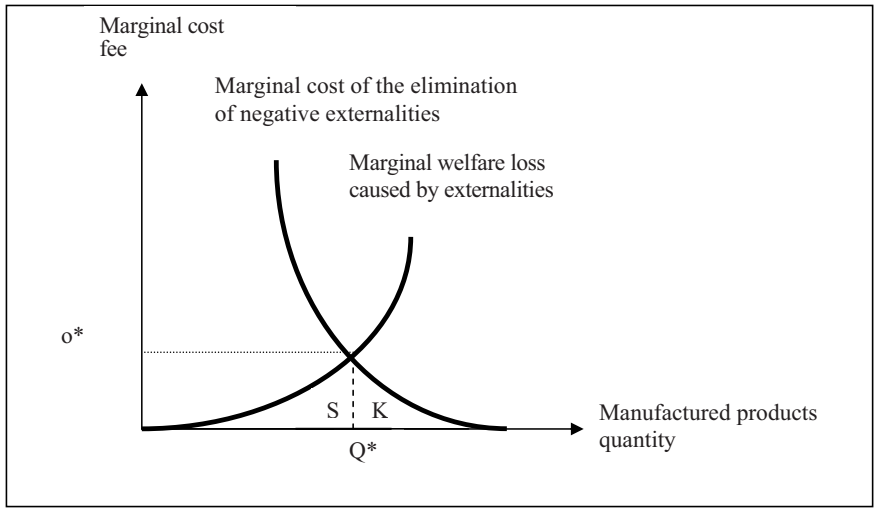
[10] In the case of the positive externalities of agricultural activity, the illustration should be the opposite, or it can be expressed in the second segment of social costs (i.e. decreasing external costs).
[11] R. Eckersley (2004), *The Green State: Rethinking Democracy and Sovereignty*, MIT Press, Cambridge MA, London.

cal instruments, must create boundary conditions for the activity of economic entities, so they can produce externalities in a permissible or desirable amount, with the result of these activities, optimal in microeconomic sense, being at the same time as close as possible to the social optimum.

Therefore, the internalisation of externalities requires imposing boundary conditions on farmers' (agricultural producers') decisions while using certain instruments which would cause modifications in conventional economic calculations. In the case of the EU member states these instruments involve the norms and standards on the use of the environment, cross-compliance requirements, and animal welfare requirements, through which direct internalisation takes place, along with a total environmental payment (i.e. subvention elimination) and total remuneration for producing public goods, e.g. through the Agri-Environmental Programme. Supporting agricultural public goods production is of both a direct and indirect character. Although up to the present day no quantification in that matter has been carried out, the relevant analytical research has been commenced[12]. Indicating the level of desirable public goods in the future will let us use more precise – oriented towards objectives – economic instruments, such as tradeable permits, taxes and payments, land purchase, quotas, etc. We shall illustrate this with the example of establishing the price payable by the producers who, aiming at reaching the optimum economic benefit, negatively influence others' welfare by producing negative externalities (Fig. I.2). Introducing the fee (the Pigou tax) compensating the results of externalities in the amount of o* would help us find the social optimum, which is attainable at the production rate Q*.

[12] T. Cooper, K. Hart, D. Baldock (2009), *Provision of public goods through agriculture in the European Union*, Institute European Environmental Policy, London; ENRD (2009), *A Pan European Overview of how Member States Approach the Delivery of Environmental and Social Public Goods through the 2007-13 Rural Development Programmes*. *(Task 2.1. of the TWG3 Work Plan)*, European Network for Rural Development, Thematic Working Group 3; ENRD (2009), *Public goods and public intervention. Overview of RDP screening exercise and member state survey*. *(Tasks 1.1. and 1.2. of the TWG 3 Work Plan)*, European Network for Rural Development, Thematic Working Group 3.

Figure II.2. Compensation for externalities caused by producers



Source: [Zegar, 2007a].

The factors behind the discrepancy between economic competitiveness and social competitiveness can be divided into three groups, as follows:

(1) Externalities (negative externalities). These costs are caused by the decrease in:
   a) natural environment value (welfare);
   b) socio-cultural value (welfare);
   c) the economic values of other economic process participants.

(2) Public goods (positive externalities). The most important public goods concern:
   a) the natural environment;
   b) the socio-cultural environment.

(3) Food quality. Including this factor in the division is relevant due to the relationship between:
   a) agri-food product quality and production costs;
   b) food quality and the economic activity of the population;
   c) food quality and population welfare;
   d) food quality and health *ergo* health protection (health care) costs.

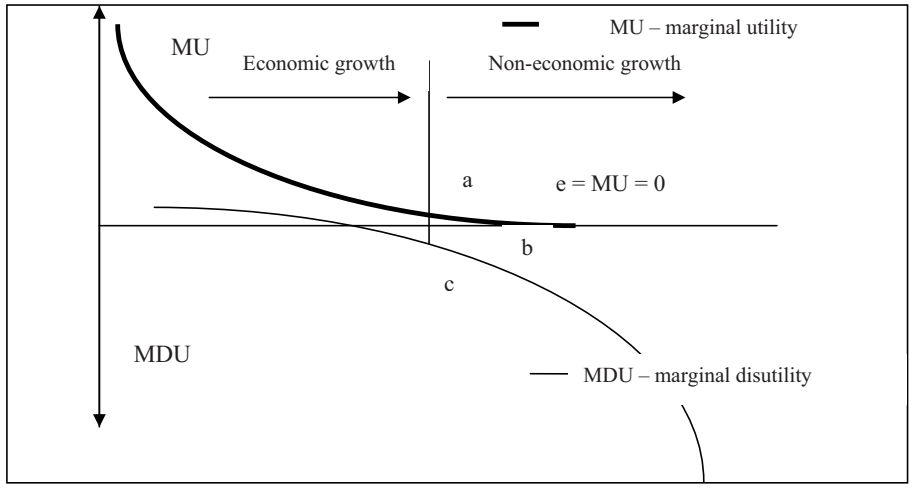
Including externalities brings about the issue of production scale in physical terms on an everyday basis. These externalities are the function of the physical values of manufactured products (scale), not the prices indicated by the market (supply and demand situation). The theoretical basis for the scale of the economy,

which can also be applied to agriculture, is provided by ecological economics. Following this theory, the scale of the economy is defined by two measures: (1) physical resources flow, which creates the material component of the flow of goods (advantages) and anti-goods (disadvantages). If this flow does not exceed the ecosystem restorability (resources and capacity/absorbability), the scale of the economy is environmentally sustainable; (2) the accumulated reserve of goods in the form of wealth and disadvantages[13].

The marginal utility of consumed goods and services (MU) falls because rational units first satiate the most desired needs, whilst the disadvantages, such as the reduction of free time and environmental degradation (MDU), accompanying the growing production and consumption increase; they can be regarded as lost advantages.

The production of disadvantages (anti-goods) is inextricably linked to the production of utility goods. If we wished to cease the production of anti-goods, we would need to cease economic growth. This is where the terms economic and non-economic growth, as well as optimal economic growth, come from. Economic growth reaches its maximum (optimum) when the marginal growth utility is equal to marginal disutility (lost advantages), when ab = bc (Fig. I.3). Therefore, the optimum is achieved when economic growth equals the generated advantages and disadvantages. It is a situation analogous to the one illustrated in Figure. I.1.

Figure I.3. Optimal production growth (scale)



Source: [Daly, 2007].

[13] Daly H. (2007), *Ecological Economics and Sustainable Development, Selected Essays of Herman Daly*, Edward Elgar. Cheltenham, UK*Northampton, MA, USA, p. 86.

4. The agricultural model and competitiveness

Reconciling competitive requirements with environmental protection and other social values not only becomes a postulate – a political aim – but even a necessity. Efforts are being made in this regard within the frameworks of conventional (industrial) agriculture involving the implementation of integrated and precise technologies, and various forms of alternative (unconventional) agriculture. The last-named involve agricultural holdings which are sustainable environmentally, economically and socially, integrated, organic, ecological and socially sustainable. Alternative forms of agriculture, apart from the competitiveness of the agri-food sector and environmental protection, are of pivotal importance in agricultural productivity, agricultural structure efficiency, food quality and the generally sustainable development of agriculture and rural areas. The development of specific forms of agriculture is influenced by many factors: global and local (niche) market requirements, environmental policy, agricultural policy, macroeconomic policy, agricultural structures, innovations (technical and biological progress), and consumers' preferences. In general, as up to the present day the major focus is on the methods of agricultural production, which are in compliance with environmental requirements. This is achieved within the framework of conventional agriculture, especially if integrated, precise, organic and ecological. This way, using good agricultural practices, significant progress in sustainability in the environmental (ecological) sphere has been achieved. Yet, it is harder to be successful in agricultural (agricultural holdings) sustainability in the economic sphere and especially in the social sphere, or generally concerning sustainable agriculture (in the sustainable development sense) and socially sustainable agriculture. Between the different aims in these spheres of sustainability a discrepancy or even a certain contradiction can be observed. This creates considerable difficulties in the choice of a strategic path of agricultural development. Nowadays, in this context, a certain question of a strategic nature is often posed, namely whether sustainable agriculture is only an alternative to conventional (industrial) agriculture or a necessity. In my opinion it is clearly a rhetorical question, but in this article I leave it open for discussion.

In a market economy the main driving force of agricultural development is obviously the market mechanism. This mechanism proved to be very efficient in the development of capitalism, which developed an agricultural model, called industrial (conventional), placing a farmer in the so-called technological treadmill[14], which operates according to a sequence of events:

[14] Term introduced by W.W. Cochrane: *The technological treadmill* – [W.W. Cochrane (1979), *The Development of American Agriculture: A Historical Analysis*, University of Minnesota Press, Minneapolis].

the growth of production (supply) beyond demand ⇒ farm price reduction ⇒ technological change towards increased production (intensification, concentration, specialisation) ⇒ supply growth (overproduction) ⇒ price reduction ⇒ …

Within the conditions of the competitive market this forced work efficiency growth and the concentration of the production potential *eo ipso* in agriculture. Specialisation served the same purpose, following the principles of reductionism and Fordism. The volume of production began to outgrow the frames of traditional peasant farms, which initiated a revolution towards family farming, and then agricultural enterprises[15]. Goods production and private microeconomic advantage began to determine the main direction.

Directing production at the market involved agricultural holdings in a vertical integration system. Despite the increased agricultural potential and agricultural holdings production scale, farmers were losing the freedom of decision to agricultural companies and corporations. The processes of concentration and specialisation in agriculture – directed at the maximisation of economic benefits for farmers – were stimulated (even forced) by intermediaries and the food industry, who cared about their own interests. In the conditions of overproduction, scattered and made economically weaker by nature, farmers had no chances to impose their conditions on the agricultural market and were forced more and more to submit to stronger participants in the market.

The model of industrial agriculture not only obtained more from non-renewable natural resources but also deposited more and more waste in the environment. Due to the industrialisation of agriculture highly-developed countries and some developing countries raised their agricultural production several times. It was made possible by increasing the use rate of inputs from beyond agriculture (mineral fertilisers, pesticides and other crop production products, agricultural engineering), by achievements in biological progress (new varieties of plants and species of farm animals), and by increasing areas of irrigated and meliorated land[16]. The costs of this success, however, turned out to be enormous, as industrial agriculture is blamed for the risks to the natural environment (i.a. loss of fertile soils, air and water pollution, loss of biodiversity, dependence on non-renewable resources), socio-cultural environment or even for consumers' health, just to mention the most famous diseases in recent years, BSE (*Bovine Spongiform Encephalopathy*) and FMD (*Foot-and-mouth disease*). Not without

[15] F. Tomczak (2005), *Gospodarka rodzinna w rolnictwie: uwarunkowania i mechanizmy rozwoju*, IRWiR PAN, Warszawa.
[16] WCED (1987), *Our Common Future. The World Commission on Environment and Development*, Oxford University Press, Oxford, New York.

blame is the microeconomic-decision-making theory, which assumed economic advantage (profit) maximisation as the only goal function. Economic balance achieved at the maximum profit level included the equilibrium of neither the ecological system nor social system[17]. Moreover, industrial agriculture, driving people out of farming and rural areas, contributed to a decrease or, in many cases, decline, of the economic and socio-cultural viability of rural areas.

Therefore, the future development of agriculture according to the model of industrial agriculture, encounters the limitations of natural resources (especially soil and mineral energy resources) as well as the environment capacity in the area of anthropogenic impact. This influences agricultural economics and fluctuating price relations connected with the theorem on scarceness and, or even most of all, a resulting pressure on accounting (internalising) externalities, the evaluation of agricultural production, and accounting the "rights" of farm animals, as well as socio-cultural effects, including the impact on the viability of rural areas.

The basic factor of agricultural success, and the foundation of the economics of industrial agriculture, was the use of fossil energy in mechanisation, and the irrigation and production of chemical fertilisers and pesticides. The era of cheap fossil energy is a thing of the past. The prices of oil and gas are growing rapidly, which is leading to less profitable pricing for agriculture.

Observing the limitations of industrial agriculture and the awareness of the growing limitations of ecosystems in general, and especially host ecosystems, prioritised the question of agricultural and rural sustainability. The "discovery" of multifunctionality brought a totally new view on the discourse concerning agricultural and rural development, including the interaction between agriculture and the countryside.

Agricultural multifunctionality switches the traditional – productive – orientation of agricultural activity to new areas: new goods and services. Agricultural (farm) multifunctionality has two directions which can be provisionally termed broadening and deepening. The former means extending the activity to new areas (such as agritourism, services, crafts, recreation, wind power plants, transport, the food trade), the diversification of production (biofuels, herbs, fibre plants, horse breeding, water retention and fish farming), nature and landscape management (water protection, the preservation of rare animal/plant species) and establishing agro-industrial companies. The latter involves e.g. organic

[17] A.Woś, J.St. Zegar (2002), *Rolnictwo społecznie zrównoważone*, IERiGŻ, Warszawa.

farming, high-quality production, direct deliveries[18]. These functions of agriculture bring about a significant reprioritisation in many spheres of its development, A different light is put on, e.g., the question of progress in agriculture, which cannot be further one-sidedly associated with conventionally-understood concentration, specialisation and intensification. Today progress does not mean enhancing energy (power), but enhancing knowledge. At the same time, we are presently much more aware of the possibilities and threats of nature management and the drawbacks of technological progress than we were at the beginning of industrialisation or a few dozen years ago. It turns out that breaking environmental limitations is possible through the multifunctionality of agricultural holdings and that this is easier to achieve under the conditions of family agriculture (usually multi-directional) than a specialised agricultural enterprise. Yet, there is no functional relation here, as a large, specialised farm can be environmentally friendly and a small peasant farm can be greatly oppressive to the environment. Everything depends on the technologies used and complying with the code of agricultural good practices. Nevertheless, it is undoubtedly better to combine the preservation of ecological, economic and socio-cultural equilibrium in a family agricultural holding with multi-level production.

Multifunctionality has become the basis of managing agricultural development. It is the core feature of a new agricultural development strategy, which currently cannot be reduced to mere economics: efficiency maximisation, or, even more so, production maximisation. Present-day agriculture has more functions, including especially nature management – a commodity which is absolutely immobile, which means it cannot be exported nor imported. The role of agriculture in environmental preservation is unquestionable. At the same time, agriculture still plays a major role in the development of rural areas. In particular, multifunctional agriculture is essential for the sustainable development of rural areas and the sustainable development of the whole economy[19]. It is often reflected in the policy of many countries, including the European Union, whose economics is beginning to notice that agriculture cannot remain without remuneration for delivering goods and services, which the market does not value or compensate, but it also cannot be excluded from the duty to bear negative environmental consequences. Public demand is expanding beyond the products offered by the market. The time when city residents expected only the supply of cheap food is far gone. Demand today involves new goods and utilities, in-

[18] K. Knickel, H. Renting, J.D. van der Ploeg (2004), *Multifunctionality in European agriculture* [in:] *Sustaining Agriculture and the Rural Environment*. *Governance, Policy and Multifunctionality*, Edited by Floor Brouwer, Northampton.
[19] Daly H. (2007), *Ecological Economics*…, op. cit.

cluding especially those connected with the natural environment and landscape[20]. This is what, besides the question of agricultural production, rural, economic and cultural viability, determines the present role of agriculture. In this context the first place goes to sustainable agriculture, based on family agricultural holdings, as it is environmentally friendly, provides high-quality products, makes use of the marginal workforce and other marginal production features, reaching beyond the traditional agricultural products for food needs.

The differences between the industrial agricultural model and the sustainable agricultural model are manifold. In Diagram I.1 the most important differences (features and impact) are specified, more detailed descriptions being omitted due to lack of space.

Diagram I.1. The features and impact of industrial agricultural model and sustainable agriculture model

Industrial agriculture		Sustainable agriculture	
Features	Impact	Features	Impact
Concentration	High production and high work efficiency	Multifunctionality	Supporting the viability of rural areas
Specialisation	Low wholesomeness quality of food	Sustainability	Environmentally friendly
Intensification	Environmental degradation	Family holdings	High food quality
Chemisation	Damaging rural viability	Organic farming	Participation in the culture
Competitiveness	High economic competitiveness and relatively low social competitiveness	Competitiveness	Mild economic competitiveness and relatively high social competitiveness

Source: Own study.

The main advantage of industrial agriculture lies in higher work efficiency and production scales. Limited land resources which may be considered doing no harm to ecosystems, and so biodiversity, bring about a new dilemma faced several dozens years ago: to maximise work efficiency or land efficiency? Accounting for externalities brings new elements in approaching this dilemma.

[20] G. van Huylenbroeck, G. Durand (2003), *Multifunctional agriculture: a new paradigm for European agriculture and rural development*, Ashgate, Hampshire – Burlington.

A similar situation concerns the production scale problem, which was brought to our attention in the previous sections. The optimum in the case of the production scale differs significantly under accounting and non-accounting externalities.

5. Levels of competitiveness

Competitiveness may be considered in relation to different levels, from which three are the most relevant: micro (economic subject), macro (national) and global (planetary).

The competitiveness of economic subjects – agricultural holdings (called microeconomic competitiveness) refers to private advantages, defined by the price indicated by the market (or established by a political factor and constituting an external parameter). The competitiveness of an agricultural holding reflects the resources of the holding: material, environmental and human (including skills and abilities), which give it an advantage over other agricultural holdings. Maintaining competitiveness forced or stimulated processes of concentration, specialisation and intensification, leading to cost reduction and meeting the requirements of the food industry and other participants in the market with regard to quality, organisational and technological requirements. To some extent agricultural holdings were able to face the requirements defined by cooperation (horizontal). The integration process (vertical cooperation) significantly stimulated these processes, contributing at the same time to the raise of large agri-food enterprises. Concentration in the sphere of agribusiness and the emergence of corporations changed the conditions of competition for agricultural producers. With the excess of supply, it forced the acceleration of the industrialisation process and complying with larger transfer of added value for the other links of food chain as well as for the consumers.

The competitiveness of corporations is also characterised as microeconomic, although it increasingly diverges from the conditions of perfect competition. There is, however, a significant difference between the competitiveness of private economic subjects (especially farms but also industrial enterprises) and corporations. In the first case, which reflects the situation of owner capitalism, the owner-producer acts not only to achieve an economic advantage but he also takes into account long-term advantages. This refers to both a capitalist – a business owner – and an individual farmer. For instance, an individual farmer is aware of the need for soil fertility restoration and the interests of the future owners of the holding in general. In the second case, i.e. – the corporation, which reflects the situation of corporate capitalism, the managers running the corporation act mainly on the motivation of increasing the capital provided to them by the owners (shareholders), as this is what they are assessed on and

paid for by the latter. The pressure to increase economic advantages (*money making corporation*) often leads to short-term advantages – in a given financial year – at the expense of the environment, and other subjects or *values* as well as the future. In such case ethical motives, even if present, pale into insignificance. The owners of capital being under the supervision of the corporation become anonymous and the real economy is replaced by the symbolic economy in the form of transfers and financial transactions. Under these conditions there is practically nothing which can restrict acting on microeconomic decision-making criteria, and the global market – perfectly anonymous – bears the ethical impact of acting only upon this criterion. So-called corporate responsibility is, as for now, more of a marketing action than a real phenomenon.

Competitiveness on the macroeconomic level is reflected through the competitiveness of subjects (that is, microeconomic competitiveness). However, it is not the only criterion, as on this level it is necessary to include the social and environmental components (in the interests of mute market participants), which may result in observing external costs and public goods. Competitiveness on the macroeconomic level – the economies of individual countries – means the ability of a given economy to compete on global markets, which favours a long-term and effective economic growth[21]. Competitiveness in this case exceeds the indicators relevant to microeconomic competitiveness, such as price, quality, efficiency, profit, and market share, whilst more important factors are economic development, income, and life quality (welfare)[22]. The fundamental element of competitiveness on the macroeconomic level is therefore the involvement of the political factor, which puts the priority on social goals. Politics must define the boundary conditions for economic subjects so that, while competing in their own interests, they also realise social goals. The main point is to achieve a convergence between the microeconomic optimum and the social optimum. In general, established boundary conditions are not sufficient and there comes a need for compensating and stimulating measures, which requires certain redistribution of added value.

The regional competitiveness of international economic groups – such as the European Union – brings the problem of macroeconomic competitiveness to a higher level. New elements are the competition between countries of a common market and the competition among a whole group on the global market.

[21] In this case international competition is also included.
[22] M.E. Porter (1990), *The Competitive Advantage of Nations*, Free Press, New York.

Globalisation brings the technological treadmill to a higher level, creating *ceteris paribus* a strong stimulus to lower prices. The main result of globalisation in the agri-food sector is fuelling the mechanism of competitiveness.

Production surplus on the global market ⇒ competitive pressure ⇒ concentration and consolidation ⇒ increasingly strong transnational corporations (controlling product markets) ⇒ declining decision areas for farmers ⇒ declining participation of agriculture in the final price of food products.

The dominance of larger and larger corporations on markets results in the disappearance of any features of classical (ethical) competition[23]. Classical competition assumed the immobility of capital. In the global economy capital is mobile, thus the advantages of specialisation and free trade do not have to be present in every country. Comparative advantages may transform into absolute advantage, which ruins countries with no advantages whatsoever[24].

Economic competition on the global market may not lead to reduction in production costs and price. This may result from a new situation concerning agricultural development. The main concern here is connected with the dilemma standing before the global society regarding food production, which lies in the way in which to combine the necessity of agricultural (food) production growth, essential for feeding the ever-growing number of people, with the increasing awareness of the necessity of preserving the natural and socio-cultural environment of rural areas. This gives rise to a new challenge in agriculture, which comes down to **satisfying the demand for agri-food products, at the same time reducing the pressure on the environment**. Demand is determined by the needs for feeding the increasingly higher level of the growing human population and the needs of non-food sectors. The still growing number of people, combined with the increase in consumed products, especially regarding animal products, requires further growth in agricultural production. According to projections, by 2030 global agricultural production must increase by at least 50% in order to satisfy the food demand of a 25% larger population and 23% higher

[23] It is worth reminding that classical competition was based on the differences in production costs between countries, resulting from the differences in work efficiency in individual sectors, which led to comparative advantages (such competitiveness was analysed by Adam Smith and David Ricardo), differences in the time of introducing new products and taking advantage of the position of monopolists, or a novelty rent, as it is now the case with regard to GMO (such competitiveness was analysed by Raymond Vernon) and the differences in the production factors possessed by the countries, especially natural resources (such competitiveness was the subject of analysis for Eli Heckscher, Bertil Ohlin and Paul Samuelson).

[24] In order to control the impact of unlimited capital mobility – often for speculative purposes – a proposition has been filed to use Tobin's tax, the profits from which could be devoted to finance global goods [Daly H. (2007), *Ecological Economics*…, op.cit]. This concept is recently attracting more and more attention in the European Union.

income[25] and by 2050 it should increase by 70%[26]. Considering bioenergy needs, agricultural production should double during the next four decades.

The pressure on the environment is caused by the practically unincreasable acreage of agricultural land and the inevitable decrease in fossil energy and water and the greater role of agriculture in climate change mitigation.

Both agricultural production growth and reducing the agricultural pressure on the natural environment are becoming a necessity. This way we have a nearly dead-end situation with only one solution: more production from a smaller outlay, i.e. using sustainable intensification.

The distinctive feature of agriculture is the relationship between agricultural products and natural and climatic conditions, which cannot be duplicated or imitated by competitors. Natural conditions are assessed in a given example on the basis of the soil efficiency at comparable outlay of capital and work. Work efficiency mainly depends on the relationship of land acreage to engaged labour resources, which is no novelty. Land capacity, next to technical and capital capacity, was the decisive factor in the processes of intensification, mechanisation and land concentration in countries with high population density and those with low density[27]. The significance of the relationship between land and work is currently growing due to the negative externalities of intensive agricultural production methods. Countries with a large land capacity per capita or with agricultural holdings of larger areas have *ceteris paribus* more competitive power than countries with lower agricultural land capacity per capita. Due to the deteriorating relationship between the price of agricultural intensification factors and ecological limitations, less intensive agriculture is gaining an advantage. Labour costs are also of significance as permits for lower labour costs would mean the improvement of competitiveness in relation to agriculture, in which this cost is higher, if it is not compensated by higher work efficiency.

Agricultural evaluation of the environmental factor is of utmost significance to the economic efficiency of the capital applied by corporations, which, acting exclusively upon the economic motive, strive for the eventual adjustment of its marginal effectiveness. Capital mobility reduces limitations resulting from the immobility of land, because, as was aptly captured by R. Sobiecki *attractive*

[25] J.A. Bakkes et al. (2008), *Background report to the OECD Environmental Outlook to 2030. Overviews, details, and methodology of model-based analysis*, OECD, NEAA, Bilthoven, Paris.
[26] FAO (2009), *How to Feed the World in 2050*, Rome.
[27] This issue was approached, i.a. [Herlemann H.H., Stamer H. (1963), *Rolnictwo w dobie technizacji: rozwój ekonomiczno-techniczny a produkcja rolna i wielkość gospodarstw*, PWRiL, Warszawa; Brandt H., Otzen U. (2007), *Poverty Orientated Agricultural and Rural Development*, Routledge, London and New York].

land draws capital[28]. The urge to use the land by attracting capital in the situation of increased competition may, however, lead to resorting to ecological dumping, which means lower environmental standards[29]. The cost of such dumping is obviously borne by the societies of the countries forced to use such a resort, whilst the profits go to the owners of the capital – the corporations. We must therefore distinguish between corporate competitiveness and the country's competitiveness. In the first case competitiveness, together with microeconomic advantages, depends on the quantity of sold products, whereas, in the case of countries, competitiveness does not necessarily have to mean an increase in welfare (advantage), because the growth of microeconomic competitiveness through social or ecological dumping is profitable to corporations, but the advantage to the country is very doubtful. This means that globalisation driven by huge powers, especially informational technologies, transnational corporations, capital markets, consumerism, eliminating limitations for unrestrained operation of market mechanism, is in opposition to the need for the sustainable use of immobile land.

Globalisation is moving towards large agricultural holdings (megafarms), joined or integrated vertically with corporations or trade networks. Such megafarms, with highly-advanced specialisations – including monoculture – are generally extracted from rural society. This undermines the number of workplaces, sources of income, and demographic power in general, which means it may initiate the downfall of the economy, as it disrupts the economic viability of these regions, because the advantages are taken away from the rural areas. This is why we must weaken the effects of the market operation by the internalisation of externalities, stopping the subsiding of such holdings, and, should the need arise, establishing a limit on farm size. Megafarms are an even bigger risk in developing countries – with weak institutions of environmental protection and low awareness of health and animal needs (welfare) protection. These countries are at risk by excessive specialisation and monoculture, as well as intensification through the inputs of industrial origin. These activities, on one hand, improve the work efficiency and economic efficiency of agricultural production, which in overpopulated developing countries is not a priority, and draw people out of agriculture and rural areas, mainly to city slums, transfer the advantages to transnational corporations, destroy the wealth of the local environment and very often leave this problem to a local community. In such way, the basic wealth of rural areas, composed of nature and landscape, may be irrevocably lost.

[28] R. Sobiecki (2007), *Globalizacja a funkcje polskiego rolnictwa*, SGH, Warszawa, p. 107.
[29] Czyżewski A., Grzelak A., Matuszczak A. (2006), *Integracja versus globalizacja – jako problem polityki rolnej*, Roczniki Naukowe SERiA, t. VIII, nr 4.

The globalisation process brings the problem of negative externalities and public goods to a higher level[30]. Globalisation, based on strengthening the microeconomic criteria and weakening the social ones, stands in the way of the internalisation of externalities. Ignoring these criteria in microeconomic calculus lowers production costs, *ergo* increases competitive power. The internalisation of these effects in microeconomic calculus – forcing agricultural holdings to include them – may be done only in the process of political intervention. However, at the planetary level there is no subject capable of introducing such a policy. At the same time the erosion of state power in the globalisation process may lead to the weakening of the intervention required to internalise external (negative) effects, also on the macro economic level. This means that these effects are going to be produced excessively. The excess of negative externalities on the global scale is difficult to control, because of the total lack or the weakness of the institutional (political) factor on the global level – the difficulty to perform relevant arrangements and complete these arrangements[31].

A similar situation concerns global public goods, whose production in *stricte* market conditions is deficient. On the national scale farms can be stimulated to produce public goods by tax transfers. Also on the level of regional groups, as in the case of the European Union, such transfers are possible. Yet, on a global scale, as for now, no mechanism has been developed to reward farmers for providing global public goods. At most, attempts are being made to stop the degradation of such goods (halting the destruction of tropical rainforests, ocean fishery protection, preventing sea and ocean pollution, preserving traditional arable plants varieties and animal species). Meanwhile, we are observing increasing demand from the international society to take action in the interests of global public goods, among which we find the global natural environment. The same refers to limiting harmful externalities[32].

On one hand globalisation heightens competition on local markets, as the markets are subject to the penetration of global corporations (global market), on the other hand it creates the opportunity for local producers to penetrate global markets, i.e. it removes the barrier of demand for so-called niche products (of ecological farming, produced through the use of traditional technologies, and regional). The market for such products becomes a global market, through joining them to trade networks, whilst demand becomes potentially unlimited. Local products become global products. Demand for niche products grows quickly

[30] J.St. Zegar (2010), *Ekonomia wobec kwestii agrarnej*, „Ekonomista", nr 6.
[31] J.E. Stiglitz (2007), *Wizja sprawiedliwej globalizacji. Propozycje usprawnień*, PWN, Warszawa; W. Szymański (2007), *Czy globalizacja musi być irracjonalna?*, SGH, Warszawa.
[32] J.E. Stiglitz (2007), *Wizja sprawiedliwej*…, op.cit.

on international markets, as well as on national and local ones. In the case of the local market the demand can be used to promote agritourism and tourism in general, as an attractive alternative for the McDonaldisation and Disneyisation of consumption. Moreover, apart from the traditional factors of competitive advantages (comparative advantages resulting from the differences in production costs or natural resource capacity) we have the competitiveness of brand, regional and niche products[33].

Impassable limitations of the biosphere throw new light on the question of global competitiveness. The socio-economic system has to be located in a primary ecological system and the criteria of global rationality, i.e. economic, social and ecological, have to be adjusted to the system in order to make decisions which would be optimal from the Earth's point of view. The views on the question of global rationality, if formulated at all, always differ between the representatives of different professions. Orthodox economists bring the criterion of economic efficiency to the planetary level. Anthropogenic capital should bring the highest-possible added value (GDP) as the result of the self-contained and independent activity of market mechanisms. Alternative economists extend the efficiency indicated by the market by externalities and draw our attention to the question of welfare. The differences in the approach are related to the definition (scope, capacity) of the category of welfare. Humanists raise the question of hunger and poverty. Philosophers frequently refer to the knowledge of Ancient Greece, especially the works of Aristotle and Plato. Ecologists prioritise ecological rationality, formulated from the stance of the sustainability (restoration) of the biosphere's function. Some refer to the functions giving life to humans, and others (deep ecology) to the functions necessary to the longevity of the goddess Gaia.

Even our commonsense emphasises the necessity to protect the global ecosystem. This results from the change in the situation, expressed metaphorically as the transition from an empty world to a full world. It highlights the question of global public and common goods. And even more – natural goods in general. Using these goods, regardless of the formal and legal property entitlement and location in physical space, becomes important for the planetary community, therefore it should be the subject of its interest. This form of use should meet the requirements of global rationality. We must avoid the so-called fallacy of composition. Activities fulfilling the requirements of optimality, whether referring to economic subjects, countries or individual sectors, or differently-expressed fields of human activity, do not lead to a planetary optimum if they

[33] M.E. Porter (1990), *The Competitive Advantage*…, op.cit.; P. Krugman (1991), *Geography and Trade*, MIT Press, London.

are not in line with global rationality. What violates such rationality is shifting problems in space – developed countries get rid of ecological problems, i.a. by exporting them – moving activity (factories) to poorly-developed countries (*vide carbon leakage*, virtual water, purchase of land, forests).

On the global level, the economic system must be unavoidably included in the primary system, whereas the order of the following systems raises controversies among economists and ecologists. The main point is whether the programming of the development should include the triad of *economic system* < *social system* < *ecological system* or the triad of *economic system* < *ecological system* < *social system*. Regardless of the above controversy, economic theory is facing an enormous challenge of replacing the imperative of growth, the foundation of the whole construction of present economic theory framework, with the imperative of global ecosystem sustainability.

The planetary community has found itself in a very difficult situation. The nature of the present development processes in relation to the causes and results is on planetary scale. The main subjects defining the course of events are global corporations, which take advantage of economic and ideological orthodoxy to increase profits. The market mechanism unchained or yet being unchained from nation state shackles acquires new opportunities, enforced by the changes in the cultural sphere. The reign of the god Mammon seems to have no boundaries, same as privatisation and liberalisation. The material economy gives way to the symbolic economy, which expands (*vide* financial intermediation sphere) to an enormous size. The primacy of capital accumulation is released from the restrictions laid down by the national state. This unlimited capital accumulation leads to unlimited Earth exploitation. The time has come to admit that the Earth's resources are for the common good. This was expressly emphasised by Pope Benedict XVI in his Encyclical Caritas in Veritas*: What is also needed (...) is the worldwide redistribution of energy resources, so that countries lacking those resources can have access to them. The fate of those resources cannot be left in the hands of whoever is first to claim the spoils, or whoever is able to prevail over the rest*[34].

Global corporations, the subjects of globalisation in the economic sphere, acting only on the motive of short/medium-term economic benefit, fuel the race to cross the boundaries of the biosphere. This way they shorten the time which remains to prepare an alternative to exploiting the natural environment.

The solution of global problems requires global management, but without global government in conventional thinking. A more realistic solution is to co-

[34] Benedict XVI (2009), *Encyclical Caritas in Veritas*, Liberia Editrice Vaticana, p. 39.

ordinate the activities of individual countries, while restricting the actions of global corporations in such a way as to appropriately capture in the economic mechanism the connections between its parts and the global ecosystem. The difficulties connected with this issue involve the resistance which could result from the necessity to restrict the state's sovereignty. If the consensus concerning global issues is reached, it is usually burdened with the syndrome of the common denominator principle. By way of digression, it is paradoxically easy to restrict sovereignty to the benefit of global corporations (there are even special incentives made to draw their capital), but extremely difficult to restrict the same sovereignty for the planetary common good.

In the context of the main challenge, the key issues are dilemmas concerning the method, place, subject and scale of the production, which come down to the answer to the questions: how?, where?, who?, how much? Suggestions concerning the main challenge (how?) have two directions. The first direction is related to improving the agricultural model based on the industrial paradigm, which facilitated the repeated agricultural production growth in 20th Century, and the second direction concerns the development of alternative models based on the paradigm of sustainable agriculture. The latter focuses on new technologies of agricultural production, which could be more accessible to a wider range of farmers (agricultural holdings) and at the same time more efficient (productive) than industrial technologies. The main point is to solve the problem of feeding through "sustainable intensification" − without deepening the degradation of natural environment. This goal may only be achieved by the development and dissemination of the agricultural progress, which is of vital importance to create all three key factors of agricultural production growth, i.e. maintaining soil fertility, efficient water use and fighting weeds, pests and diseases, which significantly reduce agricultural production.

Also two standpoints developed as regards the second question (where?). One of them opts for the concentration of agricultural production in the regions with the most favourable natural (environmental) conditions, through the intensified use of industrial inputs, which is supposed to save agricultural lands for other purposes. In favour of such option works the trade liberalisation, on the assumption that socio-economic connections are comparable. The second approach opts for using the capacity of all agricultural land, but without increasing the spatial concentration of crops and for agrobiological intensification. In favour of this approach speak environmental reasons, whose values are diminished due to excessive intensification and setting of land aside. Regardless of the option, the protection of lands, which can be utilised for the purpose of agricultural production, becomes the key duty of the planetary community. Such lands (agri-

cultural land), regardless of their parameters in the legal sense, constitute one of the basic public goods and should be subject to protection and law regulations in respect of their utilisation. The only sustainable way to broaden the range of opportunities for mankind is increasing biomass, and therefore every land procurement for the purpose of building development of the technological infrastructure should be compensated by increasing biomasses on other land. The time of "the empty world", which through the last centuries allowed the economic expansion of some (highly-developed) countries at the expense of others (mostly poorly developed), has ended. Natural resources on a global scale are limited. Therefore, under the necessity of a global formulation of planetary community development, they need to be divided in a new way. It is extremely difficult, if just to refer to the willingness of some countries to seize the resources of the Arctic region and Antarctica. But this also concerns agricultural land, in reference to which the phenomenon of its purchasing by huge investors (corporations), also the international ones, is gathering momentum, which hampers family farmers from developing and threatens the food safety of local communities. How can we prevent this in the situation of gaining new benefits from selling land in the form of capital inflow, new technologies and infrastructure development?

With reference to the third question (who?) a historic debate, concerning large and small property (agricultural enterprises/agribusiness) and family agricultural holdings, is being continued. The latter of the above not only receive a new chance in the socially-sustainable model, but also seem necessary in poorly-developed countries.

The fourth question – how much? – is only seemingly determined. The projected doubling of demand for agricultural products in the next four decades involves components of a different certainty level and a different reaction capacity. The most certain component is the population, which, within the above-mentioned period, is already determined. Less certain, but with a low threshold, is the component of satisfying the caloric needs, in order to eliminate hunger or bring it to the structural level (as in the case of unemployment). One can assume that in the case of efficient food distribution, the needs of the starving may be, to a large extent, covered by decreasing the consumption rate of the obese[35]. Roughly speaking, both populations reach about 1 billion. Food needs may be covered by plant products or animal products. This demand component is relatively flexible to economic regulation. Thus, a direction for the control of animal product consumption (especially those with a less favourable

[35] Obviously, obesity is not only the result of improper diet, especially the excessive consumption of food products, but it can also arise from genetic, cultural and other causes.

feedstuff conversion factor) is recommended. Within the demand-supply equation an important element is also the supply side. The limitation of agri-food product waste, which is estimated at about 1/3 of the produced volume of agricultural products, would significantly reduce the need for a growth in agricultural production. Large opportunities may be also found in the use of living organisms in waters, especially oceans and seas. Rational management of this common good would reduce the pressure on agriculture, enriching at the same time the diet of millions of consumers by fish, crustaceans, algae and others.

The performed survey indicates that on the global (planetary) level competition is neither an effective nor an efficient way of protecting global public and common goods, and that it requires cooperation in order to, i.a., "civilise" competition.

6. Polish agribusiness under the challenge of competition

The backwardness of Polish agriculture according to the industrial model, mass production on a large scale, reduces the economic competitiveness of Polish agribusiness. Despite this, it is commonly considered competitive. In the assessment we have to consider that the contribution of several factors, which compensate for the results of the said backwardness, and which are as follows: lower labour costs, a modernised (in accordance with the latest standards) food industry, lower rents and land rent, and good quality of production. Labour costs will strive for alignment with other EU countries, as will rents. This means that the competitive advantage currently resulting from it is gradually eroding. An increase in importance is, on the other hand, being observed in the factors deciding about long-term competitiveness, namely the adjustment of mobile to immobile, environmental factors, observing environmental standards, and product quality.

As regards the relationship between production factors, we should strive for an agricultural structure which facilitates the highest possible efficiency of agricultural production – productivity. In the conventional understanding of productivity (i.e. in *Total Factor Productivity* – TFP) it is the easiest to achieve through the increase in the production scale, which usually requires land concentration. Undoubtedly, the size of family agricultural holdings are, generally speaking, too small to achieve the optimum scale, not to mention achieving income parity. Yet we do not need to strive for higher numbers and volumes of agricultural enterprises, as it narrows the opportunities for family farms development, which are the most desirable in the light of the concept of sustainable agricultural development. However, assuming rapid transformations of the agrarian structure, i.e. a *de facto* sudden reduction in farm numbers, is indisputably justifiable under certain conditions. One such condition is the limita-

tion of the possibility of agrarian restructuring during the coming years. This results from many factors, inter alia, the demographic factors (farmers' age, presence of successors), economic (work demand, access to the capital for agricultural restructuring and modernisation), social (farmers' children education, family income sources, location of farmers' houses on farms) and environmental (rural viability preservation, growing water deficiency and climatic changes). This is why, adding to the pile the orientation of a growing number of consumers on high quality products and globalisation of niche products, it is crucial to seriously consider the dual form of agricultural development, in which niche products would gain the equal position, as a strategic option. This way the agricultural backwardness could be transformed into an instrument of competitive advantage.

Environmental standards are strictly political choice. The European Union raises these standards, therefore this factor of competitive advantage directly loses its significance. Although, paradoxically, it may contribute to the improvement in competitiveness, facilitating high quality production. Food quality can be the area, in which Polish agribusiness could compete on the global market (mass products of high quality; regional products; ecological products).

In rich countries food is no longer a necessity but a consumer good, which is expected to comply with the highest quality standards. Farmers are given a choice: either to produce more at a lower price or to produce less at a higher price. Farmers are not philanthropists and expect the production to be profitable, as well as the production of not completely integrated public goods. Consumer's awareness of food quality, as well as environmental friendliness of production methods, is very important; in the long term it is even more important than supporting (subsidising) such production. The consumer has to be certain regarding the quality of production. This is why certificates, licences, monitoring labelling, etc. are so important. Yet, it is the price which plays the main role in creating the demand. Hence the significance of productivity and internalisation of externalities. Consumer's education is also important. To achieve this goal it would be desirable to work out a complex policy of healthy diet, including the least expensive instruments of such policy. This involves banning the advertising of "junk", unhealthy food products, information about the actual properties of food products, education in healthy eating habits.

The characteristics of the current stage of development is defined by the necessity to compete for national client not only on foreign market, but on the national market as well. Niche products could be sold in a diversified way: in trade networks (global and regional), on local markets and in direct form (the Internet). The local market and direct sale, including the Internet, bring many

advantages: apart from the quality, it also eliminates the growing costs (margins) of intermediation. Delivering high quality (niche) products requires the cooperation of all the links of the food chain, including food processing sector. It is also necessary to overcome one of the weakest points in this cooperation, namely strengthening social capital. Such development of agriculture has the potential to combine the economic necessities (competitiveness) with preserving social and environmental preferences.

Environmental factors have to be included in the research on social competitiveness and must be given more importance in the research of economic competitiveness. The latter is the primary goal of Lisbon Strategy, whilst the former is a message of the sustainable development strategy. In relation to agriculture these strategies are reflected in the European Agricultural Model (EAM), which determines the direction of the development of Polish agriculture through the CAP solution: the *cross-compliance* principle, animal welfare, Rural Development Programme, including the Agri-Environment Programme, gradual transfer of resources to Pillar II of CAP. Reorientation of the policy to social competitiveness requires joint action of all EU countries. Therefore, we should prepare a coherent plan with new strategic solutions, which are in accordance with the concept of sustainable development.

II

SUSTAINABLE AGRICULTURE IN THE LIGHT OF THE SELECTED CRITERIA – A MICROECONOMIC VIEW

1. Introduction

This study constitutes the first attempt to assess the sustainability of Polish agriculture based on data collected in the public statistics system and the Farm Accountancy Data Network – FADN. It involves data from a sample survey of the structure of farms conducted in 2007, processed specially for the purposes of this study, as well as data involving FADN agricultural holdings for 2007.

Nevertheless, the assessment of agricultural sustainability is a complex task that faces significant obstacles. Firstly, the concept of the sustainable development of agriculture, similarly to sustainable socio-economic development, is still in the *in statu nascendi* phase – sustainability indicators have yet not been fully established on the international and national scales. Secondly, conditions of sustainability are not identical in the case of farms (in the microscale) and in the case of the whole agricultural sector (in the macroscale). Thirdly, the local nature of significantly diversified agro-ecosystems leads to the situation where the same value of a given sustainability indicator in the case of one farm (locality, region) may support its sustainability (or unsustainability), and in the case of another it may not. Fourthly, statistical surveys so far have consisted mainly of determining the value of production and economic features – social values to a lesser extent – whereas values related to the environment have been marginalised – mainly in the context of their impact on economic benefits.

The authors of the study approach the sustainability of agricultural development in the context of a certain harmony (order) in three spheres, namely environmental, social and economic. The most attention was paid to sustainability within the first sphere, which stems from both the accessibility of data and fundamental importance of sustainability with regard to the environment.

This study presents the methodology of sustainability measurement and a rough assessment of the obtained results.

In the description of the sustainability of farms, the fulfilment of threshold values in respect of the environment was assumed as the basic criterion, and, more precisely, the component relating to retaining soil fertility – the permanent ability of soil to produce biomass. The values have been set within the framework of six criteria which are of great significance in running a farm in a reasonable way (the share of cereals in the structure of the area under crop,

the number of plant groups cultivated on a farm, the index of vegetation cover on arable land in a winter period, the density of livestock on agricultural land, the balance of soil organic matter and the gross balance of main fertilising macro-elements, i.e. nitrogen, phosphorus and potassium).

The delineation of some groups of farms which show a potential for sustainability proved to be helpful in the assessment of agricultural sustainability. The following groups of farms were distinguished: without livestock, without field crops, with crops and livestock, organic, Norfolk and agricultural holdings of farmers. The last of these are understood as farms that generate the majority of income for agricultural activity.

The effects of the sustainability of agricultural development in the macroscale result from the activities of particular farms. However, they do not constitute a simple arithmetic sum or mean. One should take into account the highly-complex and changing structure of agriculture that reaches beyond farms. Changes in this structure are inherent in the development of agriculture – they are even indispensable for such development. The structure of agriculture aims at achieving a state of equilibrium, which is constantly being disrupted by changes in the agricultural environment and in internal factors. This is analogous to particular farms which also aim at achieving equilibrium. Still, the balance and sustainability of all farms, assuming that it is possible, does not mean the sustainability of agriculture as a whole.

In order to assess agricultural sustainability, data involving particular groups of farms were used, namely the share of respective groups of farms in respect of the number, area of cultivated land, labour input, livestock and standard gross margin. It is assumed here that the greater proportion of farms fulfil the criteria of sustainability, the greater the sustainability of agriculture.

The analysis of statistical data allowed the determination of the percentage of farms fulfilling the particular criteria of environmental sustainability, which have a great – and even fundamental – importance in restoring soil fertility. The percentage of farms simultaneously fulfilling several such criteria is low, similar to the percentage of Norfolk farms. The percentage of such farms is very varied at the national and regional levels. It has been determined that a greater percentage of farms fulfilling environmental criteria of sustainability can be found in the higher area groups, and this fact is quite important. In relatively larger farms (taking into consideration agricultural activity) a higher standard gross margin was generated, and the organisation of agricultural production (crop and animal production) may be deemed more environment-friendly. In most micro-farms, that is farms with a very small area of agricultural land, animals are not bred, but one may find farms with animal production on a large

scale. The size of a farm has an influence on the difficulty level of the implementation of certain agricultural practices that are conducive to environmental protection. Apart from the fragmentation of farms, one may distinguish the following important factors that are unfavourable for environmental protection: a high percentage of farms without livestock, a fertilisation level that is inadequate for the nutritional requirements of plants and a state of soil nutrient availability related to main macroelements, as well as a high proportion of acidified soils and insufficient liming.

In the context of agricultural development, agricultural holdings of farmers (obtaining income mainly from agricultural activity) are clearly much more sustainable than others. Such farms use more organic and mineral fertilisers and the differences between the input and output of fertilisers are greater than in the case of other groups. The level of environmental sustainability is even higher in the case of agricultural holdings of farmers and those with greater economic potential. It is clearly an optimistic sign that it is possible to reconcile environmental and economic purposes.

The FADN holdings analysis has confirmed the conclusion that there exists a positive correlation between environmental sustainability and farm area. FADN data also made it possible to draw the significant conclusion that environmentally sustainable farms relatively more often generate income at least at parity level. Clearly, an important reason for that is the larger area of the farm. The production type and structure (e.g. type of farming) are also important, so special attention was paid to farms with plant and animal production.

Accession to the European Union has contributed to an increase in agricultural output and thus to an increase in food security (self-sufficiency of food) and has increased the incomes of farmers. In the latter case, payments resulting from certain mechanisms of the Common Agricultural Policy have played a significant role. At the same time, inputs of agrochemicals have increased, whereas soil liming was still neglected. There was also an unfavourable tendency with regard to the agricultural prices relations, which does not bode well for the future incomes of farmers. In the context of agricultural sustainability, certain threats may result from an increase in the number and area of agricultural land owned by farms without livestock, as well as the increasing specialisation of crop and animal production.

Following accession to the European Union, new stimulus for the implementation of the environment-friendly agricultural practices. This was related to the propagation of packages within the agri-environmental programme and activities aimed at meeting the requirements of the cross-compliance rules and animal welfare, as well as with other Common Agricultural Policy pro-

grammes. Organic farms received a new stimulus, but they are not numerous in Polish agriculture. Within the sector, agriculture does not pose much threat to the environment. Nevertheless, on the local scale, such threats appear as a result of improper practices related to fertilisation and using crop protection chemicals, or too great a concentration of livestock, or too great a share of cereal crops in the structure of arable land under crops.

The image of Polish agriculture depicted in this study with regard to fulfilling the criteria of sustainable development leads to a general, not very optimistic, conclusion pointing to the range of existing or potential threats. Particular areas of threats to sustainable development include insufficient care for the condition of the soils and water, the proper directions of breeding and waste management and, above all, the poor economic condition of the majority of farms. It has to be stressed here that most statistical data at the national level "conceal" the actual regional and local diversification. It means that in many areas of the country the situation is much worse that it appears from the "averaged" assessments.

The presented assessment of agricultural sustainability is of a preliminary nature, as a more in-depth assessment requires further research, and, above all, collecting empirical data, which, in turn, requires complementing statistical research with new components that will mainly enable the assessment of the qualitative nature. At the same time, within the research already being conducted, one should strive for selecting information related to "pure" agriculture and expand its distribution in regional sections. First and foremost, it is necessary to limit the frequency and scope of changes introduced in the methodology and organisation of statistical research that disrupt the comparability of multi-annual time series. In situations where such changes cannot be avoided, one should evaluate them "deeply" in respect of the numerical representation of their impact on particular values of variables. The ideal solution, rarely applied by the Central Statistical Office (GUS) nowadays, would be to convert the retrospective data series to the current methodological and organisational conditions.

2. Research objectives and methodology

The objectives of the research task were of an ***implicite*** cognitive nature and ***explicite*** utilitarian nature. As to the former, it was to examine the theoretical assumptions of socially-sustainable agriculture in comparison with the conventional (industrial) model of agriculture, as well as various concepts of agricultural sustainability, the premises of this type of agriculture, and the place of this concept in economic and social theory. In the latter case, the objectives consisted of seeking answers to the following questions: 1) **can the model**

of socially-sustainable agriculture constitute the basis for national agricultural and rural policy? and 2) **does the model of socially-sustainable agriculture create the conditions for an increase in the competitiveness of Polish agriculture?**

The scope of the research involved in respect of:

1) **entities:** private farms with the identification of a group of organic farms and other groups of farms essential for the assessment of agricultural sustainability;
2) **area:** the whole country and all voivodships (Map II.1);
3) **subject matter:** the production capacity of farms, the management method, and the situation of agricultural households.

Map II.1 The administrative division of Poland into voivodships

Source: www.mapaswiata.pl/mapa_polski.php?op=wojewodztwa

The research method consisted of:

1) theoretical studies, including studies of the literature, aimed at identifying various concepts, approaches and results;
2) critical judgements of the partial results obtained;
3) an analysis of the generally available public statistics data (GUS) and the results of calculations carried out for the purposes of the task (this involves the survey of farm structure in 2007);
4) FADN data analysis for 2007.

Primary empirical databases used in the research involved public statistics data, included or not included in GUS data collections, including especially data on the generalised results of structural research conducted in 2007 on a random sample of ca. 200 thousand farms in Poland and data from the Farm Accountancy Data Network (FADN). The observation area of the Polish FADN includes 12 thousand farms of an economic size of at least 2 ESU, generating in total at least 90% of the standard gross margin in Poland[36].

This **study attempts to assess** the sustainability of farms, taking into account primarily selected environmental criteria and, to a lesser extent, economic and social criteria. The choice of sustainability measurement criteria resulted from subject-related reasons and data availability in data collections in GUS and FADN. The assumed indicators allow the assessment of the sustainability of farms in the environmental context, although an incomplete one. Numerous essential organisation and production factors indicating the level of sustainability of farms are not taken into consideration in the research by GUS and FADN. It was impossible to verify the extent to which the minimum standards related to the maintenance of arable land, the broader scope of the so-called good agricultural practices, the agricultural and environmental condition, and other practices distinguished in agri-environmental programmes, were observed. The sustainability of selected groups of farms, in which the manner of agricultural production might have had a strong impact on sustainability, was also evaluated.

The criteria adopted to assess the environmental sustainability of farms are the following:

- the share of cereals in the structure of arable land under crop – not exceeding 66%;
- the number of plant groups cultivated on a farm – at least 3;
- the index of vegetation cover on arable land in a winter period – at least 33%;
- the density of livestock on agricultural land – not exceeding 2 livestock units per 1 hectare.

Apart from the aforementioned criteria, the assessment of agricultural production in terms of its being environment-friendly also included such qualities as:

- the balance of soil organic matter;
- the gross balance of fertilisers: nitrogen, phosphorus, potassium.

[36] The economic size (strength) of farms is expressed in European Size Units – ESU (1 ESU = EUR 1 200). It is expressed by means of the sum of all standard gross margins (SGM) of all activities occurring within a farm. Each country belonging to the European Union defines individual thresholds for the economic size relating to the minimum size of farms participating in the FADN system.

The applied criteria of sustainability resulted from legal prerequisites (involving beneficiaries of agri-environmental programmes) and/or principles of the rational economy in environment-friendly agriculture.

Cereals are the primary group of crops cultivated in Poland. The information on the share of cereals in arable land under crop is a statistical indicator of environment-friendly agricultural production. This measure defines the correctness of crop rotation and the biodiversity level of agrocenoses[37]. The high percentage of cereals in arable land under crop means that they have to be sown for the period of two, three or more consecutive years. Such agricultural practices make it impossible to apply correct crop rotation, which leads to, e.g., the spread of diseases among cultivated crops, growing weeds, a higher risk of crops being damaged by pests, and soil impoverishment in respect of organic matter[38]. Sowing cereals in consecutive years results in a distinct decrease in their yields, which depends mainly on the type of cultivated cereals, habitat conditions, and the level of agricultural engineering[39].

From the point of view of agricultural engineering, the optimal share of cereals in land under crops is 50%, but such a proportion is not very viable in the current economic conditions[40]. As is stressed by, i. a., J. Kuś and J. Fereniec, in the case of cereals, one has to avoid their share on the land under crops exceeding 66%[41]. The maximum level of this indicator is identical to the assumed value in the rational farming and in the system of integrated production[42]. Confirmation of this value can be found in the study by G. Blohm, who stressed that hardly any other crop is as destructive for the condition of the soil as cereals, mainly due to soil drying. In this respect in crop rotation one should alternate cereals and possibly

[37] A. Faber i inni (2010), *Ocena stopnia zrównoważenia rolnictwa w Polsce w różnych skalach przestrzennych* [w:] *Ocena zrównoważenia gospodarowania zasobami środowiska rolniczego w wybranych gospodarstwach, gminach, powiatach i województwach*, Studia i Raporty IUNG-PIB, nr 20, Puławy, p. 12.

[38] J. Smagacz (2000), *Rola zmianowania w rolnictwie zrównoważonym* [w:] *Gospodarowanie w rolnictwie zrównoważonym u progu XXI wieku*, ed. J. Borowiecki, Pamiętnik Puławski, tom II, z. 120, IUNG, Puławy, p. 411-414; J. Grabiński (2011), *Problemy gospodarstw zbożowych*, „Wieś Jutra" – Zboża, nr 3-4 (152-153), p. 12.

[39] J. Smagacz (2011), *Skutki długotrwałego stosowania płodozmianów zbożowych*, „Wieś Jutra" – Zboża, nr 3-4 (152-153), p. 23.

[40] W. Ziętara (1998), *Ekonomika i organizacja przedsiębiorstwa rolniczego*, FAPA, Warszawa, p. 109-110.

[41] J. Kuś (1995), *Rola zmianowania roślin we współczesnym rolnictwie*, IUNG, Puławy, p. 34; J. Fereniec (1999), *Ekonomika i organizacja rolnictwa*, Key Text, Warszawa, p. 258; J. Kopiński (2005), *Opracowanie metodyki oceny stanu zrównoważenia gospodarstw rolnych o różnych kierunkach produkcji*, IUNG-PIB, Puławy, p. 15 – Final report of the research project No. 3.06 implemented under statutory activity in research sub-programme No. 3.

[42] E. Majewski (2002), *Ekonomiczno-organizacyjne uwarunkowania rozwoju Systemu Integrowanej Produkcji Rolniczej (SIPR) w Polsce*, SGGW, Warszawa, p. 83.

good forecrops, or at least sow cereals in the same field for no longer than two consecutive years. Due to these reasons the land under cereals should not exceed 66% of the area of arable land[43].

Therefore, the appropriate share of cereal crops in the structure of arable land under crop in environment-friendly farms (justified in respect of subject matter and practice) has been assumed at the level of 66%, which includes such types of cereals as wheat, rye, barley, oats, triticale, mixes of cereals, corn for grain, and other cereals (e.g. buckwheat, millet).

The number of groups of crops cultivated on arable land is an important measure informing us about the adequacy of crop production[44]. On the basis of this measure it is possible to specify farms that are marked by a more diversified structure of crops. This is another indicator allowing the verification of the correctness of crop rotation. This number shows if the requirements involving the selection and succession of crops are followed. This ensures limiting the growth of the pest population, the reduction of weed infestation and a decrease in nitrogen losses.

For the purposes of this study it was assumed that on a sustainable farm at least three of the following crops should be cultivated: *cereals* – wheat, rye, barley, oat, triticale, mixes of cereals, buckwheat, millet, corn for grain, other cereals; *papilionaceous plants* – leguminous plants for dry grain, i.e. edible legumes (including: edible pea, bean, broad bean, lentil, soya bean and others), forage legumes (including: forage pea (field pea), vetch, field bean, sweet lupine and others), mixes of legumes with other crops; legumes for green fodder, serradella; small-seed papilionaceous plants for green fodder; *root crops* – potatoes, sugar beetroots, root forage crops (including: forage beetroots, forage rutabaga, forage carrot, turnip, Jerusalem artichoke, forage pumpkin, forage cabbage and others); *oil crops (industrial)* – rape and agrimony and other oil crops (including: sunflower, flax and camelina and others); *grasses on arable land* – grasses in field cultivation for green fodder (temporary; or *others* – other species not classified to the aforementioned groups. This limit is one of the requirements put before the beneficiaries of the agri-environment programme (the sustainable agriculture package).

The index of vegetation cover on arable land in winter period is recognised as one of the agro-ecological indicators for the synthetic assessment of soil resources, balance of ecosystems and level of the implementation of a sus-

[43] G. Blohm (1961), *Ekonomika i organizacja gospodarstw rolniczych*, PWRiL, Warszawa, p. 117.
[44] I. Duer, M. Fotyma, A. Madej (2002), *Kodeks Dobrej Praktyki Rolniczej*, MRiRW, Ministerstwo Środowiska, Warszawa, p. 20; E. Majewski (2002), *Ekonomiczno-organizacyjne*…, op. cit., p. 81.

tainable production system in agriculture[45]. This index is expressed by the ratio of the area of winter and perennial crops and catch crops to the general area of arable land under crops. The soil plant cover in the winter period prevents the negative impact of climatic factors on soil, such as precipitation and wind. Leaving soil without any plant cover for a long time is particularly dangerous, because, as a result of the destructive impact of precipitation, wind and insolation, the soil is subject to physical, chemical and biological degradation[46]. Higher values of this index inform us about the lesser risk of the washing out of nitrates and the better protection of soil against erosion[47].

The main source of pollution of water caused by agricultural activity are nutrients provided with natural and mineral fertilisers (nitrogen, phosphorus) and residues of crop protection chemicals. The pollution of water by nitrates of agricultural origin occurs mainly in regions with high stocking density and intensive crop production with a great amount of fertilisers and crop protection chemicals.

Therefore, in order to assess the condition of the agricultural environment and ecological sustainability at the level of the farm, it is necessary to define the indicator of plant cover. It is advisable to make the area under winter crops as large as possible. According to the experts, the sufficient soil protection effect produced by the crops being cultivated is defined by such threshold values as 40%[48], 50%[49], or even 60%[50]. In this study, 33% has been assumed as the

[45] A. Harasim (2009), *Regionalne zróżnicowanie pokrycia roślinnością gleb Polski* [w:] *Wybrane elementy regionalnego zróżnicowania rolnictwa w Polsce*, Studia i Raporty IUNG-PIB, nr 15, Puławy, p. 77.

[46] R. Dębski (2000), *Degradacja gleby i jej skutki w środowisku przyrodniczym*, Rocznik Akademii Rolniczej w Poznaniu 317, Seria Rolnictwo nr 56, Poznań, p. 209-224.

[47] S. Krasowicz (2005), *Cechy rolnictwa zrównoważonego* [w:] *Koncepcja badań nad rolnictwem społecznie zrównoważonym*, ed. J.St. Zegar, seria „Program Wieloletni 2005-2009", nr 11, IERiGŻ-PIB, Warszawa, p. 31-34; A. Faber i inni (2010), *Ocena stopnia zrównoważenia rolnictwa w Polsce*…, op. cit., p. 11.

[48] In dairy farms, the index of vegetation cover below 40% may indicate a higher degree of washing nitrates out and lower protection against erosion [S. Krasowicz, J. Kuś, J. Jankowiak (2007), *Ekonomiczno-organizacyjne uwarunkowania funkcjonowania gospodarstw rolniczych o różnych kierunkach produkcji w aspekcie rozwoju zrównoważonego* [w:] *Współczesne uwarunkowania organizacji produkcji w gospodarstwach rolniczych*, Studia i Raporty IUNG-PIB, nr 7, Puławy, p. 58].
The threshold level of a vegetation cover is also mentioned in Ordinance of the Minister of Agriculture and Rural Development of 11 March 2010 *on minimum standards*, Dz. U. z 2010 r., nr. 39, poz. 211. According to this Ordinance, minimum 40% of arable land located in areas at risk of water erosion, included in a farm, should be under vegetation cover at least for the period from 1 December to 15 February.

[49] A. Harasim (2004), *Wskaźniki glebochronnego działania roślin*, „Postępy Nauk Rolniczych", nr 4, p. 39.

[50] J. Kopiński (2005), *Opracowanie metodyki oceny*…, op. cit., p. 15.

minimum value of the plant cover. The indicator of plant cover on arable land was calculated as a ratio of the total area of winter crops (such as wheat, rye, barley, triticale, mixes of cereals, vetch, mixes of leguminous crops with other winter crops, rape and agrimony), catch crops on arable land[51], grasses in field cultivation for green fodder, small-seed papilionaceous plants for green fodder to arable land under crop.

Environmental limitations in respect of animal production in a farm involve, first of all, **the density of livestock on agricultural land**[52]. This limitation results mainly from the possibility of exceeding the level of the absorption of natural fertilizers by an agroecosystem[53]. Due to this fact, an indicator of stocking density on agricultural land is especially important in the comprehensive definition of the sustainability level of a farm. This measure allows an ecological assessment of farm organisation, because it provides information on the intensity level and, what is more, it indicates the extent to which the environment is loaded with natural fertilizers (for example manure)[54].

The permissible level of livestock density on agricultural land should result from the equivalent of the legally-permissible amount of natural fertilizers – 170 kilograms of nitrogen[55]. Each country of the European Union was obliged to specify the equivalent of an annual amount of nitrogen of animal origin expressed in livestock units. In the Polish literature one may find a justification for equivalents amounting to 1.5-2.5 livestock units per one hectare of agricultural land. The lack of consensus in the literature on this field is the result of using various research methods, including different coefficients for converting physical units of animals into livestock units, because researchers took into ac-

[51] The great significance of catch crops in the organization of field economy, especially in the development of humus in soil, was stressed by R. Manteuffel (1984), *Ekonomika i organizacja gospodarstwa rolniczego*, PWRiL, Warszawa, p. 311.

[52] E. Majewski (2002), *Ekonomiczno-organizacyjne*…, op. cit., p. 113.

[53] A. Faber i inni (2010), *Ocena stopnia zrównoważenia rolnictwa w Polsce*..., op. cit, p. 11.

[54] J. Kuś (2006), *Oddziaływanie dobrej praktyki rolniczej na gospodarstwo rolne* [w:] *Z badań nad rolnictwem społecznie zrównoważonym*, ed. J.St. Zegar, seria „Program Wieloletni 2005-2009", nr 52, IERiGŻ-PIB, Warszawa, p. 29; J. Kopiński, A. Madej (2006), *Ilość azotu dostarczanego w nawozach naturalnych w zależności od obsady zwierząt*, „Nawozy i nawożenie", nr 4 (29), IUNG-PIB, Puławy.

[55] National legislation – Act of 10 July on *fertilisers and fertilisation,* Dz. U. z 2007 r., nr 147, poz. 1033; Ordinance of the Minister of the Environment of 23 December 2002 *on detailed requirements for programmes of activities aimed at limiting the outflow of nitrogen from agricultural sources*, Dz. U. z 2003 r., nr 4, poz. 44. EU legislation – the Council Directive of 12 December 1991 *concerning the protection of waters against pollution caused by nitrates from agricultural sources* (91/676/EEC), the so-called Nitrates Directive. The aforementioned legal Acts present the principles concerning the use and storage of fertilisers and the maximum permissible amount of nitrogen of natural origin in the amount of 170 kg per 1 hectare of agricultural land.

count various ranges of organisational features of farms[56]. In this study it has been assumed that the indicated level of livestock density per one hectare of agricultural land should not exceed 2 livestock units.

Apart from the aforementioned criteria, in the sustainability assessment two other measures were also used, informing us about the effects of the agricultural activity being conducted, i.e. the balance of organic matter and the balance of fertilizers – the main macroelements[57].

The soil organic matter balance is drawn up only for arable land, because under the permanent plant cover on grasslands the outcome of the balance always assumes positive values[58]. The accumulation (reproduction) of the organic matter takes place under perennial field crops such as papilionaceous plants, as well as their mixes with grasses, and especially on permanent grasslands. The positive organic matter balance proves good rotation, the systematic enrichment of the soil with humus, and also the gradual decomposition of the organic matter in the soil, which guarantees the proper supply of cultivated plants with nutrients during the whole vegetation period. Decomposition processes (degradation) occur under root plants, corn, and to a minor degree, cereal plants. The transformation of permanent grasslands into arable land causes rapid decomposition and loss of organic matter content. The negative organic matter balance suggests the necessity of changing the way of farming. A negative balance that remains for a couple of years can result in soil degradation, loss of fertility and productivity. Another negative effect of degradation is releasing a large number of mineral ingredients, including nitrogen, which results in polluting underground and surface water[59].

Applying data on the structure of farming and sowing land, the amount of particular plant species harvested, the animal livestock and class, the methodology serving to calculate the outcome of the organic matter balance on a private farm was prepared. The methodology of calculating the outcome of the organic

[56] See e.g. *Poradnik PROW – przepisy ochrony środowiska, normatywy i wskaźniki funkcjonujące w produkcji rolniczej* (2006), ed. P. Pruszek, CDR Brwinów, Brwinów, p. 45; H. Jankowska-Huflejt (2005), *Wykorzystanie nawozów gospodarskich na użytkach zielonych zgodnie z wymogami Wspólnej Polityki Rolnej*, „Wieś Jutra", nr 3 (80), p. 47; J. Kopiński, A. Madej (2006), *Ilość azotu dostarczanego w nawozach*…, op. cit., p. 43; I. Duer, M. Fotyma, A. Madej (2002), *Kodeks Dobrej Praktyki*…, op. cit., p. 20; E. Majewski (2002), *Ekonomiczno-organizacyjne*…, op. cit., p. 113.

[57] This issue was raised in the publication of W. Wrzaszcz (2009), *Bilans nawozowy oraz bilans substancji organicznej w indywidualnych gospodarstwach rolnych* [w:] *Z badań nad rolnictwem społecznie zrównoważonym [7]*, ed. J.St. Zegar, seria „Program Wieloletni 2005-2009", nr 129, IERiGŻ-PIB, Warszawa.

[58] M. Fotyma, J. Kuś (2000), *Zrównoważony rozwój gospodarstwa rolnego* [w:] *Gospodarowanie w rolnictwie zrównoważonym u progu XXI wieku*, ed. J. Borowiecki, Pamiętnik Puławski, tom I, z. 120, IUNG, Puławy, p. 109.

[59] I. Duer, M. Fotyma, A. Madej (2002), *Kodeks Dobrej Praktyki*…, op. cit., p. 22.

matter balance that is being used by the Institute of Soil Science and Plant Cultivation – State Research Institute, was adjusted to the available statistical data, working on the assumptions on the production of natural fertilisers, and the production and distribution of organic fertiliser (straw) on the researched farms.

The organic matter balance was calculated as the ratio of the sum of the products of multiplying crop areas, the mass of produced natural fertilisers and the mass of straw that is potentially intended to be ploughed as well as the respective reproduction or degradation coefficients in relation to the area under crop on a given farm (Formula II.1, tab. II.1).

Formula II.1. The outcome of the organic matter balance

$$\mathrm{OMB} = \frac{\sum_{i=1}^{n}(x \times w_i) + (y \times w_1) + (z \times w_2)}{\sum_{i=1}^{n} x_i}$$

where:

OMB – organic matter balance(t/ha),
x_i – the area of particular plant group sowing (in hectares), *i=1,2, 3, ..., n,*
y – the amount of natural fertilisers – manure (in tonnes),
z – the amount of organic fertilisers – straw (in tonnes),
w_i – coefficients of reproduction and degradation of organic matter for particular plant groups (in tonnes),
w_1 – the coefficient of reproduction for natural fertilisers (in tonnes),
w_2 – the coefficient of reproduction for organic fertilisers (in tonnes).

Table II.1. Coefficients of reproduction (+) and degradation (-) of organic matter for medium soils

No.	Plants and fertilisers	Unit	Coefficient
1	Root crops	1 ha	-1.40
2	Corn and vegetables	1 ha	-1.15
3	Cereal crops, oleaginous and fibrous	1 ha	-0,53
4	Leguminous	1 ha	+0.35
5	Grasses	1 ha	+1.05
6	Papilionaceous	1 ha	+1.96
7	Catch crops for green manure	1 ha	+0.70
8	Straw for ploughing (85% dry mass)	1 tonne	+0.18
9	Manure (20% dry mass)	1 tonne	+0.07

Source: A. Harasim (2006), Przewodnik ekonomiczno-rolniczy w zarysie, IUNG-PIB, Puławy, s. 67-69 oraz Poradnik PROW – przepisy ochrony środowiska, normatywy i wskaźniki funkcjonujące w produkcji rolniczej (2006), ed. P. Pruszek, CDR Brwinów, Brwinów, p. 49.

The coefficients of reproduction and degradation of organic matter provide information on how many tonnes of organic matter have accumulated (reproduction coefficients with a "+") or have been decomposed in the soil (degradation coefficients with a "–") on an area of 1 hectare of particular plants growing, or how much organic matter has been accumulated as a result of 1 tonne of natural or organic fertilisers per 1 hectare[60]. Root plants, corn and vegetables impoverish the soil to a great extent, whereas old papilionaceous, their blends with grasses, and catch crops for green manure, as well as organic manures, enrich it with organic matter. The arable land under crop not classified into the above-mentioned plant groups (resulting from differences between sowings on arable land and the overall area under the above-mentioned plant groups), was treated as neutral, that is, it was attributed the "0" coefficient.

Supplying the cultivated plants with the proper amount of **nutrients** is a condition of having a good crop, and making the most of plant production potential[61]. Despite the key role that fertilising plays in the technology of agricultural production, the results of fertilising can be of a positive or negative nature[62], as fertilising is connected with an economic and environmental risk. Improper fertilising badly influences production profitability (high costs of fertilisers), and is hazardous for human and animal health as well as natural environment. Fertilising should balance nutrition needs of plants, but it cannot create too high macroelements reserves in the soil at the same time[63].

The surplus of unused nutrients indicates the negative impact on the environment, as well as on the particular nutrient loss. The generated macroelements surplus accumulates itself in the soil, or it reaches underground and surface (lake, river) water as well as the atmosphere (nitrogen compounds), whereas a low balance implies an incorrect setting of nutrients doses in relation to the needs of cultivated plants. The deficit of merely one nutrient (nitrogen, phosphorus or potassium) causes the lack of full soil productivity use, plant productivity potential and a relatively poorer crop. The deficiency in nutrients also leads to lowering the soil fertility and even to its degradation.

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[60] J. Kuś, A. Madej, J. Kopiński (2006), *Bilans słomy w ujęciu regionalnym* [w:] *Regionalne zróżnicowanie produkcji rolniczej w Polsce*, Studia i Raporty IUNG-PIB, nr 3, Puławy, p. 216.

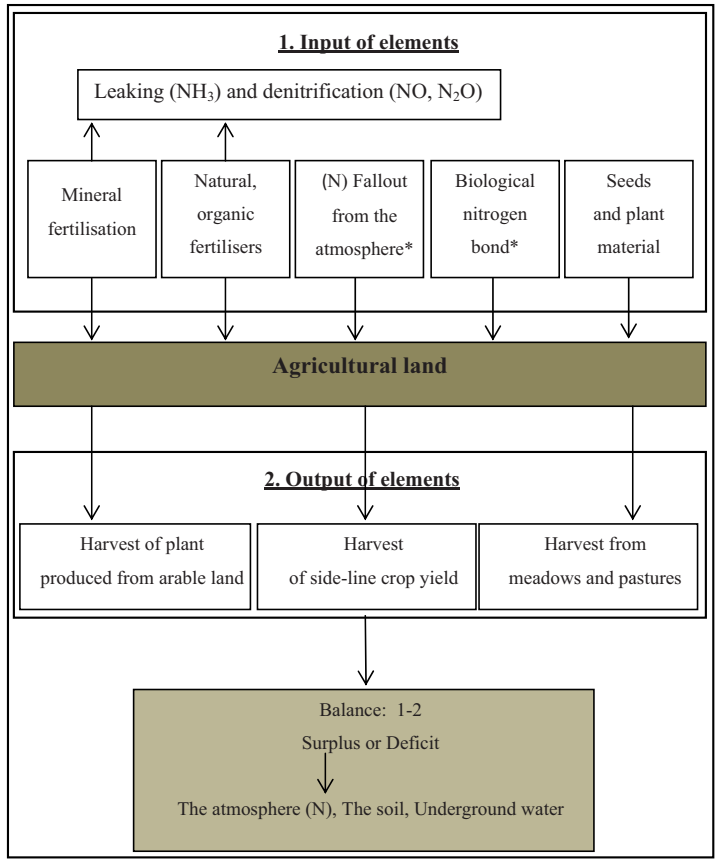
[61] J. Igras, J. Kopiński (2007), *Zużycie nawozów mineralnych i naturalnych w układzie regionalnym* [w:] *Sprawdzenie przydatności wskaźników do oceny zrównoważonego gospodarowania zasobami środowiska rolniczego w wybranych gospodarstwach, gminach i województwach*, Studia i Raporty IUNG-PIB, nr 5, Puławy, p. 108.

[62] J. Kopiński (1999), *Uproszczony bilans składników nawozowych w gospodarstwach indywidualnych o różnej intensywności*, „Roczniki Nauk Rolniczych", seria G, nr 88/1, p. 127.

[63] M. Fotyma, J. Igras, J. Kopiński, M. Głowacki (2000), *Bilans azotu, fosforu i potasu w rolnictwie polskim* [w:] *Gospodarowanie w rolnictwie zrównoważonym u progu XXI wieku*, ed. J. Borowiecki, Pamiętnik Puławski, tom I, z. 120, IUNG, Puławy, p. 91.

The gross fertiliser balance of particular mineral elements i.e. nitrogen (N), phosphorus (P), and potassium (K) is counted in relation to agricultural land, so per 1 ha of agricultural land (AL). The balance is the difference between the sum of input macroelements and the sum of output macroelements (Diagram II.1). On the input side the macroelements from (mineral, natural, organic, and in the case of nitrogen also from the atmospheric fallout and biological bonding of the element) fertilisers are taken into consideration, whereas on the output side the number of output components in yield from agricultural land (main and side-line crop) is calculated.

Diagram II.1. The main elements of gross NPK balance in accordance with OECD methodology



* involves only the nitrogen balance

Source: J. Kopiński (2008), Określenie kryteriów do obliczania sald głównych składników nawozowych w ujęciu wojewódzkim, exspertize, IUNG-PIB, Puławy, according to: OECD (2006), Environmental Indicators for Agriculture, Publication Service, vol. 4, chap. 3, Paris.

Table II.2. The optimal ranges of the balance of major macroelements by voivodship (kg/1 ha AL)*

No.	Voivodship	Balance of					
		nitrogen (N)		phosphorus (P)		potassium (K)	
		min	max	min	max	min	max
1	Dolnośląskie	23.0	28.1	-1.1	3.9	3.5	8.5
2	Kujawsko-Pomorskie	50.1	60.1	-2.9	2.1	0.7	5.7
3	Lubelskie	33.3	40.7	0.1	5.1	9.4	14.4
4	Lubuskie	28.9	35.3	-2.1	2.9	5.9	10.9
5	Łódzkie	44.6	54.6	-0.2	4.8	15.2	20.2
6	Małopolskie	38.2	46.6	1.7	6.7	9.1	14.1
7	Mazowieckie	40.1	49.1	-1.7	3.3	15.5	20.5
8	Opolskie	37.2	45.4	-2.7	2.3	9.1	14.1
9	Podkarpackie	27.9	34.1	0.5	5.5	9.4	14.4
10	Podlaskie	45.9	55.9	0.8	5.8	17.5	22.5
11	Pomorskie	35.3	43.1	-2.4	2.6	4.8	9.8
12	Śląskie	35.2	43.0	-0.2	4.8	5.7	10.7
13	Świętokrzyskie	33.5	40.9	1.5	6.5	10.5	15.5
14	Warmińsko-Mazurskie	37.3	45.5	-0.9	4.1	4.6	9.6
15	Wielkopolskie	55.9	65.9	-3.5	1.5	12.8	17.8
16	Zachodniopomorskie	24.8	30.4	-0.7	4.3	5.0	10.0
17	POLAND	38.6	47.2	-1.0	4.0	8.7	13.7

* The basis of the calculations was the richness of the soils in particular voivodships in the above-mentioned macroelements. The range in relation to the optimal outcome of particular elements was established in the following manner. 1. for nitrogen: the criterion of the allowed outcome (surplus) gross nitrogen ± 10%, but no more than a 10 kg gap; 2. for phosphorus and potassium: the criterion of the correct outcome of the balance ± 2,5 kg, that is a 5 kg gap.

Source: Elaborated on the basis of research by and consultation with IUNG-PIB.

The obtained results of the outcome of the fertiliser balance enabled us to differentiate between farm groups with these outcomes of nitrogen, phosphorus and potassium:

- optimal (sustainable, if the macroelements supplied to the soil met the nutrition needs of the cultivated plants and they did not cause any hazardous surplus in the soil);
- overstated (implied surplus, that is the supplied amount of macroelements to the soil exceeded the fertiliser needs of plants);
- understated (if the balance was below the suggested minimal level, it implied a deficit of macroelements in relation to the nutritional needs of the cultivated plants).

The study also analyses **the selected groups of farms** in the context of their influence on the condition of the natural environment and, namely, sus-

tainable farms (complying simultaneously with the four environmental criteria), without livestock, without field crops, with field crops and with livestock, the "Norfolk" type, organic, as well as farms used by families maintaining themselves mainly from agriculture, that is households of farmers.

The farms meeting all **four environmental criteria** at the same time constitute a relatively small fraction of the overall number of farms (around 6%), though interesting due to being highly environmentally friendly. From the environmental protection point of view, and more exactly limiting the negative impact of agricultural production on the natural environment condition, the most desirable are the farms with **sustainable plant and livestock production**.

Farms without livestock, applying specialist simplified rotation crop rotations, constitute a threat to soil fertility. It is of particular importance, because over 60% of arable land in Poland are characterised by low humus content (only 1-2%). This involves lighter and light soil types in particular, originating from different kinds of sands, which have fast mineralisation of soil organic matter, with little possibility of its accumulation. At the same time economic reasons and livestock breeding concentration result in the situation where more and more farms withdraw from animal production.

The "**Norfolk" farms** apply a crop rotation called Norfolk four-course system, positively influencing the soil fertility. The structure of sowings in the "Norfolk" system includes 50% cereal crops, 25% structure-forming plants (leguminous, fodder) and 25% root crops[64]. Such a system of sowings is most desirable, because it guarantees growing crops after good forecrops, so after non-cereal plants[65]. Providing sustainable fertility of the soil is one of the main characteristics of sustainable agriculture at the farm level. In order to retain the desirable soil specifications, it is vital to use multilevel crop rotations with the participation of papilionaceous plants together with catch crops for green manure.

For the sake of the present study, an approximate system of sowings similar to that recommended in the "Norfolk" crop rotation was established. Taking into consideration the present production and economic conditions of agriculture, the maximum and proper share of cereal crops in the sowing structure was agreed to be 60%. The examined group of farms was distinguished on the basis of the following assumptions: arable land under crop – 100%; *maximum 60% of cereal crops* – species: wheat, rye, barley, oats, triticale, cereal blends, buckwheat, millet, corn for grains, cereal and leguminous blends for grains, the other cereal crops; *minimum 20% of leguminous and fodder plants* – species: legumi-

[64] W. Ziętara (1998), *Ekonomika i organizacja przedsiębiorstwa*…, op. cit., p. 109.
[65] S. Krasowicz (2005), *Cechy rolnictwa*..., op. cit., p. 30.

nous for grains, i.e. edible leguminous (including: peas, beans, broad beans), fodder leguminous (including: field pea, vetch, field beans, sweet lupine), fodder leguminous for green fodder, fodder papilionaceous (including: bird's-foot, other fine-grained papilionaceous) for green fodder, field grasses for green fodder, other fodder plants on arable fields for green fodder; *maximum 20% root plants and others* – species: root plants – potatoes, sweet beetroots, root and fodder plants (including mangolds), oleaginous plants (industrial) – rape and agrimonia, other oleaginous plants (including sunflower for the grain, soya, oleaginous flax), the other industrial plants, vegetables and soil-grown strawberries crop rotation with agriculture crops, corn for green fodder, the remaining species not classified in the above-mentioned groups.

The term **organic farm** is understood as a farm using organic methods of agricultural production, holding a certificate granted by a certificate unit or being in the process of transforming into ecological methods of agricultural production (monitored by a certificating body)[66]. The key rule in the organic system is plant cultivation in accordance with good cultivation standards, with proper care for the phytosanitary condition of plants and soil protection. The plant yields gained are used for producing organic feed, and for direct animal feeding, and they are passed to other farms or are used for other purposes (e.g. composting). Another duty to be fulfilled by ecological agriculture producers, and encouraging them to care for the natural environment, is the necessity of preserving the permanent grasslands and the elements of landscape that are not used in agricultural production.

Agricultural households of farmers are the kind of farms that obtain income predominantly from agricultural activity. Households of farmers are of a great socio-economic significance. They constitute the core of private agriculture.

The number of the given groups was calculated at the national and regional levels. The farm were characterised on the basis of a proportion of the above-mentioned farm groups, as well as their proportion of the area of agricultural land (AL), labour inputs (expressed in Annual Work Units – AWU)[67], and the headage of agricultural animals (expressed in Livestock Units – LU)[68] as well as in the Standard Gross Margin (SGM in ESU units)[69]. The average values of the basic

[66] In Poland, organic production is run in accordance with the rules determined in the Act on Organic Agriculture and (WE) Council Regulations No. 2092/91 and 1804/99.
[67] Annual Work Unit (AWU) – total labour input of holding expressed in fulltime person equivalents 2 200 hours/year.
[68] Livestock Unit (LU) – denotes livestock expressed in so-called Livestock Units, which is the equivalent of 1 cow of 500 kg, producing 10 t of manure annually.
[69] Standard Gross Margin (SGM) – is the surplus of the value of output of given activity over

characteristics of the given farm groups at the national level were also presented, in relation to total private farms.

3. The concept of socially-sustainable agriculture

The concept of sustainable development constitutes a great idea being a response to the imperfections of industrial development and growing problems with preserving the natural environment – a habitat for the human race as well as flora and fauna comprising unique biodiversity. The concept of sustainable development was considered at the international forum (the UNO) in the 1970's and was developed during the global conferences of the United Nations Organisation (the so-called Earth Summit) involving the association between the progress of civilisation and the environment. Such conferences were held in Stockholm (1972), Rio de Janeiro (1992) and Johannesburg (2002). Three basic assumptions for sustainable development were defined in the report of the World Commission on Environment and Development at the UNO, known under the name of the Brundtland Report. The central idea of sustainable development is to preserve the environment and natural resources for future generations, but not by traditionally-perceived direct environmental protection, but mainly by the change in the development paradigm, including the consumption model creating a lower pressure on the environment, a change in the system of values, and also the kind of farming method in which the pressure on the environment does not exceed its capacity. Under the present concept – speaking most concisely, but in accordance with spirit of UN document – under the concept of sustainable development, one understands the kind of social and economic development which satisfies the needs of the contemporary generation without eliminating the possibility of satisfying the needs of future generations. Specifically, the international global economy has to satisfy justified human needs, but its progress should remain within the limits of the ecological capacity of our planet.

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the value of direct costs in conditions of production, which are average for a given region. In order to eliminate the influence of changes in output (e.g. caused by bad weather) or the prices of products and means of production, the calculations cover average amounts taken from three years of the relevant period. SGM coefficients are calculated for each statistical region and for each conducted activity in relation to 1 ha of crops, or one animal head.
European Size Unit (ESU) – is a parameter which serves for determination of the economic size of agricultural holding, being established on the basis of standard gross margins of the farm. One ESU corresponds to equivalence of 1 200 EUR.

Sustainable development presupposes the harmony of multiplying goods with ecosystem efficiency, so that the latter do not lose their ability to regenerate. And that requires obeying at least four strategic rules in their development:

1. The consumption rate of renewable resources, such as land, fresh water, forests and fish, should not be higher than the rate of their renewal.

2. The consumption of non-renewable resources, such as fossil fuels, metal ores and underground water, should not be more extensive than the level resulting from the possibility of their substitution by renewable resources, as well as by the increased productivity of both renewable and non-renewable resources.

3. The pollution entering the environment should not exceed its absorption potential (the capacity of the environment), i.e. the possibility of their absorption, processing or neutralising by the environment.

4. It is necessary to retain the time compliance of the substances entering the environment with the natural processes in the environment.

The idea of sustainable development also relates to agriculture. Moreover, it would not be an exaggeration to claim that, in the case of agriculture, the idea is of crucial importance, and there are several reasons for that. Firstly, agriculture is the main user of the basic natural resources: land and physical space, and also one of the main users of the natural environment. Secondly, agriculture plays an important role in the interactions between civilizational progress and the environment. Thirdly, agriculture is generally multifunctional – it produces food products (satisfying basic needs), as well as non-food products (substituting non-renewable natural resources that are being depleted), and it preserves (conserves and protects) the environment and landscape, and also makes a significant contribution to the viability of rural areas. Fourthly, agriculture – so far – has been excluded from the administrative and economic regulations of utilising the natural environment, as it does not bear the negative consequences of agricultural production's impact on the environment, but it does not receive any payment for positive results either (the public goods and services produced).

Sustainable agriculture, similarly to general sustainable development, comes down to the simultaneous and harmonious realisation of economic, environmental and social objectives (functions). Economic, ecological and social orders are discussed in turn. **The environmental order** – involves farming in a way which does not disrupt the balance in the natural environment (the rational utilisation of the renewable resources in a way which does not cause their total depletion and does not destroy their ability to regenerate), simultaneously protecting resources and preserving their high quality for future generations. **The economic order** – involves supplying the proper amount of agricultural products that have the quality required by the consumer and guaranteeing farm-

ers and their families a high enough income, with the simultaneous maintenance of agricultural products prices at the level accepted by the consumers. **The social order** – aims at gaining acceptance by the non-agricultural part of society of the undertakings of agricultural producers (in the context of landscape protection, cultural values, and the historic heritage of farmlands), and also the participation of the population of farmers in social and cultural progress (access to education and education system health diagnosing and healthcare etc.).

A sustainable agriculture model is *in statu nascendi.* The idea and basic characteristics of such agriculture are more or less obvious. What is being focussed on in particular is such a way of utilising environmental resources, especially the soil, which allows sustainable, renewable, agricultural production, together with the maintenance of those resources, and particularly soil fertility. The quality of food and other agricultural products, as well as the economic and social structure, are also important.

Agriculture is not only one of the main users of the natural environment, but it plays a double role in the process of social and economic development: it provides renewable resources and absorbs pollution. It is necessary to obey two basic rules to allow those two structures – the natural environment and the economy – to develop harmoniously:

1. Renewable natural resources must be utilised in such a way that their consumption rate is not higher than their renewal rate i.e. in a way which does not disrupt their natural ability to regenerate.
2. The streams of pollution entering the environment cannot be bigger than the absorption capacity of the environment in question.

Sustainable agriculture is directed at such utilisation of the earth resources that does not destroy their natural sources, but allows the satisfaction of the basic needs of the subsequent producers and consumers' generations. The concept of a sustainable model of agricultural development assumes a collision-safe performance of various agricultural and non-agricultural functions by agriculture and farmlands. The most important of those include:

1. Producing food and non-food products with a defined quality and in defined amounts, guaranteeing food security for farmers and consumers, as well as animal welfare (production, resource and energy functions).
2. Guaranteeing the proper standard of life for country inhabitants – technical infrastructure, providing work and good income (social function).
3. Protecting the natural environment in the area of agriculture and farmlands (ecological function, environmental protection function).
4. Maintaining and developing the aesthetic and recreational values of farmlands (shaping the landscape function).
5. Maintaining the cultural heritage of rural areas.

The sustainability of agriculture may be considered on various levels, namely, in a particular field, single business, farm, local, regional, sector, or macroeconomic, continental and global (planetary). The nature of the sustainability of each of the levels will be the same, whereas the range and indicators (measurements) of sustainability will be different, as agroecosystems are of a highly local nature, allowing more or less human interference. The applied means of agricultural production can be for or against the environment (can be environmentally friendly or not) depending on the applied agricultural practice. In other words, **agricultural activity can both destroy and degrade the natural environment, but at the same time preserve and protect it, and even create natural values**. The condition in that range depends on particular local standards. The local character of agricultural production results in the situation where the same kinds of practice can become harmful in the case of some agro-ecosystems and in the case of others not. A particular form of organisation and production (technology) can maximise the value of an objective function according to one criterion, but minimise it according to another. The problem then comes down to determining characteristics (variables), which are to be taken into account in the objective function, as well as determining threshold values in the area of those values. It appears then that sustainable agriculture exists when the requirements (threshold values) of the three above-mentioned areas: economic, ecological (environmental) and social – are simultaneously fulfilled.

The sustainability of farms is not identical to the sustainability of agriculture. It means that evaluating farm and agricultural sustainability requires partially applying different measurements. In the case of farms it is indisputably fundamental to acknowledge reaching threshold values in the area of the environment, and, more strictly speaking, the component involving soil fertility preservation – a permanent ability of the soil to produce biomass. That seems to be unquestionable. What follows is also eliminating harmful emissions to the environment – beyond the ecosystem capacity – as well as protecting biodiversity. However, the issue is not so explicit in the economic and social areas. The measurement of economic sustainability can be assumed as farm income, payment for labour inputs, the efficiency of effort, and the outlays and the resources applied. In the case of income, sustainability can be discussed if it allows a farm to develop (investments) and a farmer's family to maintain itself. In the first and the second case the issue is very general and is hard to specify. In the case of payment for work (labour input remuneration) it is also difficult to determine precisely the quantity that implies sustainability. In the case of hired labour input, the threshold quantity could be payment outside agriculture in the compara-

ble applications of labour inputs. In the case of family labour input the matter becomes complicated, both in the area of the income category itself and the amount of payment. It looks different in respect of the labour input of a user permanently and exclusively involved in a farm, and different again in respect of marginal work labour inputs. Also, contrary to appearances, it is not easy to interpret efficiency factors. There appears, for example, a problem of differentiating between microeconomic (private) and social efficiency. With regard to social order the indicators may involve living conditions, healthcare, access to education, justice, coexistence in the local community, etc.

Farms are both a highly complex and time-variable structure of agriculture. The changes in the structure inevitably accompany the development of agriculture − they are simply crucial for such a development. The agricultural structure aims at achieving a balance that is constantly being disturbed by changes in the environment of agriculture as well as by internal factors. One can notice an analogy here that is aiming at reaching balance by particular farms. However, the balance and sustainability of all the farms – assuming it to be possible – does not mean sustaining overall agriculture. At the macroeconomic level it is necessary to add to those sustainability characteristics, in particular national food security, spatial order, viability of farmlands, apart from those considered on a microeconomic level.

Putting a greater stress on the issues of social order leads to a concept of socially-sustainable agriculture, the essence of which is *the activity of individuals that does not threaten the long-term interests of the community*[70]. The effects of this are significant. First of all, everybody is expected to combine their private interests with social ones, to which searching for a balance point of microeconomic and macroeconomic criteria leads. Last but not least is interpreting agriculture as a complex socio-economic structure, where solutions are found for the sake of dominant farm groups (farmers), and not only for the benefit of a relatively small, though economically-strong, group.

4. The premises of socially-sustainable agriculture

The economic prosperity improvement of societies undoubtedly raises awareness regarding the state of the natural environment as well as food quality. The former results from the fact that a dramatic rise in prosperity in the last half-century had its darker side, namely it has restricted the ecosystems' potential in performing their environmental functions (like e.g. clear water supply, clean air, fish resources renewal, benefits of forests), and it has also endangered the proper

[70] A. Woś, J.St. Zegar (2002), *Rolnictwo społecznie zrównoważone*, IERiGŻ, Warszawa.

functioning of global geochemical processes. Climatic changes are the most striking example of that. The question arises on whether it is possible to reverse these unfavourable phenomena without a dramatic reorientation in the attitude to economic growth – and there is no straightforward answer to this. Some think that the progress of science and technology is eliminating the environmental barrier to economic growth, even if it is due to reducing material consumption of useful products (*vide* multiplier four[71]) or the substitution of production factors. Others think, however, that economic growth cannot be limitless, as it has to hit the environmental barrier, because the ecosystem (the environment) is closed (limited), and the economic system constitutes the ecosystem's subsystem. That leads to the theorem of impossibility[72]. **The growing awareness of the necessity to protect the global ecosystem of the Globe (Biosphere) constitutes the key premise of sustainable development in general, especially including agriculture**.

The necessity to protect the Biosphere results from the functions of the global ecosystem: regulative, habitat, productive and informative. The former regulate the processes occurring in ecosystems in the way that they retain the potential of self-reproduction (the continuity of functioning) and keep the parameters of ecosystems in the relatively narrow band of existential conditions of human and other living creatures (e.g. the structure of gases in the atmosphere, the clarity of the air and water). The latter involve creating habitats for fauna and flora, i.e. creating conditions for preserving biodiversity. The main objective of the third function is producing biomass in different forms and for different use (food, non-food resources, genetic resources). And finally, informative functions consist in providing aesthetic, cultural, artistic, spiritual, historical and scientific information.

In the environmental sphere enormous global problems are constantly increasing, and among them the most crucial are considered to be a) the degradation of waters and fresh-water deficiency; b) the protection of soils; c) diminishing biodiversity, d) climatic changes; e) the problem of reducing pressure on non-renewable natural resources through substituting them with renewable ones.

The problem of fresh-water deficiency has a significant meaning for agriculture, which uses up 66-70% of overall water consumption, and it many countries even more. Unfortunately, the amount of water does not increase but rather

[71] Multiplier four – a concept assuming reducing the demand for material goods for producing a usefulness (benefit) unit for consumers [E.U. von Weizsäcker, A.B. Lovins, L.H. Lovins (1999), *Mnożnik cztery. Podwójny dobrobyt – dwukrotne zużycie zasobów naturalnych*, ed. K. Żmijewski, Raport dla Klubu Rzymskiego, Polskie Towarzystwo Współpracy z Klubem Rzymskim, Wydawnictwo Rolewski, Toruń]; the concepts of multiplier ten are currently being formulated.

[72] H. Daly (1993), *Sustainable growth: an impossibility theorem* [in:] *Valuing the Earth: Economics, Ecology, Ethics*, MIT Press (MA), Cambridge.

decreases because of utilising the underground water above the renewal rate, as well as polluting many natural fresh-water basins. Hence, it becomes more and more complicated to satisfy the need for water supply in agriculture, other economic sectors and households.

The problem of the protection of soils results from progressing soil degradation especially because of wind and water erosion, salinity and heavy-metal pollution, as well as taking over land for industrial and housing building, technical infrastructure and other purposes. It creates diminishing potential possibilities for biomass to constitute the basis of trophic chain that decides about Planet Earth's life.

The problem of diminishing biodiversity consists of the irretrievable loss of fauna and flora species, which endangers basic life on Earth, because each species plays a defined role in the global ecosystem. Biodiversity is also a fathomless treasure of utility for humankind. These functions and utilities have not been fully recognised yet. Agriculture, being the main user of the environment – physical space (around 60% in Europe) – can protect biodiversity (some species take part in the process of agricultural production, the others are inherently connected with it), but it can also destroy it.

The problem of climatic change, according to the opinion of many international committees (e.g. IPCC), with enormous consequences for existence on the Earth, has also anthropogenic reasons, caused by the emission of so-called greenhouse gases. Opinion on the issue is divided. Undoubtedly, however, anthropogenic greenhouse gases emission has its contribution to climatic changes and the prudence (precautionary) principle, which requires limiting it. Agriculture is a significant emitter of those gases (especially methane, ammonia and nitrogen oxides), but also carbon dioxide absorbent. Depending on economic development scenarios all over the world and the greenhouse gas emissions (mainly CO_2, NO_2 and CH_3) that follow it, the level and spatial distribution of global climatic changes are being depicted on the basis of the developed (IPCC) models. In Poland, according to the scenarios assuming the unchanging trends in gas emissions increase or keeping their condensation in the troposphere at the present level, the ground layer of the atmosphere can warm up by 4-6°C. This process will be accompanied by a change in rainfall (the transition of some rainfall from the summer to the winter period) and also as a result of a rise in temperature, summer drought will intensify. The number and scale of so-called extreme phenomena will be increasing (long periods without rainfall, storms, hurricanes).

The problem of running out non-renewable, *ergo* depleting, natural resources, and also diminishing many renewable resources, has obvious meaning for further socio-economic (civilisation) development. Economic development

requires more and more energy that has been so far provided most cheaply by energetic fossils (coal, oil, natural gas), as well as material necessary to produce useful goods. Agriculture can make a considerable contribution through withdrawing from using up depleting resources (especially fossils) on the one hand, and replacing such resources with renewable production of biomass used for human needs on the other.

The most serious threats to agriculture will mainly result from water deficiencies and extreme weather conditions. The extent of climatic changes effects will depend on the introduced mechanisms of adaptation to changes and so-called *effects mitigation*. Climatic changes will also provide opportunities for agriculture (growing stenothermic species, greater plant productivity through CO_2 concentration and more intensive microbiological activity).

The growing awareness of food quality for health protection, and also for competitiveness on the market, constitutes an important premise for developing sustainable agriculture. The dependencies that are present between food quality, the manner of nutrition and human health, have led to a significant increase in quality standards in relation to plant products for direct consumption, feedstuff and industrial material. It is industrial agriculture technologies that influence the quality of food products. It is not only these, however. Threats to food security also arise in the area of processing and trading. They are also connected with globalisation, and strictly speaking, with trans-national corporations' activity being motivated by economic benefit (profit), disrupting the relationship between producer and consumer (a producer's anonymity) as well as the low efficacy of quality control systems. The quality of plant products can be shaped by a particular agrotechnology treatment (fertilising, plant protection). Yet it requires deep professional knowledge, and very often asking for professional advice too. A factor that favours safe food production and the limitation of the natural environment threats generated by agriculture is also obeying the rules included in the Code of Good Agricultural Practice, which facilitates realising the concept of sustainable agriculture as well.

However, the consumer en masse demands a cheaper product, which can be provided by an industrial agriculture model. To consume more, and strictly speaking to buy more, is the main task of oppressive and ethically-doubtful advertising – at the consumer's cost anyway. This is where the phenomenon of consumerism arises, one that creates a discrepancy between shopping and actual needs, forces one to make more and more effort in order to gain resources for more shopping (demand) and… the spiral is winding up. The phenomenon of green consumerism has so far been of a minor character and it falls behind the mega-trend called consumerism.

The multifunctionality of agriculture is becoming important – the environmental role, supplying other branches of the economy with resources, providing public goods and services, managing natural environment resources, and shaping the landscape, as well as social, cultural and aesthetic functions. Performing the functions in question is generally combined with agricultural activity, however, a relationship of that kind is not of a function character. It depends on an agriculture model determined by a dominating mass of farms. The problem is that making progress in the area of one function may contradict the level of another function's realisation. Agricultural production is constantly being accompanied by – and they are combined with each other – both positive and negative effects in relation to the environment. The advantage of the former or the latter depends on agricultural practices (technologies). The accumulated experiences show that success in the production function is to the detriment of performing environmental and socio-cultural tasks.

The non-food production functions of agriculture has always accompanied agricultural activity. Some are becoming more meaningful, others less so. The former undoubtedly include environmental (ecological) functions, replenishing materials production for the sake of non-food production needs (the materials produced in agriculture for the sake of such industry branches as chemical, pharmaceutical, textile, fuel-energetic, as well as other economy branches, are meant here), the function of preserving environmental public goods, as well as creating the conditions for the active use of the spare time of city dwellers, i.e. recreation and leisure. The function that is becoming less and less important is the economic one – consisting in creating an added value, providing workplaces and income for a still high percentage of the population maintenance. Some social functions are still vital, especially agriculture's contribution to social-system viability, and creating and cultivating culture, patriotic and other values.

The growing significance of multifunctionality of agriculture, especially in the field of creating public goods, expands the economic accounts of agriculture considerably. The accounts in question should include the negative exterior effects (external costs) on the one hand and positive exterior effects (public goods precisely) on the other. Introducing the exterior effects within the orbit of agricultural economics significantly changes the calculation of economic benefits and it speaks in favour of a sustainable agriculture model[73]. The calculation cannot omit increasing the prices of energy from fossil resources, *ergo* the stimulations for intensifying agriculture on the basis of agricultural chemistry become weaker.

[73] See J.St. Zegar (2007), *Przesłanki nowej ekonomiki rolnictwa*, „Zagadnienia Ekonomiki Rolnej", nr 4.

Price relations are becoming a substantial premise for developing sustainable development in the market economy. So the prices of fossil fuel energy in the form of artificial fertilisers, pesticides and engine fuels are growing faster than agricultural products prices. In that situation the effectiveness of the ”oil into beefsteaks” transformation decreases. And that reinforces the premises to make agricultural production rely on agrobiotechnology, and better use of various plant, animal and micro-organism species, which *de facto* produce food. Making use of these riches of Nature, in combination with effective agricultural practices, should create agro-ecosystems, which will be harmonised with broader ecosystems, they provide a permanent (replenishing) and effective way of producing food through the system of agriculture that is more friendly to nature, environment and unique landscape.

Finally the *last but not least* **premise of sustainable agriculture is the accumulating “weaknesses” of industrial (conventional) agriculture, including especially exhausting the possibilities of that model to increase agricultural production**. It takes place especially in economically-developed countries and is a consequence of the critical evaluation of intensive agriculture characterising itself with high specialisation, mechanisation and heavy concentration of production. Sustainable agriculture is treated as an alternative to intensive agriculture of an industrial character, in case of which substantial investments of industrial origin production materials are crucial. Internalising the effects of those investments in the environment as well as their influence on the food quality, and also price relations change the economics of both conventional and substantial agriculture.

5. The inefficiency of industrial agriculture

It seems paradoxical to formulate a thesis on the inefficiency of the industrial (conventional) agriculture model in the situation where throughout the last century, and especially the second half of the 20th Century, it provided – owing to high efficiency and effectiveness – profound and relatively inexpensive food production, *ergo* feeding a growing number of the world’s population. The benefits of industrial agriculture for consumers (the profound supply of agricultural and food products) as well as the social profits in the form of transferring an ineffectively-used farm workforce in agriculture to more efficient sectors, which resulted in a great acceleration in economic growth and development, are undisputable. Nevertheless, the problem of starvation and undernourishment that affect over 1 billion people remains unresolved. The reason for that is considered to be poverty, so not enough income, *ergo* lack of demand. Yet it is economic

and social mechanisms that decide on goods allocation. Conventional agriculture is subordinated to the profit motive and not to a common-interest one – which is feeding in this case.

The success of industrial agriculture, as it is becoming more and more noticeable, has also got its darker sides. For the social vices (the loss of economic and cultural viability by many country towns) as well as environmental ones (environment degradation, non-renewable resources depletion) are undisputable, and the effects are also ambiguous for the community of farmers (deprivation). Many symptoms indicate the collapsing of the industrial road to agriculture development. The reasons for that lie in the increasing awareness of the lost benefits in the form of public interest, the decreasing effectiveness of utilising limited resources as well as in consumers' preferences (green consumerism). Most often in the discourse the negative effects of agricultural activity are highlighted. Most of all they consist of: a) excessive surface and underground pollution; b) excessive soils pollution and their physical, chemical and biological pollution; c) atmospheric pollution, especially through ammonia and methane emissions, as well as nitrogen oxides from fertilisers, which contributes to the greenhouse effect, d) destroying habitats and limiting biodiversity, especially including many bird species, which nest and feed on arable land; e) decreasing natural resources, especially including the landscape (by destroying small ponds, small springs, bogs, boggy lands, baulks, hedges etc.); f) endangering animal welfare (which is the case especially in industrial farms: large pig fattening houses, broiler and laying-hen farms); g) endangering safe food, not only due to the new and not fully recognised effects of introducing GMO (genetically modified organisms), as well as due to animal derived illnesses (about 40 such illnesses have been identified). On a local scale also the odours from big farms, feedstuffs and silage mixers are uncomfortable.

The system of industrial agriculture satisfying the needs of industrialisation phase in civilisation's progress subordinated production activity on the farm to the rule of the optimal use of production factors (capital, work, land). The rule was introduced following production regulations, which explain the conditions of maximising economic quantities (profit, physical product, national income) or minimising others (costs, material investments), and the criteria were limited to the economic sphere exclusively. The natural and social planes, as well as health effects, for consumers were omitted. The regulations were additionally supported by the need to gain profitability by a farm owner, with freedom of choice for the kind of realised production processes and their size, as well as supply and output markets.

The rule of economic effectiveness created the possibility of efficiency competition domination on farms. At that time the period of introducing industrial production technologies in agriculture began and it was an expression of adapting to the rules forced by a less complex system (i.e. an industrial one) for a more complex one (i.e. an agricultural and natural one). The plant varieties and animal species with greater potential to yield crops and be efficient were introduced, increasing the level of using nutrients produced by chemical industry plants. Industry is very interested in an increase in demand for its produce by farms. Technologies relying on the chemical industry produce in combination with a negative balance of managing macro- and microelements in the soil, optimised productivity conditions, and also contribute to raising the demand for the industry in question's produce. Generally speaking, that is the way in which the growing dependency of the quantity and quality of agriculture produce on that industry manifests itself, and also the income situation of farm owners to a higher and higher degree.

The intensification of agricultural chemicals' use is not indifferent to the environment perceived in the local agro-ecosystem categories, but in the whole hierarchy of ecological systems at the regional, national or even planet level. It is not only a matter of the environment degradation (water and soil pollution, as well as diminishing biological diversity), but quite often also about a decrease in the usefulness value of a product for a purchaser, e.g. an increase in cancerous substances in starchy plants (nitrites and nitrates).

Applying industrial technologies of agriculture production leads to a negative energetic balance on farms. The relation between the energy contained in food in the form of calories to the energy previously placed in it has become significantly worse, together with industrial agriculture progress. Hence, the technologies that should be used on a farm are the ones that will allow us to gain a positive energy balance. A negative energy balance commonly explains the reasons for a low or negative level of profitability on many farms.

The investments that directly contribute to agricultural production growth (mineral fertilisers, plant and animal protection means, mineral fertilisers and concentrates) obey the law of decreasing income. Increasing the level of investments use brings lower and lower individual income. Bilateral effects appear in this case. First, expanding the volume of investments is more and more harmful for the natural environment due to its limited capacity. In such conditions, yield maximisation, as an expression of efficiency competitiveness, needs to be considered harmful to the environment in the long-term. This conduct can be understood only from a single farm's point of view, whereas the evaluation becomes negative only in respect of the agriculture sector and the national economy. The yield should reach such a level and be produced with such technology that

it guarantees a product that is safe for the consumer's health and a sustainable balance of macro- and microelement management in the soil, and also at least as much energy used up to produce it as is gained. Second, a decreasing income per an investment unit worsens economic relations, especially when investment unit prices begin to rise in respect of their limited supply. That creates a new economic situation for industrial agriculture.

Efficiency competition, as well as the necessity to guarantee the economic effectiveness of agricultural production, has created the need for land concentration on the individual farm, and also the most advanced production specialisation, together with extensive mechanisation and motorisation. The biodiversity of crops became limited and the soil started to be pressed down by heavy and very efficient machines. It has negative effects on keeping the soil in a good condition.

Industrial agriculture is coming in for harsher and harsher criticism in connection with disappearing socio-cultural functions. Land and production concentration implies eliminating a certain group of farmers, frequently forcing them to migrate to towns due to the lack of alternative workplaces in the country. Such migration, whether permanent or pendular, necessarily diminishes the countryside's viability. It also enfeebles the cultural environment in the countryside, as well as the rural social capital.

6. The main results of the research

6.1. Agriculture sustainability based on GUS data

Agriculture sustainability evaluation is a very complex issue, and this is the case, most of all, because of two main reasons. First, there is still no defined set of indicators for such an evaluation – there are still many methodological problems left. Second, the data available for such evaluation are insufficient. The complexity is also proven with making an attempt by various international organisations as well as scientific and research centres to develop indicators of sustainability evaluation[74]. The attempt to evaluate it was made by means using public statistics data, among others structural research data[75].

Polish farms can be divided into two groups: one is composed of farms owned by the private farmer, i.e. so-called private/individual farms; and the other of farms with a legal entity (collective farms and private companies belonging to the public sector). Among the 2 391 thousand farms 3.7 thousand of them had a legal entity. It is a mere 0.2% of all the farms in Poland. Although farms with

[74] The approaches of the OECD, UNO and UE deserve special attention.

[75] Representative research by GUS done according unified methodology in the EU countries on a representative sample of 7,2% from a general number of farms (204 937 farms).

a legal entity had a nominal share in Polish agriculture in comparison to privately-owned agriculture, especially in terms of number, an average farm with a legal entity presented a far greater area of agricultural land, with higher stocking density, as well as many time greater labour inputs than in the level of the standard gross margin production. Further on we will refer to and present the results only in relation to privately-owned farms.

It is commonly acknowledged that Polish agriculture produces safe (healthy) food products and their production is environmentally friendly. In general unpolluted or little polluted, the soils and traditional technologies, as well as the environmentally-friendly production organisation (the way of cultivation) are highlighted. It is, most of all, connected with fragmented privately-owned agriculture, which is the dominant structure of Polish agriculture. The curiosity of the Polish agricultural structure is the great number of farms mainly and exclusively satisfying their own needs, with a relatively small number of farms characterising themselves with significant goods production. However, it does not determine farm sustainability yet. The structural research data show that a substantial group of private farms does not fulfil the environmental criteria of sustainable agriculture.

The adopted criteria of farm sustainability allowed us (only of course to some degree) to evaluate farms in respect of agricultural production friendliness to the natural environment. 25% of private farms were characterised by the suggested cereal crops share in sowing arable land, 34% with the correct index of covering land with plants during wintertime, 21% with the right number of cultivated plant groups on arable land, over 97% with stocking density on the agricultural land area (tab. II.3). The farms characterised by agricultural production sustainability in a particular field, displayed a greater production potential expressed in the area of agricultural land, as well as in the standard gross margin in relation to the rest of the private farms.

Table II.3. The percentage of private farms fulfilling the chosen criteria of environmental sustainability and their production potential

No.	Specification	Cereal crops share	Plant cover share	Plant groups	Density of livestock	Listed criteria in total
1	Number of farms (%)	25.1	34.2	21.6	97.5	5.6
2	Agricultural land (ha)	27.6	48.3	40.8	97.7	11.7
3	Labour inputs (AWU)	28.1	42.0	36.4	96.6	9.0
4	Total livestock units (LU)	28.2	50.9	48.3	82.1	12.1
5	Economic size (ESU)	33.8	49.1	43.4	92.8	12.1

Source: Own study based on GUS data.

Table II.4. The basic (average) production and economic quantities of private farms fulfilling the chosen criteria of environmental sustainability*

No.	Specification	Cereal crops share	Plant cover share	Plant groups	Density of livestock	Listed criteria in total
1	Agricultural land (ha)	6.55	8.40	11.23	5.96	12.43
2	Labour inputs (AWU)	1.05	1.16	1.59	0.93	1.51
3	Total livestock units (LU)	3.58	4.72	7.09	2.67	6.86
4	Economic size (ESU)	4.46	4.75	6.66	3.15	7.15

* The average private farm was characterised by 6.0 ha AL, a labour input of 0.9 AWU, a livestock of 3.2 LU and an economic size of 3.3 ESU.

Source: Own study based on GUS data.

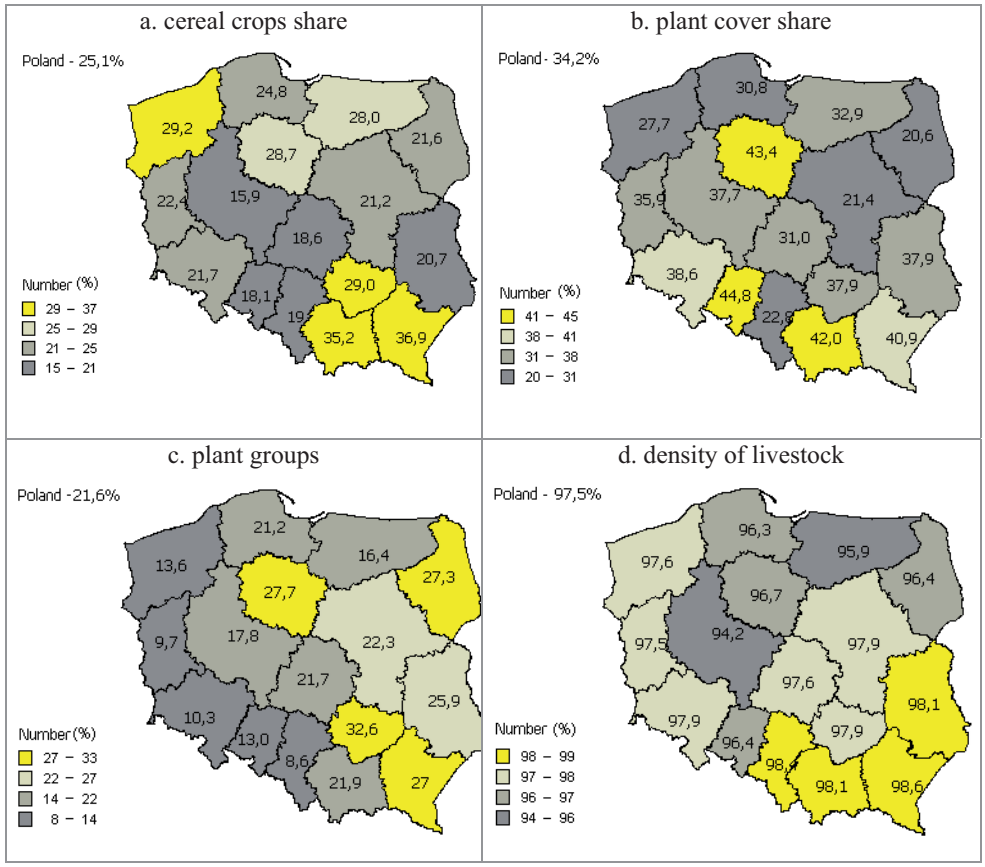
The farms fulfilling **the cereal crops criterion** cultivated 28% of agricultural land, so was their share of labour inputs and livestock, as well as 34% the standard gross margin. The farms in question were larger in terms of agricultural land in comparison to the rest, by 14% on average, whilst even greater differences were exhibited by their economic size, which reached the level of 50%. The relatively biggest number of private farms characterised by the suggested cereal crop share in sowing was shown in the south-east voivodships (Podkarpackie and Małopolskie voivodships) – above 35%, whereas the smallest was in the Wielkopolskie (16%), Opolskie (18%) and Łódzkie (19%) voivodships (Map II.2a).

Cultivating winter and spring catch crops played quite an important role in farm sustainability. Apart from the supplied green fodder, the stubble catch crops protect the soil from water and wind erosion, provide organic substance and play the role of a seasonal stock of the ingredients that are easily ploughed deep underground. Cultivation of spring catch crops occurred in the year 2007 in 56.1 thousand farms, whereas winter catch crops in 59.3 thousand farms. The share of those farms in relation to the farms involved in agricultural activity and having arable land was 2.8% and 3.0% respectively. The total surface area of spring and winter catch crops was 424.5 thousand ha in Poland. That constituted an additional area of crops on 3.6% of arable land.

The correct **index of vegetation cover on arable land in winter period** was stated in every third private farm (34%). Private farms fulfilling this criterion made up 48% of agricultural land, 58% of labour inputs, 51% of livestock and 49% of standard gross margin. These farms were larger in respect of agricultural land area compared with the farms with a low share of winter plants in sowings (8.4 and 4.7 ha respectively) as well as standard gross margin (4.8 and 2.6 ESU). The relative majority of the farms fulfilling the criterion was found in Opolskie – 45%, Kujawsko-Pomorskie – 43%, and Małopolskie – 42% voivod-

ships, and the minority was present in Podlaskie – 21% and Mazowieckie voivodships – 21% (Map II.2b).

Map II.2a-II.2d. The share of private farms according to the accepted criteria of the environmental sustainability by voivodships



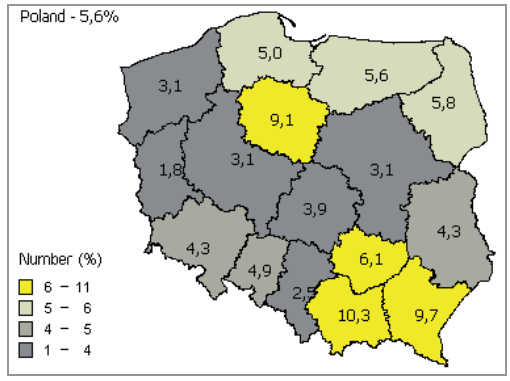
Source: Own study based on GUS data.

The criterion of **the number of cultivated plant groups** was fulfilled by22% of private farms, which included 41% of agricultural land, 36% of labour inputs, 48% of livestock and 43% of standard gross margin. The group of farms in question was significantly larger than the one not fulfilling the criterion. On average a farm in the first group included 11.2 ha of agricultural land (4.5 ha in the second group) as well as 6.7 ESU of standard gross margin (2.4 ESU in the second). The relative majority of farms fulfilling the criterion of plant groups was found in Świętokrzyskie (33%) and Kujawsko-Pomorskie (28%), and the minority in Śląskie (9%) and Lubuskie (10%) voivodships (Map II.2c).

The only index (and at the same time a very important one) that was applied in order to examine the relation of plant and animal production at the farm level was **density of livestock on agricultural land**. Among private farms the criterion was fulfilled by almost 98%. The group of farms included 98% of agricultural land area, 97% of labour inputs, 82% of stocking density and 93% of the standard gross margin. An average farm characterised by the above-mentioned stocking density included 6.0 ha of the agricultural land area, whereas the subjects with a higher stocking density were characterised by a area equalling 5.5 ha. The major differences were found in the case of standard gross margin value, because the former had the quantity of 3.2 ESU, whilst the farms with a high stocking density of as much as 9.5 ESU. The relative majority of the farms not fulfilling the livestock density criterion was found in Wielkopolskie (5.8%) and Warmińsko-Mazurskie (4.1%) voivodships as opposed to those in the southern part of the country (Map II.2d).

The farms that are characterised by **the four environmental criteria** constituted merely 5.6% of the population of private farms. The private farms fulfilling simultaneously the four sustainability criteria included 12% of the agricultural land area, 9% of labour inputs, 12% of livestock and 12% of standard gross margin. An average sustainable farm had 12.4 ha of agricultural land area, the labour inputs equalled 1.5 AWU, the livestock was 6.9 LU, whereas their economic value was at the 7.2 ESU level. The relative majority of sustainable private farms (9% – 10%) were found in the Małopolskie, Podkarpackie, and Kujawsko-Pomorskie voivodships, whereas the minority in Lubuskie and Opolskie (Map II.3).

Map II.3. The share of private farms that are characterised by the required level of the four chosen criteria of agriculture sustainability



Source: Own study based on GUS data.

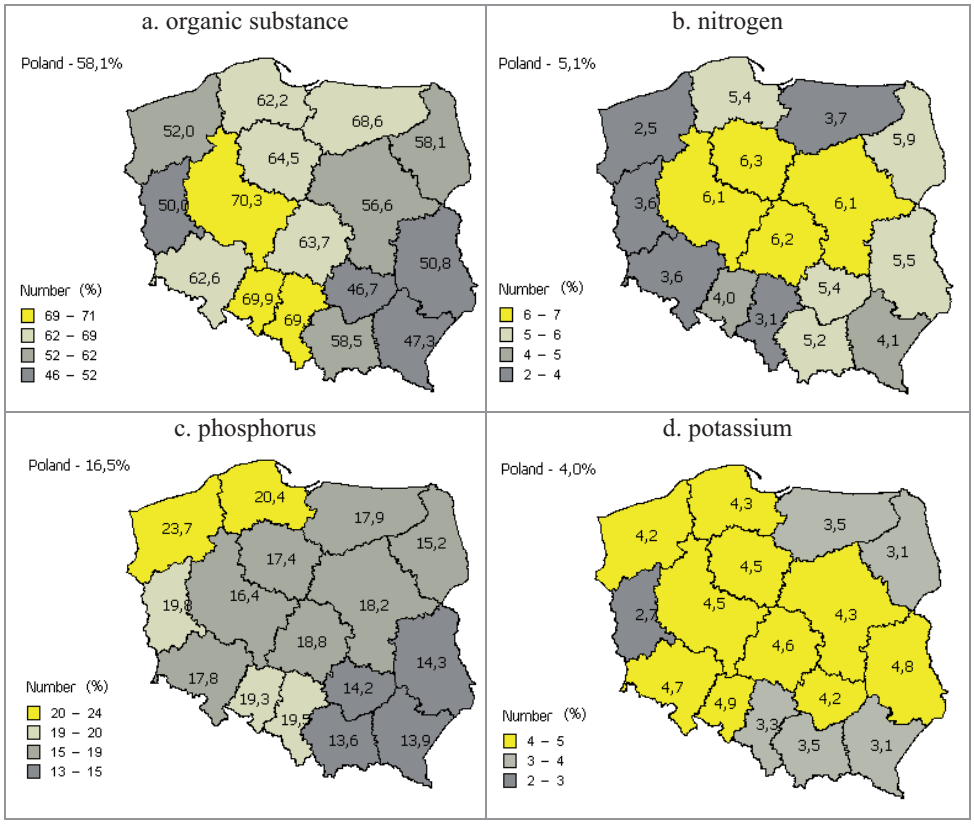
An important criterion for ecological compensation is the area of **permanent grasslands**, i.e. meadows and pastures. Permanent meadows were owned in 2007 by 1 365.8 thousand farms, i.e. 57.1% farms engaged in agricultural activity. Permanent pastures were presented in 477.6 thousand farms i.e. in 20.0% of farms engaged in agricultural activity. The total area of permanent grasslands in farms engaged in agricultural activity was 3 271.2 thousand ha, i.e. 20.6% of agricultural land area. Permanent meadows covered an area of 2 497.4 thousand ha, whereas permanent pastures covered 773.8 thousand ha. 183,6 thousand ha of permanent grasslands, i.e. 5.6% of their overall area were excluded from production in 2007. Extensive pasturing of permanent pastures took place on 82.3 thousand ha, i.e. 11.3% of the pasture area.

In order to evaluate the friendliness of agricultural production for the natural environment indices the balance of soil organic substance (matter) and the balance of the main mineral elements, that is nitrogen, phosphorus and potassium. The findings provide information on the results of agriculture activity, as well as its scale of influence on soil fertility.

It occurred that over half the farms was characterised by **the correct (positive) outcome of organic substance balance** (58%)[76]. The farms in question included 54% of agricultural land, 55% of labour inputs, 55% of livestock and 56% of standard gross margin. The differences between the farms with a positive and negative outcome of the organic substance balance were relatively small. The average area of the farm with a positive outcome was 5.5 ha, whereas the units with a negative outcome was 6.5 ha. The average value of the standard gross margin reached the levels of 3.1 and 3.6 ESU respectively. The relative majority of the farms with a correct balance of organic substance is situated in Wielkopolskie – 70%, Opolskie – 70% and Śląskie – 69% voivodship, whereas the minority can be found in Świętokrzyskie – 47% and Podkarpackie – 47% (Map II.4a).

[76] In the overall community of farms 1 389.5 thousand of them had a positive organic substance balance on arable land, i.e. 58.1% farms conducted agricultural activity and 73.1% of the ones that had sowings on arable land. The remaining farms were characterised by a negative organic substance balance that led to the soil impoverishment.

Map II.4a-II.4d. The share of private farms with a positive balance outcome of organic substance as well as optimal balance of main macroelements by voivodships



Source: Own study based on GUS data.

The average balance outcomes of humus calculated at the regional level allow us to make a generalisation about the issue of balancing the organic matter in the soil (Map II.5). Zachodniopomorskie, Lubuskie, Dolnośląskie, Podkarpackie as well as Świętokrzyskie are the regions of Poland with a negative level of outcomes, which indicates the process of the soil humus impoverishment. The reverse situation was observed in Warmińsko-Mazurskie and Wielkopolskie voivodships, where the outcome was on a relatively greatest positive level. Positive outcomes of the organic matter were stated in eleven voivodships.

Mineral and calcium fertilisers were applied in 2007 by 1 722.0 thousand of farms, i.e. 72.3% farms having agricultural land in good cultivation. The reflection of plant production intensity is the consumption of mineral fertilisers per 1 agricultural land unit. The average level of mineral fertilising NPK per 1 ha of agricultural land in good cultivation was 106.8 kg of a pure chemical

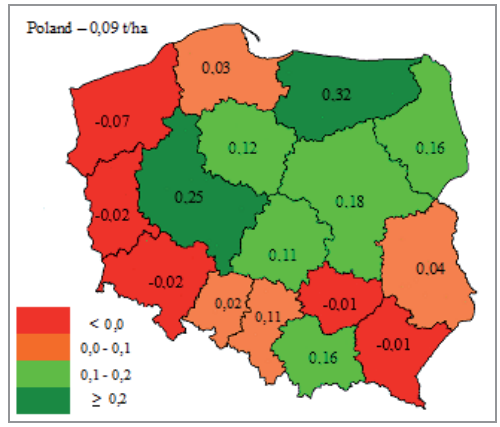
element in Poland, including 68.2 kg of nitrogen, 11.6 kg of phosphorus and 27.0 kg of potassium.

Table II.5. The basic (average) production and economic quantities of private farms fulfilling the criteria of organic substance balance and macroelements

No.	Specification	The criterion of the outcome balance of			
		organic substance	nitrogen (N)	phosphorus (P)	potassium (K)
1	Number of farms (%)	58.1	5.1	16.5	4.0
2	Agricultural land (ha)	5.53	7.3	5.8	7.6
3	Labour inputs (AWU)	0.89	1.2	1.0	1.2
4	Total livestock units (LU)	3.08	3.3	2.5	3.7
5	Economic size (ESU)	3.11	3.8	2.9	4.0

Source: Own study based on GUS data.

Map II.5. The average output of soil organic matter balance in voivodships (t/ha)



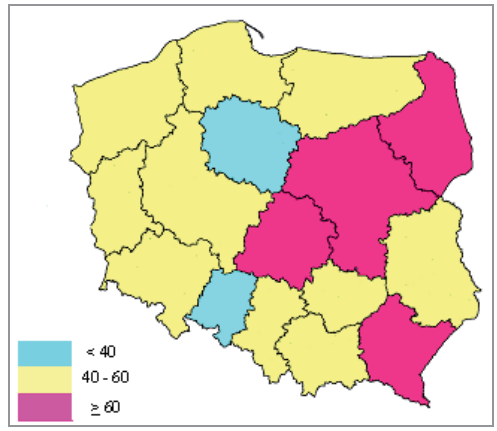
Source: Own study based on GUS data.

An important issue is **a problem of the soil acidity.** The reaction of the soil is the most significant factor that is responsible for its fertility, apart from the soil's richness in micro- and macroelements, as well as the content of mineral forms of nitrogen[77]. According to the statistics, more than 50% of area of agricultural land includes acidic or very acidic soils. Also, there is a regional diversity of soil reaction (Map II.6). The smallest share of the soils with an acid and very acid reaction can be found in Opolskie and Kujawsko-Pomorskie voivodships, whereas the greatest one can be observed in eastern and central part of the country

[77] J. Igras, W. Lipiński (2006), *Regionalne zróżnicowanie stanu agrochemicznego gleb w Polsce* [w:] *Regionalne zróżnicowanie produkcji rolniczej w Polsce*, Raporty PIB, nr 3, IUNG-PIB, Puławy, p. 71.

and in the Podkarpackie voivodship. In Łódzkie, Podlaskie and Podkarpackie voivodships the acidic or very acidic soils share reaches as much as 70%.

Map II.6. The share of acidic or very acidic soils by voivodships (2003-2005 on average)



Source: [Igras, Lipiński, 2006].

The basic way of neutralising an acid reaction in the soil is calcifying it. Against a background of that the data involving calcifying the soil cannot be evaluated as optimistic. The relatively small number of the farms **calcium fertilisers** is alarming, because in 2007 they were used only by 203.5 thousand, i.e. 8.5% of farms having agricultural land in good cultivation. The average level of calcium fertilising in the farms applying calcium fertilisers was at a level approaching 190 kg of CaO per 1 ha AL, and the average area of these farms was 12 ha. The farms were at the same time twice as big as the average private farms in Poland and had almost 17% of agricultural land area in Poland at their disposal. A further increase in the level of acidity of the soil can limit the effective use of fertilising elements and decrease the yield productivity.

Organic fertilisers of animal origin were applied by 1 249.1 thousand farms, i.e. 52.5% farms with agricultural land in good cultivation. On average 77.7 kg of a pure NPK ingredient fell on 1 ha of agricultural land, with natural fertilisers. The main natural fertiliser is manure, whereas liquid manure and slurry are produced more rarely. Such a layout of natural fertilisers results from the system of animal maintenance.

The most serious threat generated by agriculture is considered to be **nitrogen and phosphorus compounds,** which can reach underground and open waters (rivers, lakes) as well as in the case of nitrogen, and they can leak into the atmosphere. Their deficit on the other hand leads to soil impoverishment. Integrated

agriculture has to obey rational norms in a possibly closed chain of nutrients: fertilisers → soil → plants. One of the most commonly-accepted methods of evaluating losses and nitrogen flow in the environment, just as in the case of phosphorus, is the balance of that element drawn up according to the method suggested by OECD, the so-called "in field surface method". The significance of the balance results becomes even greater when compared with soil fertility condition.

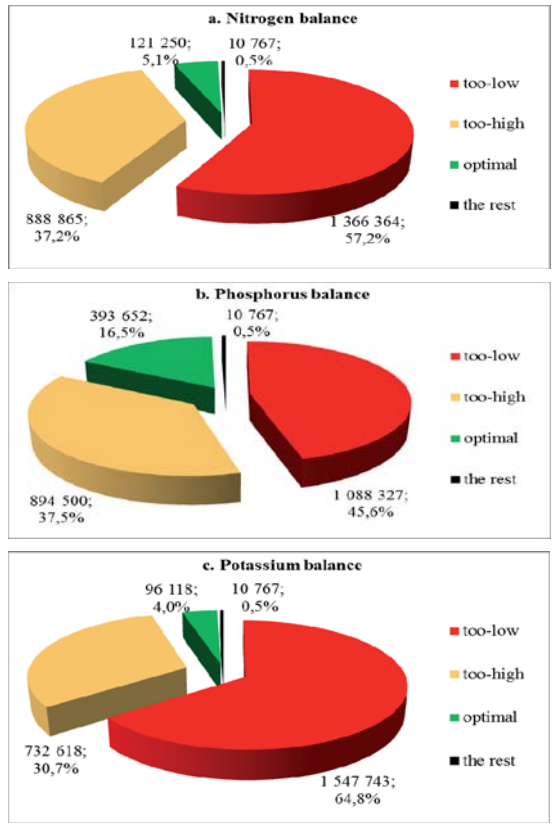
The correct output of nitrogen balance characterised 121.3 thousand farms – 5.1% of the farms having agricultural land in good cultivation (Fig. II.1a). The majority of the farms were characterised by an understated balance of the macroelement (1 366.4 thousand; 57.2%) – too small amount of nitrogen was supplied when compared with the fertilising needs of the cultivated plants on the given farms. A potential threat to the environment was 888.9 thousand farms with an overestimated outcome of nitrogen balance (37.2% of farms having agricultural land in good cultivation). Similar relations among groups of farms (characterised by an optimal, overestimated and underestimated balance) were observed in the process of dividing the community according to the outcome of potassium balance (Fig. II.1c).

The correct output of phosphorus balance was calculated in 393.7 thousand farms – 16.5% of the farms having agricultural land in good cultivation (Fig. II.1b). It is a much higher share (by more than three times) in comparison to the farms with an optimal outcome of nitrogen and potassium. The structure of private farms in respect of phosphorus distribution can be acknowledged to be the most correct in relation to the other macroelements. Nevertheless, a relatively large number of farms with a too-high outcome of phosphorus balance was found – 894.5 thousand (37.5% of the farms with agricultural land in good cultivation). It was an unfavourable phenomenon, because nitrogen and phosphorus are considered to be the main dietary mineral of agriculture origin that cause the euthrophisation of waters.

The maps presented in the paper indicate a significant regional diversity of private farms according to the correct balance of the macroelements.

The correct nitrogen balance was calculated in about 5% of the farms, which had 6% of the agricultural land area, 6% of labour inputs, 5% livestock and 6% of the standard gross margin value. On average, a farm fulfilling the nitrogen criterion had 7.3 ha of agricultural land, as well as 3.8 ESU. The relatively smallest share of farms fulfilled that criterion in Zachodniopomorskie (merely 2.5%), Śląskie (3.1%), Lubuskie (3.6%), Dolnośląskie (3.6%) and Warmińsko-Mazurskie (3.7%) voivodships (Map II.4b). The share in the present case did not go beyond 7% in any of the voivodships mentioned.

Figure II.1a-1c. The structure of private farms according to the outcome of macroelements balance

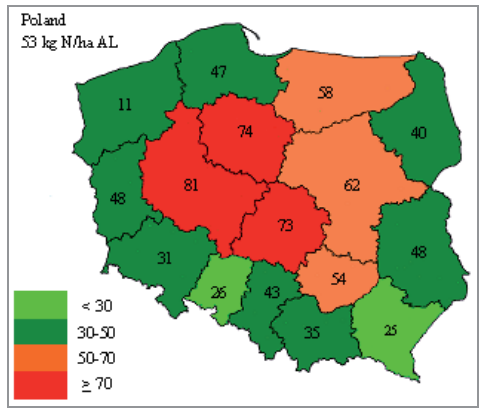


The figures present a group of "the rest" of the farms. They are those without a calculated outcome of fertiliser balance, because they did not have any agricultural land or had agricultural land without good cultivation.

Source: Own study based on GUS data.

The average results of nitrogen balance outcomes calculated on a regional level suggest a different evaluation of the correctness of fertilising distribution from the regional perspective (Map II.7). A point of reference was acknowledged to be the average norms of nitrogen balance for voivodships, i.e. 30-70 kg of nitrogen per 1 ha of agricultural land. The biggest threat to the environment caused by a too-high nitrogen balance appeared in Wielkopolskie, Kujawsko-Pomorskie and Łódzkie voivodships. Podkarpackie and Opolskie voivodships were similarly characterised by unsustainable fertilising distribution of this macroelement, resulting from insufficiency of satisfying nutrition needs of the plants cultivated with industrial means of production.

Map II.7. The average outcome of nitrogen balance in private farms by voivodships (kg N/ha AL)



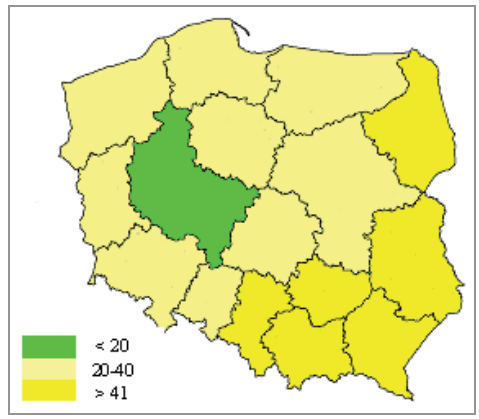
Source: Own study based on GUS data.

The criterion of **phosphorus balance** is fulfilled by almost 17% of the farms, which contain 16% of the agricultural land area, 16% of labour inputs, 13% of livestock and 15% of standard gross margin. On average, 1 farm in the group has 5.8 ha of agricultural land as well as 2.9 ESU. The highest share of the farms fulfilling the phosphorus balance criterion is situated in Podkarpackie (24%), Pomorskie and Lubuskie voivodships (20% each), however, the smallest one can be found in the south-eastern voivodships (the Małopolskie, Podkarpackie, Świętokrzyskie and Lubelskie voivodships) – about 14% (Map II.4c).

The analysis of the spatial diversity of soil richness in assimilable phosphorus shows that about 38% of the soils (agricultural land) have a low or even very low content of phosphorus, 28% of the soils have a medium content, and only 35% of them have a high or very high one[78]. The vastest surface areas of the soils with a high and very high content of assimilable phosphorus are situated in northern, north-western, western and south-western Poland, whereas the eastern and south-eastern part of the country is characterised by soils with a low or very low content of phosphorus (Map II.8). In the areas of Poland that are richer in phosphorus there is a bigger share of farms with an optimal phosphorus balance, as well as the regions including the majority of the farms with a relatively higher outcome of phosphorus balance (especially in Wielkopolskie and Kujawsko-Pomorskie voivodships).

[78] J. Igras, W. Lipiński (2006), *Regionalne zróżnicowanie stanu*…, op. cit., p. 76-77; A. Tujaka (2007), *Krajowy bilans fosforu w ujęciu regionalnym* [w:] *Sprawdzenie przydatności wskaźników do oceny zrównoważonego gospodarowania zasobami środowiska rolniczego w wybranych gospodarstwach, gminach i województwach*, Studia i Raporty IUNG-PIB, nr 5, Puławy, p. 133-139.

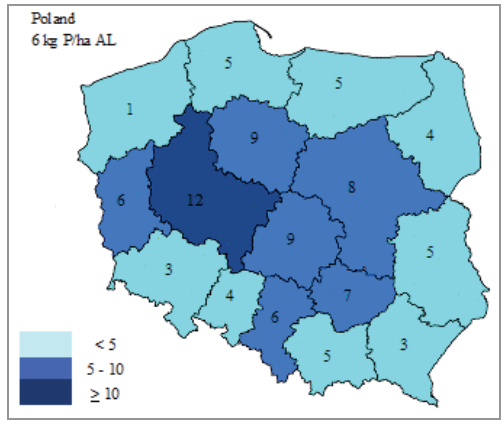
Map II.8. The share of soils with a very low and low content of assimilable phosphorus by voivodships (2000-2004 on average)



Source: [Tujaka, 2007].

Similarly to the case of nitrogen, the presentation of the average results of phosphorus outcomes calculated at the voivodship level provided additional information (Map II.9). A point of reference was acknowledged to be the average norms of the outcome of the phosphorus balance at the regional level, i.e. a positive level that does not go beyond 6 kg of phosphorus per 1 ha of agricultural land. The greatest threat to the environment caused by a too high an average outcome of the phosphorus balance is posed by the farms in Wielkopolskie, Kujawsko-Pomorskie, Mazowieckie and Łódzkie voivodships, i.e. the area of the central part of Poland. The voivodships mentioned also showed a too high an average outcome of nitrogen balance.

Map II.9. The average outcome of phosphorus balance in private farms by voivodships (kg P/ha AL)



Source: Own study based on GUS data.

It might be supposed that the soils' richness in phosphorus basically influenced the result of the fertiliser outcome. The farmers, determining the doses of phosphorus fertilisers, did not take into account the condition of the soils' richness in this macroelement, hence applied amount of fertilisers did not always satisfy the nutrition needs of the cultivated plants.

Another important macroelement is potassium. The **potassium balance** criterion is fulfilled by a small share of private farms, at a mere 4%, which covers 5.1% of agricultural land area and the same amount of labour inputs, 4.7% of livestock and 4.8% of the standard gross margin. The Opolskie and Lubelskie voivodships showed the greatest share of farms with a sustainable potassium outcome (nearly 5%), as opposed to Podlaskie and Lubuskie (around 3%), where the smallest share of the farm group in question could be observed (Map II.4d).

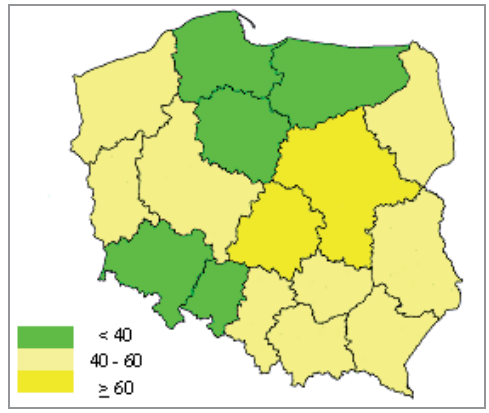
The richness of the soils in assimilable potassium in Poland is even worse than in phosphorus, because over 50% of agricultural land's soils is characterised by potassium deficit, 27% of the soils shows an average amount, and only 23% of them show a large or very large amount of the element, whereas together with a negative phosphorus balance it is a very alarming situation[79]. The area of north-western and south-eastern part of Poland was characterised by a big share of the soils with a low or very low content of potassium and it fluctuated in the range of 40% to 60%, and in Łódzkie, Mazowieckie and Podlaskie voivodships it was running at even over 60% (Map II.10)[80].

The correct outcome of potassium balance should run at a positive level, up to 15 kg per 1 hectare of agricultural land. Wielkopolskie, Mazowieckie and Łódzkie voivodships presented a high outcome of potassium balance, resulting from very intensive fertiliser management, whereas Zachodniopomorskie and Podkarpackie voivodships were characterised by a very low outcome of the element, by unsuitable fertilising for the nutrition needs of the cultivated plants and the soils' richness in the given macroelement (Map II.11).

The calculated overall input of the mineral elements per 1 ha of agricultural land was 206.6 kg NPK, whereas output constituted 132.4 kg NPK. It resulted in an average outcome of 74.2 kg NPK of macroelements per 1 ha of agricultural land. Assuming the diversified regional ranges of correct outcomes of particular fertiliser elements according to farm location, it was stated that only 3.1 thousand farms in Poland (0.1% of the farms having agricultural land in good condition) presented **the correct balance of all the three nutrition elements NPK in parallel.** The majority of such farms was stated in Dolnośląskie and Mazowieckie, whereas the minority was found in Wielkopolskie and Lubuskie voivodships.

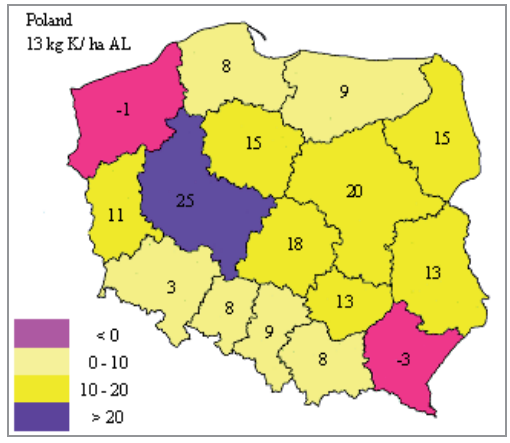
[79] J. Igras, W. Lipiński (2006), *Regionalne zróżnicowanie stan*…, op. cit., p. 78.
[80] Ibidem, p. 78.

Map II.10. The share of soils with a very low or low content of assimilable potassium by voivodships (2003-2005 on average)



Source: [Igras, Lipiński, 2006].

Map II.11. The average outcome of potassium balance in private farms in voivodships (kg K/ha AL)



Source: Own study based on GUS data.

The presented research results for the micro- and macroeconomic levels involving **the outcomes of the fertiliser balance in the basic nutrition elements** as well as **the soil organic substance** justify the necessity of conducting the research on different economic levels. The results of the research conducted on mutually complementing economic levels allow us to make an overall and multilateral evaluation of this phenomenon. The average outcome of fertiliser balance as well organic matter considered at the national level allows us to place Poland on an international scale, and the results from the regional level highlight

the problem of regional diversity and the impact of the selected regions on the natural environment in relation to the rest of the regions, whereas in the microeconomic perspective, that is the results of the research at the farm level, enable us to determine the number and the detailed characteristics of the production and organisation of given subjects.

The agricultural activity characterised by too high a level of production and organisation intensity poses a threat to the natural environment – this claim is often presented and justified in the literature on the subject. The evaluation of the influence of too-extensive agriculture production is often omitted in research. The data presented in the current paper show that unsuitable fertiliser practice in relation to the nutritional needs of the cultivated plants and agrochemical condition of soils have a negative effect on the natural environment. A too-low level of fertilising the cultivated plants, presented additionally in the light of pessimistic statistics involving the condition of soil richness in the main nutrients highlights the significance of the insufficient nutrition of plants.

The farmers who do not use mineral and/or natural fertilisers or use too little an amount of them in respect of the nutritional needs of plants, also used calcium fertilisers more seldom and in smaller amounts on agricultural land. Such agricultural practices have an effect on the insufficient use of soil productivity potential, but also on its agrochemical condition (richness in macroelements and pH reaction).

The factors determining the level of environmental sustainability were **agricultural land of farms** and their **economic size**. The agri-environmental criteria of sustainability diversified analysed **area groups of farms** (tab. II.6). The greater agricultural land area the more farms, on average, fulfil the sustainability criteria, though in the case of some criteria one can notice their worsening in the group of 50 ha and more. Such dependencies also relate to the farms applying organic and chemical fertilisers (Fig. II.2).

Considering average figures for area groups, three conclusions may be drawn. The first refers to the highest environmental unsustainability of the smallest farms. Inorganic and organic fertilisers of animal origin are applied by a relatively small number of farms from this group, which results from the marginalisation of farms. Plant groups and cover share, as well as the nitrogen balance criterion, are fulfilled by relatively the smallest number of farms from this group as compared to all area groups, and the organic substance criterion by relatively the highest number of them. The second conclusion is that farms belonging to area group 25-50 ha, i.e. those which – in the current situation and on average – are the most desired family farms in terms of their size, seem to be the most balanced. The third conclusion is that larger farms contribute to environ-

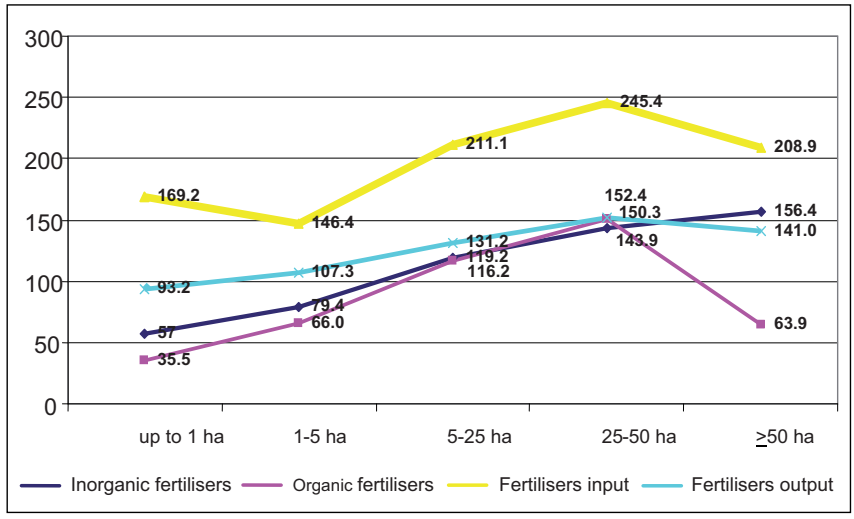
mental sustainability. This is an important non-economic premise to improve the structure of farms.

Table II.6. The share of private farms complying with the chosen criteria of environmental sustainability according to area groups in 2007 (the overall in the columns = 100)

No.	Specification	In total	Area groups of farms (ha)				
			up to 1	1-5	5-25	25-50	≥50
1	Cereal crops share	25.1	26.9	25.4	21.7	33.2	38.4
2	Plant cover share	34.2	17.6	37.4	42.4	56.2	66.7
3	Plant groups number	21.6	4.0	18.5	38.9	55.5	50.1
4	Density of livestock	97.5	95.6	98.6	97.8	97.1	97.6
5	Organic substance balance	58.1	67.2	53.2	57.2	54.2	48.4
6	Nitrogen balance	5.1	2.7	5.3	6.9	6.4	5.9
7	Applying mineral and calcium fertilisers	72.0	39.9	76.8	92.7	96.2	93.4
8	Applying organic fertilisers of animal origin	52.3	23.1	51.7	77.7	82.7	66.3

Source: Own study based on GUS data.

Figure II.2. Fertilisation in private farm according to area groups in 2007 (kg NPK/1 ha AL)



Source: Own study based on GUS data.

Estimates referring to the use of fertilisers per 1 ha of agricultural land in good agricultural condition[81] identify an interesting interdependency of the increased application of mineral fertilisers (NPK) in larger area groups. This indicates growing production, and definitely profitability, from the application of inorganic fertilisers. Organic fertilisers are more often applied to larger areas, except for the last area group, more oriented towards plant production. A similar situation refers to the total amount of fertilisers used and to a lesser extent to the total output of fertilisers. Mineral and organic fertilisers of animal origin used are given in kilograms of a pure NPK compound. A positive balance of fertilisers prevails in all area groups.

Similar correlations are observed in groups of farms categorised in terms of **economic size,** but this does not refer to the stocking density criterion, which is not complied with by relatively more farms with a higher economic potential. On the other hand, farms with a higher economic potential more frequently comply with a criterion referring to a share of cereal crops, plant groups and cover share. The level of fertilisation per 1 ha of agricultural land, with an input and output of fertilisers, as well as the balance of the main macro-substances (tab. II.7 and II.8), are growing proportionally to economic size. This tendency falls in groups of the largest economic size ≥40 ESU (Fig. II.3).

Table II.7. The percentage of private farms characterised with chosen criteria of environmental sustainability according to economic size in 2007 (percentage, by columns)

No.	Specification	European Size Unit (ESU)			
		up to 4	4-8	8-16	≥ 16
1	Cereal crops share	23.9	24.5	30.3	41.5
2	Plant cover share	31.1	42.5	47.3	56.4
3	Plant groups number	15.4	42.4	50.7	52.5
4	Density of livestock	98.0	97.9	95.8	88.6
5	Organic substance balance	58.5	57.0	56.4	55.2
6	Nitrogen balance	4.8	7.2	5.9	5.3
7	Applying mineral and calcium fertilisers	66.2	95.3	96.8	96.7
8	Applying organic fertilisers of animal origin	46.8	83.9	86.0	84.4

Source: Own study based on GUS data.

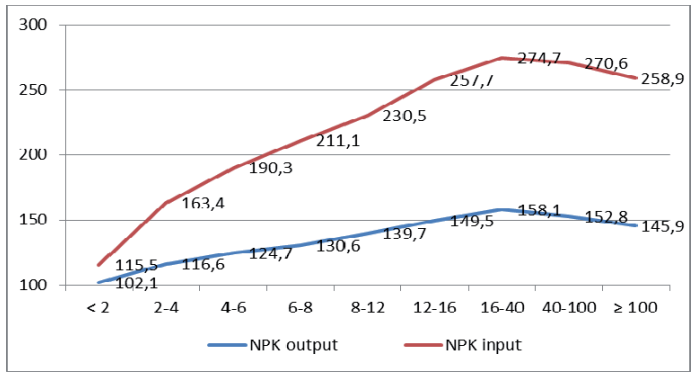
[81] The area of agricultural land in good condition constitutes 98.6% of the total area of agricultural land owned by private farms.

Table II.8. Mineral fertilisation and fertilisers input and output, in groups of private farms, by economic size in 2007 (kg NPK/ha AL)

No.	Specification	European Size Unit (ESU)			
		up to 4	4-8	8-16	≥ 16
1	Mineral fertilisation	83.4	118.6	135.4	161.0
2	Total input of fertilisers	123.0	198.1	239.9	273.7
3	Total output of fertilisers	123.6	126.9	143.1	157.0
4	Balance (2-3)	-0.6	71.2	96.8	116.7

Source: Own study based on GUS data.

Figure II.3. The input and output of fertilisers in groups of private farms by european size unit (ESU) in 2007 (kg NPK/ha AL)



Source: Own study based on GUS data.

Summing up, the results obtained point to the importance of area structure in the sustainability of farms. A higher, standard, gross margin was generated in the relatively larger farms, and the organisation of agricultural production (plant and animal) may be considered as more friendly for the natural environment. In the majority of micro-farms, i.e. farms with a very small acreage of agricultural land, animal production was on a large scale, or neglected. Various degrees of obstacles to the implementation of particular agricultural practices favouring environment protection in farming should be stressed. The percentage of farms fulfilling individual sustainability criteria (referring to plant and animal production) was much differentiated at the national and regional levels. It was found that not only the intensity, but also the direction and structure of agricultural production, are of particular importance for shaping sustainable agriculture.

The following are considered as the basic obstacles to the environmental and economic sustainability of farms: a disadvantageous area and economic structure in farms, a high share of non-livestock farms, a level of fertilisation not

adjusted to plant needs, and soil richness in terms of the main macroelements, as well as a high percentage of acidified soil and insufficient soil liming practices.

6.2 The sustainability of farms according to FADN data

Farms using agricultural accountancy under the Farm Accounting Data Network (FADN) system are the basic and the most important sub-group of private farms. The system facilitates the characterisation of selected groups of farms, which may be useful in the assessment of the sustainability of selected classes of farms.

In 2007, over 12 thousand private farms were included in the FADN (tab. II.9). The average FADN farm was characterised by substantial area of agricultural land, i.e. over 30 ha, livestock exceeding 25 LU, generating a standard gross margin over 20 ESU, and profit generated by a farm about PLN 80 thousand.

Table II.9. The production potential of FADN private farms by sustainability criteria

No.	Specification	Private farms by sustainability criteria					
		in total	cereal crops share	plant cover share	plant groups number	density of livestock	the four criteria in total
1	Number of farms	12 038	4 836	8 474	7 850	10 972	2 448
2	Share (percentage)	100.0	40.2	70.4	65.2	91.1	20.3
	on average per farm						
3	Agricultural land (ha)	31.5	32.3	35.5	33.4	32.0	41.9
4	Labour input (AWU)	2.1	2.4	1.9	2.0	2.1	2.1
5	Total livestock units (LU)	26.5	21.8	28.6	24.1	19.6	23.4
6	Economic size (ESU)	21.0	21.8	22.1	19.8	18.6	22.7
7	Family farm income (thousand PLN)	78.8	97.9	79.1	76.8	76.6	103.3
8	Family farm income per family work unit (thousand PLN/FWU*)	46.6	57.6	46.5	45.2	45.1	58.7

* FWU – Family Work Unit – unpaid labour input, refers generally to family labour expressed in family work unit (FWU = Family AWU)

Source: Own study based on FADN data.

Private farms under the FADN system were characterised by a high level of compliance with particular criteria of plant and animal production sustainability. The largest number of farms was characterised by specified stocking density on agricultural land (over 90%), and the smallest group included farms of an admissible share of cereals in the structure of crops on arable land (40%). On average, every fifth farm was considered as sustainable in terms of four analysed criteria. Sustainable farms occupied a larger area of agricultural land

(41.9 ha), which made them more profitable (103.3 thousand) as compared to the average results (31.5 ha and 78.8 thousand respectively).

The analysed group included, in the majority, farms occupying an area from 5 to 20 ha of agricultural land, and their share in the structure was equal to about 50% (tab. II.10). The basic presented statistics on private farms by **area groups** provide information on the significant diversification of the analysed farms in terms of acreage, and also by the level of the standard gross margin, livestock and income level. The farms with the smallest size, i.e. up to 5 ha of agricultural land, create a quite specific and highly-specialised group, due to intensive animal production on a small acreage. This type of agricultural production organisation was reflected in a high level of generated income.

Table II.10. The production potential of private farms under FADN by agricultural land

No.	Specification	Agricultural land (ha)					
		in total	up to 1	1-5	5-20	20-50	≥ 50
1	Number of farms	12 038	138	468	5 469	4 255	1 708
2	Share (percentage)	100.0	1.1	3.9	45.4	35.3	14.2
on average per farm							
3	Agricultural land (ha)	31.5	0.3	3.2	12.5	30.9	103.8
4	Labour input (AWU)	2.1	3.6	2.5	1.8	2.1	2.7
5	Total livestock units (LU)	26.5	49.0	16.2	13.6	33.3	51.9
6	Economic size (ESU)	21.0	25.8	19.3	10.5	23.3	49.3
7	Family farm income (thousand PLN)	78.8	121.0	64.6	34.0	77.2	226.3
8	Family farm income per family work unit (thousand PLN/FWU)	46.6	71.2	46.1	21.3	42.9	125.7

Source: Own study based on FADN data.

As far as area groups are concerned, the share of farms fulfilling the criteria of environmental sustainability in terms of the number of plant groups and cover share in arable land is increasing. A fall is observed in the lower groups and an insignificant growth in the higher ones (tab. II.11). Such an obvious correlation is not observed in relation to cereal crops share and stocking density on agricultural land. In turn, considering the coexistent fulfilment of four criteria, dependency is obvious: in groups with the smallest farms of up to 1 ha of agricultural land, such farms constituted 6.2%, whereas in the group of 50 and more ha – as much as 30.2%.

In groups under FADN accountancy, the most significant group (over 30%) is formed by farms of **economic size** 16-40 ESU (tab. II.12). The level of standard gross margin of farms was chiefly defined by their acreage of agricultural land. Although family (non-paid) work inputs in each group were simi-

lar, the input of paid labour was higher in groups of a higher economic size. Animal production trends and the intensiveness of stocking density to a large extent shaped the level of the standard gross margin, and finally also the level of income gained from farms.

Table II.11. The percentage of FADN private farms fulfilling selected criteria of environmental sustainability by acreage of agricultural areas

No.	Specification	Agricultural land (ha)					
		in total	up to 1	1-5	5-20	20-50	≥ 50
1	Cereal crops share	40.2	97.8	60.3	37.2	39.1	42.2
2	Plant cover share	70.4	2.9	32.3	65.9	77.1	84.1
3	Plants groups number	65.2	0.7	29.5	63.7	71.6	69.1
4	Density of livestock	91.1	94.9	89.3	91.3	89.5	94.9
5	The 4 criteria in total	20.3	6.2	0.2	15.9	24.3	30.2

Source: Own study based on FADN data.

Table II.12. The production potential of private farms under FADN by european size

No.	Specification	European size (ESU)				
		in total	2-8	8-16	16-40	≥ 40,0
1	Number of farms	12 038	3 489	3 425	3 739	1 385
2	Share (percentage)	100.0	29.0	28.5	31.1	11.5
	on average per farm					
3	Agricultural land (ha)	31.5	11.3	21.4	38.4	88.7
4	Labour input (AWU)	2.1	1.5	1.9	2.2	3.5
5	Total livestock units (LU)	26.5	6.0	14.6	31.4	94.4
6	European size (ESU)	21.0	5.1	11.7	24.7	74.3
7	Family farm income (thousand PLN)	78.8	24.0	49.1	94.1	248.6
8	Family farm income per family work unit (thousand PLN/FWU)	46.6	17.1	28.9	52.3	130.8

Source: Own study based on FADN data.

The economic size of farms is differentiated by the level and scope of their sustainability in terms of environmental criteria applied (tab. II.13). As far as share of cereal crops is concerned, the percentage of farms characterised by the relevant level of coefficient is insignificantly higher, and in the last group (≥ 40 ESU) it slightly falls. For the plant cover share coefficient, the tendency is to increase, i.e. the share of farms characterised by the desired level of measure applied is higher. For stocking density on agricultural land coefficient, the tendency is decreasing. On the other hand, the correlation between the share of farms characterised by various crop structure and their economic size runs

along a parabolic curve. Given the collective fulfilment of the four criteria, the percentage of farms is increasing, and a fall is observed only in the last group.

Table II.13. The percentage of FADN private farms fulfilling selected criteria of environmental sustainability by european size

No.	Specification	Economic size (ESU)				
		in total	2-8	8-16	16-40	≥ 40.0
1	Cereal crops share	40.2	36.4	41.1	42.6	40.9
2	Plant cover share	70.4	63.4	70.2	74.7	77.0
3	Plant groups number	65.2	62.1	69.6	67.9	54.9
4	Density of livestock	91.1	98.3	96.0	88.2	69.0
5	The 4 criteria in total	20.3	14.9	21.8	23.7	21.4

Source: Own study based on FADN data.

On average, every second FADN farm was specialised (tab. II.14), in particular in livestock fed under the grazing system (19%) and in field crops (16%). Various crops were cultivated in every fifth farm and various groups of livestock were housed. The highest labour profitability was observed in farms specialising in plant production, e.g. field crops (over PLN 86 thousand per family work unit), horticultural (PLN 57 thousand) and permanent crops (over PLN 53 thousand).

Table II.14. The production potential of FADN private farms by type of farming*

No.	Specification	Type of farming								
		in total	1	2	3	4	5	6	7	8
1	Number of farms	12 038	1 932	437	471	2 307	1 662	796	2 090	2 343
2	Share (percentage)	100.0	16.0	3.6	3.9	19.2	13.8	6.6	17.4	19.5
	on average per farm									
3	Agricultural land (ha)	31.5	60.3	5.8	15.2	29.0	28.2	22.4	22.0	32.0
4	Labour input (AWU)	2.1	2.1	4.2	2.7	2.0	2.0	2.0	1.8	1.9
5	Total livestock units	26.5	3.2	0.7	0.2	31.5	78.2	8.9	26.1	20.6
6	Economic size (ESU)	21.0	19.3	39.7	14.1	19.8	38.2	11.4	16.2	16.9
7	Family farm income (thousand PLN)	78.8	129.1	103.4	79.7	86.0	80.6	50.7	43.0	65.4
8	Family farm income per family work unit (thousand PLN/FWU)	46.6	86.1	57.4	53.1	45.2	47.4	31.7	25.3	38.5

* Types of farming under FADN: 1 – specialist field crops; 2 – specialist horticulture; 3 – specialist permanent crops; 4 – specialist grazing livestock; 5 – specialist granivores; 6 – non-specialised – mixed cropping; 7 – non-specialised – mixed livestock; 8 – non-specialised – various crops and livestock.

Source: Own study based on FADN data.

As far as **type of farming** are concerned, the largest number of farms specialising in permanent (86.8%), horticultural (66.8%) and field crops (55.0%) is characterised by the relevant share of cereal in crops, and the least number

among those specialising in livestock fed under the grazing system (8.7%) and mixed, housing various types of livestock – 20.0% (tab. II.15). For the correct number of plant groups, units specialising in livestock fed under the grazing system (76.4%) and unspecialised or housing various types of livestock (74.6%) are at the forefront as opposed to permanent crops (12.1%) and horticultural (22.4%). The adequate level of stocking density on agricultural land characterises all farms of the following types: horticultural crops, permanent crops and various crops, as opposed to units specialising in granivores (54.9%) and mixed, housing various types of livestock (91.4%). In farms specialising in field crops, and in grazing livestock, agricultural production friendly for natural environment, i.e. characterised by the suggested level of applied measures of impact of agriculture on the environment (30 and 35% respectively) was relatively more frequent.

Table II.15. The percentage of FADN private farms fulfilling selected criteria of environmental sustainability by type of farming

No.	Specification	Type of farming								
		in total	1	2	3	4	5	6	7	8
1	Cereal crops share	40.2	55.0	66.8	86.8	59.7	8.7	43.8	20.0	33.4
2	Plant cover share	70.4	73.3	30.4	12.7	67.6	81.0	64.6	79.3	76.2
3	Plant groups number	65.2	69.0	22.4	12.1	76.4	40.0	74.7	76.2	74.6
4	Density of livestock	91.1	99.9	100.0	100.0	95.1	54.9	100.0	91.4	99.0
5	The 4 criteria in total	20.3	30.3	6.6	3.8	35.1	1.7	21.1	13.4	22.6

* Types of farming under FADN: 1 – specialist field crops; 2 – specialist horticulture; 3 – specialist permanent crops; 4 – specialist grazing livestock; 5 – specialist granivores; 6 – non-specialised – mixed cropping; 7 – non-specialised – mixed livestock; 8 – non-specialised – various crops and livestock.

Source: Own study based on FADN data.

FADN data provide valuable information on the level of the **economic sustainability** of farms. The level of family farm income expressed per family labour unit (measured by ratio of the income value of a farm to the number of family members full-time employed) is used as a measure of economic sustainability. The highest incomes were found on farms with a larger acreage of agricultural land, from 20 ha (20-50 ha: PLN 42.9 thousand and above 50 ha: PLN 125.7 thousand), and the lowest value was found on farms with an average area, i.e. units with an acreage 5-20 ha (PLN 21.3 thousand). This coefficient is higher for units with a smaller area due to horticultural and specialised farm production (up to 1 ha AL: PLN 71.2 thousand, and 1-5 ha: PLN 46.1 thousand).

In the whole group of FADN farms, over 3% of farms were characterised by **negative income of the farm**. Among the remaining, 8% were characterised by **parity income**, i.e. about PLN 21 600 per FWU, and over 54% of farms were

characterised by **over parity income** of the farm (tab. II.16)[82]. The share of sustainable farms increased as correlation with income increased (tab. II.17).

Table II.16. The production potential of FADN individual farms characterised by relation family farm income expressed per family labour unit and average profitability in the national economy

No.	Specification	Relation of income			
		in total	below	parity	above
1	Number of farms	12 038	4 103	952	6 586
2	Share (percentage)	100	34.1	7.9	54.7
on average per farm					
3	Agricultural land (ha)	31.5	14.8	19.6	44.5
4	Labour input (AWU)	2.1	1.8	1.9	2.3
5	Total livestock units (LU)	26.5	13.4	19.0	35.7
6	Economic size (ESU)	21.0	10.3	14.1	28.8
7	Family farm income (thousand PLN)	78.8	18.4	37.8	128.0
8	Family farm income per family work unit (thousand PLN/FWU)	46.6	11.1	21.7	75.0

Source: Own study based on FADN data.

Table II.17. The percentage of FADN private farms fulfilling selected criteria of environmental sustainability by income relation (%)

No.	Specification	Relation of income			
		in total	below	parity	above
1	Cereal crops share	40.2	29.9	36.6	46.9
2	Plant cover share	70.4	70.3	69.1	71.5
3	Plant groups number	65.2	65.6	70.5	65.5
4	Density of livestock	91.1	93.9	92.1	89.6
5	The 4 criteria in total	20.3	14.5	17.6	25.0

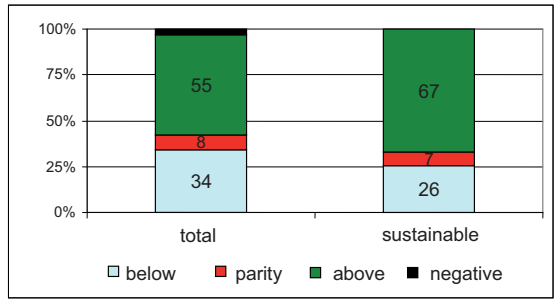
Source: Own study based on FADN data.

Among the farms complying with the **four environmental sustainability criteria,** income relation below parity level was stated in 26% of farms, 7% of farms were characterised by parity level of income, and 67% above (Fig. II.4). Therefore, the number of units of over-parity remuneration was significantly higher among sustainable farms. These results may be explained mainly by the

[82] In 2007, the pay for 1 work hour in the whole national economy amounted to PLN 9.81, therefore, assuming that the worktime of a person under full-time employment was equal to 2 200 hours, parity income amounted to PLN 21 582. Parity relation was defined as [0.9; 1.1] – A. Skarżyńska (2009), *Wyniki ekonomiczne wybranych produktów rolniczych w 2007 r.*, IERiGŻ-PIB, Warszawa, p. 17-18.

increased average acreage of agricultural land of sustainable farms (41.9 ha) as compared to average units (31.5 ha).

Figure II.4. The structure of private farms in total and sustainable farms by relation family farm income per family work unit and average profitability in the national economy



Source: Own study based on FADN data.

The share of payments in the farm income is quite significant, amounting to about 33%, and is similar for all farms as well as sustainable farms. If payments were excluded, this would definitely increase the share of farms classified below parity relationship, mostly at the expense of the relative quantity of farms classified above parity relationship. In this case, the share of farms classified above parity relationship would equal 38%, below parity relationship 56%, and 6% FADN farms on parity level. In terms of payments, the average acreage of agricultural land for parity farm equals 19.6 ha; if payments were excluded (financial support of government was stopped), it would have to be equal to 25.3 ha, i.e. 6 ha more.

The presented results of the study led to conclusions similar to those formulated according to the analysis of the Central Statistical Office (GUS) data. It was proved that the acreage and economic size of farm have particular importance in shaping the sustainability of farms. Trends in animal production also play an important role, because high stocking density is disruptive for the balance of the agricultural ecosystem (exceeding its absorption), but if this type of production is neglected, organising a farm in terms of friendliness to the natural environment is more difficult (in particular as far as humus balance is concerned).

As far as economic sustainability is concerned, the estimated (average) acreage of farm facilitating economic results on the parity level should be equal to 20 ha of agricultural land, or respectively 25 ha if farms are not subsidised.

6.3. Specific groups of farms

Agricultural sustainability may also be assessed from the perspective of certain groups of farms. These include those affected by potential environmental (un)sustainability or sustainability. This sustainability is more difficult among farms without field crops or livestock, and relatively easy in units dealing with field crops and livestock (bidirectional), Norfolk and organic farms. From the economic perspective, agricultural holdings of farmers form an important group. Considering the above, the mentioned groups are included under the analysis.

Non-livestock farms are potentially threatening for soil fertility, especially when simplified crop rotation is applied. The basic elements of agro-technical decisive for the content of humus in soil are natural fertilisers (manure or liquid manure) and organic fertilisers (straw, green fertilisers and composts), and the selection of plants cropped as well as crop rotation and intensiveness of cropping practices (depth and quantity).

The maintenance of soil fertility in non-livestock farms is relatively difficult. It requires high organisational skills and comprehensive, multidirectional knowledge aimed at predicting the consequences of actions taken in compensating or limiting the effects of permanent lack of natural fertilisers (manure or liquid manure). Catch crops (stubble type and under-sowing) play an important part in the maintenance of soil fertility. On non-livestock farms, these crops and ploughed straw have a positive impact upon the balance of soil organic substance, and, what is more important, they increase biological soil activity. The cropping of papilionaceous, multiannual plants and their grass mixtures have a particularly significant and comprehensive impact on soil fertility. Apart from greater humus content, they have a strong influence on the physical properties of soil (loosening of subsoil, structure improvement) due to the increased soil richness in nitrogen and the limited presence of weeds, as well as the increased amount of diseases and pests. Unfortunately, recently the share of this group of plants in the sowing structure was drastically limited to about 3% on average on the country level. It is higher only in 3 voivodships (Małopolskie, Podlaskie, and Warmińsko-Mazurskie), where it is equal to 7-8%. In non-livestock farms, the index of vegetation cover on arable land in winter period was equal to 60%, i.e. suitable for good agricultural practice in plain areas.

Farms specialising only in plant production with acreages of about 100 ha on better soils, where spicateous plants, sugar beets, rapeseed and corn were cropped for seed, were economically effective, whereas on weaker soils they generated too small an income. Ecologic threats associated with this type of farming are related to the increased use of crop protection chemicals, a posi-

tive (high) nitrogen balance and the limitation of biodiversity (permanent pastures transformed into arable land, and a limited assortment of plants cropped).

The maintenance of soil fertility will be of increased importance due to the progressing process of animal production concentration, and the neglect of livestock breeding in a growing number of farms. Preserving a sustainable ecosystem – in a given case especially soil fertility – is one of fundamental requirements of the sustainable development of agriculture, and the lack of livestock on farms may be a serious obstacle.

In 2007, the number of non-livestock farms was 848 thousand, i.e. 36% of the total number of private farms. These farms use 22% of agricultural land, 16% of labour inputs, and 18% of standard gross margin (tab. II.18) The average acreage of agricultural land is equal to 3.7 ha, labour input to 0.4 AWU, and economic size to 1.7 ESU (tab. II.19).

Table II.18. The percentage of the value of production potential features in selected groups of farms

No.	Specification	Groups of farms				
		non-livestock	without field crops	crops and livestock	Norfolk	organic
1	Number of farms (%)	35.5	20.5	57.7	1.9	0.3
2	Agricultural land (ha)	22.3	5.2	76.0	2.6	1.3
3	Labour inputs (AWU)	16.2	7.5	80.3	2.8	0.6
4	Total livestock units (LU)	-	3.4	96.6	3.4	0.7
5	Economic size (ESU)	18.5	4.1	80.3	2.4	1.1

Source: Own study based on GUS data.

Table II.19. The more important features of farms of differentiated groups (average per farm)

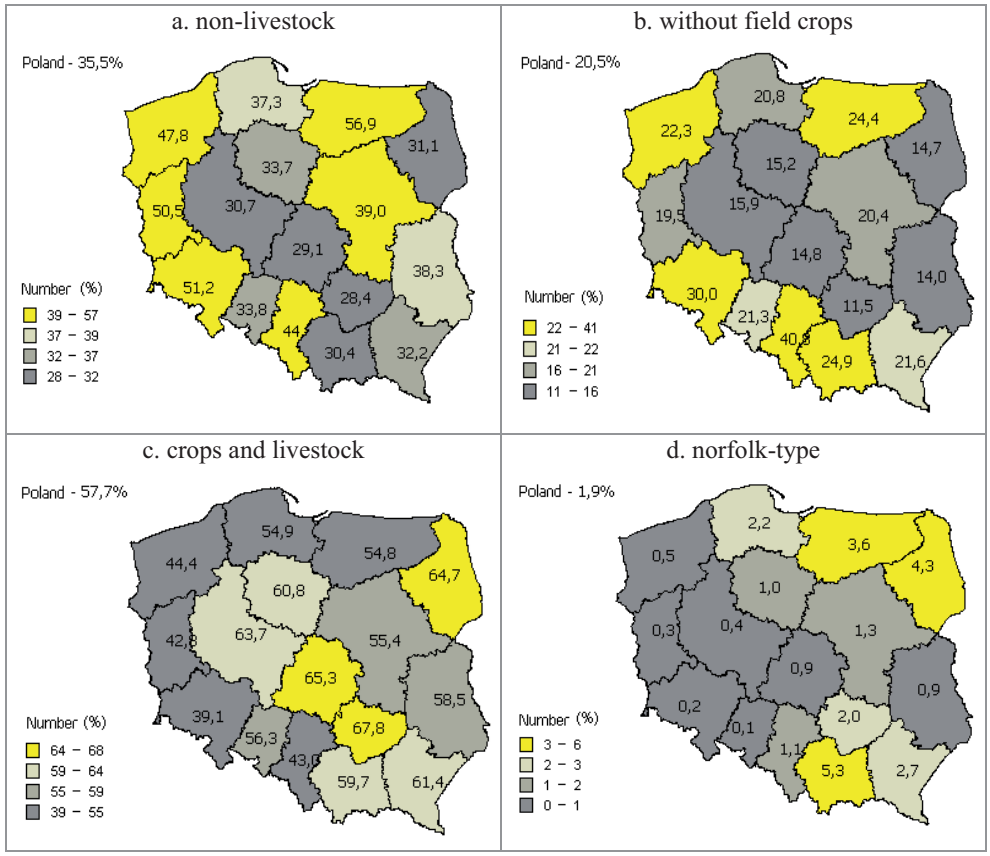
No.	Specification	Groups of farms				
		non-livestock	without field crops	crops and livestock	Norfolk	organic
1	Agricultural land (ha)	3.73	1.52	7.84	8.1	22.8
2	Labour inputs (AWU)	0.43	0.34	1.31	1.4	1.6
3	Total livestock units (LU)	0.00	0.53	5.32	5.6	6.1
4	Economic size (ESU)	1.72	0.67	4.61	4.1	10.2

Source: Own study based on GUS data.

Regional differences in terms of share of non-livestock private farms are significant. The highest percentage of this type of farms is characteristic of "post-state farms" voivodships, and the lowest for family farming (Map II.12a). The Warmińsko-Mazurskie, Dolnośląskie and Lubuskie voivod-

ships are territories where over a half the private farms do not keep any livestock. The maintenance of soil organic substance is becoming a serious agrotechnical challenge, especially in the first-listed voivodships, in order not to lose soil fertility on such large areas. It is not easy to face this challenge, particularly without livestock, but proper agricultural practices, including crop rotation and catch crops, may play an important role here.

Map II.12a-II.12d. The regional distribution of selected groups of farms (percentage of private farms in voivodships)



Source: Own study based on GUS data.

Farms without field crops form a special group. The number of such farms reaches 0.5 million (489 thousand), which is 20% of private farms, and own 5.2% of agricultural land (744 thousand ha), 7.5% labour input (169 thousand under full-time employment), 3.4% livestock (259 thousand livestock unit) and 4.1% of standard gross margin (328 thousand ESU). Generally, these are weak farms.

On average, 1 farm of this group owns 1.5 ha of agricultural land (in groups of **farms with field crops** 1.7 ha), labour inputs are equal to 0.3 AWU (in the second group respectively 1.1 AWU), livestock 0.5 LU (as opposed to 3.9 LU) and amount of standard gross margin to 0.7 ESU (4.0 ESU).

The relatively highest number of farms not dealing with field crops is located in the Śląskie and Dolnośląskie voivodships, the least number in the Świętokrzyskie, Lubelskie, Podlaskie and Łódzkie voivodships (Map II.12b). Part of these farms use only permanent green land in order to use subsidies.

Public statistics show also that about 4% of livestock is kept by farms not dealing with field crops. Their sustainability is hard to judge, because they include farms with a large acreage of meadows and pastures, and animal farms (pigs and poultry) without agricultural land.

Farms with both field crops and livestock are potentially predestined to comply with the requirements of environmental sustainability. Undoubtedly, these farms are the most "healthy" base of private agriculture, due to their multidimensional production. Among private farms 58% complied with these requirements (1 377 thousand). These farms occupied 76% of agricultural land (10.8 million ha), 96% of livestock (7.3 million LU), 80% of labour inputs (1.8 million AWU), as well as generated 80% of standard gross margin (6.3 million ESU). Therefore, these are farms larger and stronger than average.

The average acreage of such farms was equal to 7.8 ha of agricultural land characterised by labour input exceeding 1.3 AWU and average livestock equal to 53.3 LU. The economic size of these farms was at the level of 4.6 ESU. Bidirectional farms were relatively larger than the others, both in terms of area, livestock and generated standard gross margin (differences were respectively at the level of over 30%, nearly 70% and 40%).

The relatively highest number of farms of this type were situated in the Świętokrzyskie (68%), Łódzkie (65%), Podlaskie (65%) and Wielkopolskie (64%) voivodships, the least in Dolnośląskie (39%) and Lubuskie (43%) voivodships (Map II.12c).

The farms characterised by the most desired structure of sowing on arable land were named as Norfolk farms. **The Norfolk-type farms** constitute only 1.9% (45.4 thousand) of Polish private farms. In 2007, these farms used 370 thousand ha of agricultural land (2.6% of a total), held 255 thousand total livestock units (3.4%), and generated standard gross margin amounting to 186 thousand ESU (2.4%). The higher labour intensiveness of such farms means that labour inputs in these units constitute 2.8% of general labour inputs to agriculture.

Then, the average Norfolk-type farm occupied 8.1 ha of agricultural land, characterized with labour input 1.4 AWU, 5.7 total livestock units and standard

gross margin equal 4.1 of ESU. The Norfolk-type farms were limited in terms of abundance, but definitely larger in terms of production potential (economically stronger) than the average private farm. Generally, these farms occupied an acreage larger by over 25%, and were characterised by 70% higher stocking density, and larger economic size by 15%.

The relatively highest number of "Norfolk" farms was found in Małopolskie (5.3%), Podlaskie (4.3%), and Warmińsko-Mazurskie (3.6%) voivodships. The least of them are situated in Opolskie (0.1%), Dolnośląskie (0.2%), and Lubuskie (0.3%) voivodships (Map II.12d).

The organic farms are the last in the group of specific farms. Organic agriculture is a management system ensuring permanent soil fertility and animal health as well as high biological quality of agricultural products activating natural production mechanisms by the application of natural, unprocessed preparations. This system is sustainable in ecological terms, and characterised by strong prerequisites for economic and social sustainability: it does not burden the natural environment, to large extent is independent from external inputs, and enables the development and preservation of agriculture and countryside as social and cultural categories.

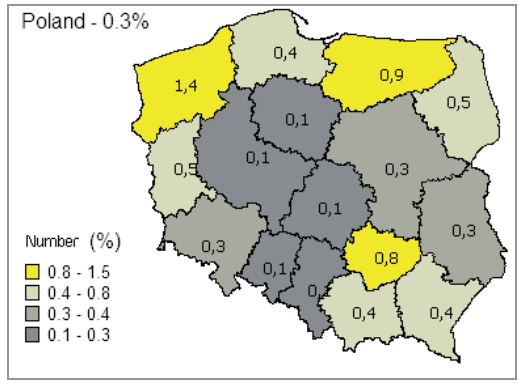
Organic agriculture is driven by the three basic rules, i.e. soil fertility, feedstuff and fertiliser balance and biodiversity. Soil fertility – in organic agriculture soil fertility is the main factor. It is achieved by feeding soil organisms (i.e. soil fertilisation) which supply roots with nutritive substances in the appropriate form, quantity and proportions. Such a balanced nutrition of plants ensures their balanced full composition, and, consequently, the high value of feedstuffs and food raw products as opposed to the input of only ionised chemical compounds. The balance between feedstuffs and fertilisers – an attempt to close the matter cycle on a farm by the balancing of plant and animal production. Stocking density at the level of 0.5-1.5 LU/ha ensures self-sufficiency on farms in terms of feedstuff and fertiliser balance. Biodiversity – organic agriculture deals also with the shaping and upkeeping of the agricultural landscape composed of fields and meadows, field buffers, protective forests and balks. The upkeep of the so-called "small-scale water retention": ponds, pools and garden ponds having an influence on water management of the whole economy are also highly important.

Organic farms are a form of management appropriate to the concept of the development of sustainable agriculture. This form is supported in the European Union and in many highly-developed countries. It is justified by the "friendliness" of this form of production for the natural environment and high nutritive value of manufactured products. Despite the rapid development of organic agri-

culture, it is still marginal[83] and in the foreseeable future it probably will not become a dominant form of agriculture. Nevertheless, the rapidly growing demand for products of organic agriculture and progressing market liberalisation let us assume that this niche can transform into quite a significant agricultural sector, especially in countries that have preserved a soil (agricultural) ecosystem close to a natural ecosystem, and family farming.

In 2007, organic methods of plant production supervised by authorised certification bodies were applied by 8.4 thousand farms, i.e. only 0.3% of farms dealing with agricultural activity. The largest number of organic farms is situated in the Zachodniopomorskie – 1.4%, Warmińsko-Mazurskie – 0.9% and Świętokrzyskie voivodships – 0.8% (Map II.13). The smallest number of organic farms was found in Śląskie, Opolskie, Kujawsko-Pomorskie, Wielkopolskie, and Łódzkie voivodships – 0.1%.

Map II.13. The percentage of organic private farms by voivodships



Source: Own study based on GUS data.

The area of agricultural land under organic crops was equal to 181.7 thousand ha, which constituted only 1.1% of their total acreage. The organic farms held only 0.7% of livestock, 0.7% labour inputs and 1.1% of standard gross margin. Organic methods in animal production were applied by 4.7 thousand farms, i.e. 55.4% of organic farms under study.

The average acreage of an organic farm was equal to 22.8 ha of agricultural land, labour inputs were on the level of 1.6 AWU, headage of livestock was equal to 6 livestock units, and their economic size to 10 ESU. The results prove that the acreage and economic size structure of organic farms turned out

[83] According to IFOAM (*International Federation of Organic Agriculture Movements*) data, the world's organic agriculture occupies over 30 million ha – the largest number in Australia, Argentina and China [www.organic-world.net].

to be more advantageous compared to conventional farms (on average, an acreage over 4 times larger, and differences in standard gross margin were over 3 times higher in favour of organic farms).

The sowing structure in organic farms is more "environment friendly" than in conventional units. This proves a lower share of cereal crops in sowing, and higher percentage of catch crops, crops for green fodder and ploughing.

Organic farms to larger extent maintain the multidirectional character of farms by animal production. In 2007, the percentage of farms housing livestock amounted to 64% of all farms and 72% of organic farms. Nevertheless, non-livestock farms are quite frequently encountered in a group of organic farms; the percentage of these farms is equal to 28%. The positive consequences of this situation may be uncertain, because the ultimate assessment of farms' sustainability without the production of fertilisers of *ergo* animal origin is difficult. Green fertilisers may only partially provide plants or different biotic elements of soil ecosystems with the necessary nutritive substances.

In terms of predominant income from agricultural activity, organic farms obtained it nearly twice as much as on all farms. This source of income prevails in more than a half of organic farms, and nearly a quarter of all private farms.

Economic size of organic farms stand out this group of farms in comparison to the rest. The average economic size in private agriculture does not exceed 4 ESU for 80% of farms, and the threshold of 16 ESU is exceeded only by 4% of private farms. As far as organic farms are concerned, these numbers are far more favourable, because they are at the respective levels of 49% and 14%.

Organic farms are different from the others by market oriented production. Two coefficients are important here. One refers to production assignment: for the market or semi-subsistence, the second to sales directly to consumers or entities buying agricultural products. If the value of agricultural production is dominated by semi-subsistence, these farms are categorised as self-subsistence. By analogy, if the value of direct sales to consumers prevails over total sales value, these farms are defined as local market farms. In comparison with other farms, the orientation of organic farms towards semi-subsistence is relatively rare – they are more oriented towards local markets (semi-subsistence farms constitute 38% of all farms and 22% of organic farms).

A higher willingness to employ organic production is observed among users of farms with a **higher level of education**, a larger family (able to generate higher family labour inputs), more oriented to make agricultural activity their source of income, and most of all – with larger and more environmentally-diverse farm acreage. This diversity creates more opportunities for non-agricultural activities in a farm, and the acreage of a farm is important for the gaining of family in-

come from agricultural activity. Apart from economic balance, the admiration and attitude of the farmer towards nature is definitely important.

Organic farms are less advantageous compared to the others of a similar acreage of agricultural land in terms of production and economic coefficients, but the difference is not "crippling". On the other hand, the situation may be different if the purchase of industrial production means and environmental pressure is concerned (the so-called "ecological footprint"). The pressure variable entered into the economic balance by certain ecological requirements (following the *polluter pays principle*) or payment for goods and services, may significantly alter this difference.

The food industry requirements definitely prefer industrial agriculture products, i.e. from farms with large-scale production able to deliver larger lots of homogeneous and cheaper products. In this competition, organic farms are more limited in terms of possibilities, and they lose if they do not manage to create separate links with consumers (trade and food-processing).

The review of organic farms shows that production and economic as well as environmental criteria may be reconciled, but it requires a statistically far better natural potential of a farm than it is now as compared to the dominant mass of farms. Therefore, the orientation for the organic farm model requires more accelerated soil concentration than in the case of conventional farms. But here we observe an important difference – we may define the concentration threshold for organic farms, but this is not the case for conventional units. Moreover, in both instances the desired pace of concentration will be different (lower) if the social criteria of agriculture are involved. As a result, we may find ourselves in a situation where an organic farm will not be a socially sustainable one.

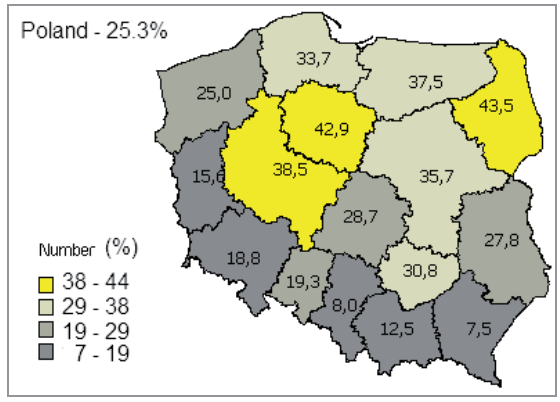
6.4. Households of farmers

Households of farmers[84] constitute one quarter of all private farms (603 thousand). They own 62% of agricultural land (8 794 thousand ha), 48% of labour inputs (1 073 AWU), 78% of livestock (5 934 thousand LU) and 71% of standard gross margin (5 643 thousand ESU). Households of farmers definitely prevail over households of the remaining social and economic groups in terms of production potential. The average household of farmers uses 14.6 ha of agricultural land, 1.8 AWU, 9.8 LU and produces standard gross margin of 9.4 ESU.

[84] Households of farmers are households where income from the farm/agricultural activity constitutes at least 50% of the disposable income.

The largest number of households of farmers is situated in Podlaskie – 44%, Kujawsko-Pomorskie – 43% and Wielkopolskie – 39% voivodships, and the least in Podkarpackie – 8% and Śląskie – 8% voivodships (Map II.14).

Map II.14. Regional distribution of households of farmers (percentage of private farms in voivodship)



Source: Own study based on GUS data.

Households generating income only from own farm form the specific group of households of farmers. This group includes 332 thousand households (55% of households of farmers), uses 5 194 thousand ha of agricultural land (59% of agricultural land in households of farmers), 585 thousand of labour inputs (54% AWU), 3 604 thousand of livestock (61% LU) and produces standard gross margin of the value of 3 410 thousand ESU (60% SGM in households of farmers). Households living only on agricultural income on average use 15.6 ha of agricultural land, labour inputs equal to 1.8 annual work units, number of livestock amounts to 10.8 LU, and standard gross margin is equal to 10.3 ESU.

Another subgroup is formed by households of farmers, that are **capable of development**, which means **economic size of a household amounting to at least 8 ESU**. This subgroup includes 212 thousand (35% of households of farmers) using 5.9 million ha (67%), 480 thousand AWU (44%), housing 4.6 million LU (78%) and producing standard gross margin of 4.3 million ESU (76%). Generally, these are relatively large farms. On average, household from this group occupies 27.7 ha of agricultural land, 2.2 AWU, 21.9 LU and 20.4 ESU.

In the context of agricultural development, a particularly significant role is played by **households of farmers**, which are clearly more sustainable than other socio-economic groups (tab. II.20). Households of farmers whose sole subsistence is their farm and those of economically stronger farmers are more sustainable on average terms (tab. II.21).This is without doubt an optimistic sign, showing that the environmental and economic criteria may be reconciled.

Table II.20. Private farms by selected environmental sustainability coefficients in socio-economic groups* in 2007 (total number of farms in columns = 100)

No.	Specification	I	II	III	IV	V	VI	VII	VIII
1	Cereal crops share	27.0	22.1	23.6	27.8	20.0	25.9	25.5	24.1
2	Plant cover share	43.5	44.1	30.7	41.5	28.0	26.9	25.6	40.6
3	Plant groups number	41.6	38.9	12.7	28.6	8.3	11.6	7.6	27.6
4	Density of livestock	96.4	98.1	98.5	98.5	98.3	96.9	96.6	98.0
5	Organic substance balance	55.6	53.4	59.5	51.5	65.7	59.7	59.5	55.3
6	Nitrogen balance	6.5	8.1	0.2	6.7	4.7	3.8	5.0	6.1
7	Applying mineral and calcium fertilisers	92.4	91.2	65.5	82.1	66.9	54.8	48.9	84.0
8	Applying organic fertilisers of animal origin	78.6	81.3	39.1	67.8	33.2	38.2	30.8	66.6

* Socio-economic groups of households: I – farmers', II – bi-professional agricultural (agricultural activity and hired labour), III – employees' (hired labour), IV – employees' bi-professional (hired labour and agricultural activity), V – non-agricultural business (self-employment in non-agricultural activity), VI – retired employees and annuitants (retirement benefits and annuities), VII – other non-paid, VIII – other combining various sources

Source: Own study based on GUS data.

Table II.21. Percentage of households complying with selected environmental sustainability criteria in groups of farms overall and in economically viable households of farmers and other households in 2007

No.	Specification	In total	Farms ≥ 8 ESU		
			in total	farmers	non-farmers
1	Farms in total	100.0	100.0	100.0	100.0
2	Cereal crops share	25.1	34.7	34.8	34.2
3	Plant cover share	34.2	50.9	52.2	41.9
4	Plant groups number	21.6	51.4	54.3	31.6
5	Density of livestock	97.5	92.9	92.6	94.5
6	Organic substance balance	58.1	55.9	55.6	57.4
7	Applying mineral and calcium fertilisers	72.0	96.7	97.5	91.6
8	Applying organic fertilisers of animal origin	52.3	85.3	88.0	67.1

Source: Own study based on GUS data.

7. The institutional factor in the development of socially sustainable agriculture

The market, propelled by the short-term motive of financial benefits on the part of economic entities (a microeconomic criterion), keeping the current price ratios and omitting externalities, is driving **towards industrial agriculture.** In contrast, social considerations – social rationality, in fact – command promoting a socially sustainable agriculture, which, *ex definitione* takes externalities into account. There is no market for those effects, no demand, but there are needs. Therefore, it is necessary to either create a market, or to lay down

threshold conditions for the activities of economic entities (farms). This leads one to the conclusion that the development of socially sustainable agriculture needs the participation of the institutional factor. This factor comprises state institutions (governments and local governments), socio-professional organisations and NGOs of various kinds. It goes without saying that the institutional factor must also include international and global organisations. Here a particularly significant role is played by the European Union, international economic organisations (Organization for Economic Co-operation and Development, World Trade Organisation, World Bank, International Monetary Fund), United Nations and its numerous agencies, as well as international organisations and networks of NGOs.

Compensation of the impact of environmental degradation by agriculture requires high expenditures from taxpayers and consumers (e.g. for treating polluted water, reverting the adverse effects of groundwater depletion for melioration, or revitalising degraded soils). Reducing this impact is the goal of state policies that involves setting up restrictions on industrial farming through certain legal regulations (environmental regulations), which force it to reduce environmental degradation. In developed countries, aside from administrative and legal restrictions imposed on industrial farming, the conscious and deliberate support of sustainable agriculture is gaining currency, mainly by means of agri-environmental programs. This mainly concerns EU member states.

Since Poland's accession to the European Union, Polish farming has been covered by **the mechanisms of the EU's Common Agricultural Policy (CAP)**, which, in the manner of an aircraft carrier, is slowly changing its course from supporting industrial farming to sustainable agriculture. This is reflected in the CAP priorities and in the transfer of funds arising from CAP mechanisms from the first to the second pillar. CAP has been generating considerable transfers of funds to agriculture for several dozen years, enabling it to modernise and restructure. It is therefore important that, in pursuing current economic (market) competitiveness, the long-range vision of agriculture, involving social competitiveness, should not be lost. Studies show a greater share of support for current goals in the case of Polish agriculture. However, the allocation of the stream of funds (measures) to the model of industrial agriculture or sustainable agriculture carries a great risk and requires such measures as a study of competitive and complementary, and even synergic, relations between the two kinds of agriculture. The first attempt serves as a great inspiration for further research. It has been found that 93% of direct payments have been earmarked for production, which calls into question the myth of the social nature of such transfers to farms. On the basis of an analysis of the directions of funds allocation within

the framework of Special Accession Programme for Agriculture and Rural Development (SAPARD), Sectoral Operational Programme "Restructuring and modernisation of the food sector and rural development 2004-2006" (SPO), Rural Development Plan for 2004-2006 (PROW 2004-2006) and Rural Development Programme for 2007-2013 (PROW 2007-2013), it was found that in total, 44% of the funds within the aforementioned programmes supported the industrial goal, 31% the social goal, and 25% the environmental goal.

In consequence, over two-thirds of EU CAP funds were directed to support the industrial agriculture model. The transfer in direct payments in the successive periods (pre-accession, 2004-2006, and 2007-2013) has favoured the industrial agriculture model. If we assume that such a configuration of support priorities will increase the competitiveness of the agricultural sector, then such transfer allocation should raise no doubts. Taking into account the gradual loss of cost-price advantages used by Polish producers on the Single European Market, shortcomings in quality competition, and an increase in competitive pressure from countries with lower production costs, arising from potential liberalisation of global agricultural trade, it seems legitimate that most funds went to improve competitiveness.

The agri-environmental programme constitutes an important instrument in promoting sustainable development in agriculture and rural areas. The principal goal of this programme is to provide an incentive for farmers to protect the environment and nature in their farms, using methods that go beyond normal agricultural good practice. The implementation of agri-environmental programmes in EU countries is considered to have brought positive environmental outcomes, such as reducing the consumption of mineral fertilisers, maintaining habitats previously endangered by intensification or fallowing, improving biodiversity and establishing new forestations and shrub growth areas, regenerating water bodies, as well as promoting the principles of good agricultural practice, and to have improved environmental awareness among farmers. In Poland, in the period between 2004 and 2006 only one in twenty five farms over 1 ha implemented the agri-environmental programme, while in the 2007-2013 programming period the number of programme beneficiaries is expected to rise to 200 thousand, and the area of its implementation is going to cover 2 million ha. To date, interest in implementing agri-environmental packages in Polish agriculture has been rather low.

The implementation of agri-environmental packages brings about certain economic outcomes for farms. Those outcomes were determined for farms covered by Farm Accountancy Data Network – FADN for the years 2006 and 2007. The results of the model analysis show that the implementation of a sustainable

agriculture package causes a ca. 20-22% loss of agricultural income in relation to conventional farming. This drop is connected with, *inter alia*, the reduction of the level of mineral fertilisation by 20-30 kg NPK/ha, which, despite more organic fertilisation, contributes to a 16-20% decrease in yield. This is paired with an increase in direct costs connected with soil assessment, the preparation of a fertiliser balance, and an increase in labour inputs. Observing the proper selection and succession of plants within the period of 5 years (at least 3 crops each year and rotation no longer than 2 years on the same land) reduces agricultural income by 3 to 5% per year. Model analysis shows that the agricultural income in an organic farm is 40-50% lower than that for a conventional farm, if the latter has optimal production structure. This difference results from a change in fertilisation technology, an increase in labour input and higher prices for green products (by ca. 20-30%), as well as lower direct costs (by 10-20%).

Less-Favoured Areas – LFAs constitute an instrument concerning a much higher number of farmers than undertakings within the framework of the agri-environmental programme. The effectiveness of this instrument is based on farmers committing themselves to observe the principles of good agricultural practice in the entire farm for a period of at least 5 years, receiving additional payment in return. In Poland in 2004 LFA payments ranged from PLN 179/ha in the I lowland zone to PLN 320/ha in the mountain zone. In 2004-2006 EUR 1.10 billion was earmarked for this purpose, 20% of which was state funds. During the transitional period a Polish farmer receives 60% of the amount received by farmers EU-15. Payments in LFAs compensate lower income. FADN data shows that agricultural income per 1 ha of agricultural land is 20--21% lower than country average.

The cross-compliance instrument has the broadest application, as it applies to direct payments from funds earmarked for the implementation of projects within the framework of Rural Development Policy. Payments for natural handicaps in mountain areas (**Natura 2000**) and animal welfare will also be reduced, if minimum requirements in the field of *cross-compliance* are not met. Direct payments are understood as social remuneration for observing practices compliant with European standards and maintaining land in good agricultural condition. Complying with the standards and requirements arising from the *cross-compliance* principle is aimed at protecting the environment, improving food quality, state of health of plants and animals, as well as caring for animal welfare and maintaining land in good agricultural and environmental condition. Should the adequate standards not be met, direct payments are reduced in proportion to the environmental risks caused.

The implementation of cross-compliance is connected with considerable costs at the level of state administration and farms. In Poland, due to a large number of beneficiaries of direct payments (ca. 1.5 million farmers), the high costs are connected not just with adjustment to the Integrated Administration and Control System and the calculation of the penalty amount, but also with expenditures for effective control. 1% of farms must be subjected to control each year. The need to fulfil the conditions in the field of administration concern ca. 500 thousand farms.

More difficulties in financing the necessary inputs will be faced by farms with livestock production, which have to comply with a far larger number of standards. An additional financial difficulty for farms is the provision of advisory services. Previously, consulting in the field of good agricultural condition was free. In 2007 a Farm Advisory System was created. Advisory services for farmers will be paid, but a partial reimbursement will be possible. To stand up to the requirements of *cross-compliance* and animal welfare, farms need technological and organisational changes. Therefore, certain investment outlays have to be made to support this.

Among many requirements, far lower difficulties and costs in comparison with EU-15 will be borne in such fields as compliance with the Nitrates Directive, referring to the protection of water bodies from agricultural pollution. According to the data of the Inspection of Environmental Protection from 1990-1999, the pollution of surface waters with nitrates is considered very low, as only 0.38% results exceeded the permissible level of nitrate content. There were 21 areas marked out in Poland particularly prone to the effluence of nitrates from agricultural sources, which amounts in total to 2.48% of the country area. In agricultural areas, the problem of nitrate pollutions is not as significant as in EU-15.

Poland, with a balance surplus of 43 kg/ha is directly behind the countries which have the lowest nitrate balance and are characterised by the highest effectiveness of its use.

The range of actions and costs in the field of protecting wild fauna and flora is still difficult to estimate. Due to the fragmented agrarian structure and a traditional type of farming it was possible to preserve the valuable agricultural landscapes and local animal species. However, in the 2000-2004 period a decrease in the numbers of bird species characteristic of agricultural landscape was observed. The issue of protecting the biodiversity of rural areas in Poland is not focused on the extensification of agricultural output and regeneration of degraded habitats, but rather on maintaining what has been preserved in a good condition and preventing the environmental impact of intensification.

Good agricultural condition. Individual requirements relate to the protection of soils against erosion, as well as counteracting the degradation of organic matter and soil structure. The major threat increasing the level of soil degradation is the intensifying water and wind erosion and the formation of impervious surface area. To prevent erosion, a recommendation to implement terrace farming on arable land was introduced. Other requirements relate to the protection of the soil by covering the area with plants depending on the slant of the land. The soil's capability to accumulate and retain nutrients is determined by the preservation of a high level of organic substance, and particularly humus. As a result of grass, stubble and straw burning, the lumpy structure of soil becomes damaged, which reduces water retention, soil porosity, and its proper aeration. The ban on burning plant residues on the surfaces of meadows and fields is obligatory in all countries discussed. The application of machinery and equipment is of high significance in preventing soil compaction and in maintaining the free filtration and flow of water. Soil structure degradation is aided by an excessively humid surface and heavy machinery. It is anticipated that special criteria will be introduced in Poland to maintain the proper soil structure.

Administration standards broadly comprise the requirements of the principle of environmental compliance, which are aimed at compensating for the adverse impacts of agriculture. These are requirements related to the protection of birds and natural habitats, and water from pollutions caused by nitrates, use of sewage sludge in agriculture, and protection of groundwater.

The issue of land rents. Agricultural ground rent arises from the use of land as a production factor in the agricultural sector. Such is the traditional approach to agricultural land, as the most important input in food production. Currently, land is gaining in importance as a location for residential housing, enterprises, technical infrastructure, an integral element of the natural environment, and also a certain cultural asset in itself. The last of these, referred to as *rural amenity*, or understood as welfare is a combination of the non-uniform assets consisting of the local landscape, leisure, tourist, sports, and environmental assets, is ascribed a different value depending on the country and region, described as the inclination of people to pay for their non-food needs. The land market is therefore divided into three parts: 1) assets essential to agricultural production and other biomass, 2) assets essential to non-farming economic activity (location), 3) assets representing the aforementioned rural amenity. Land is distinctive for its rarity and non-mobility, while it is indispensable for satisfying demand on the said markets. This particularly relates to the land of high quality (usability) to agricultural production. The problem is that all these markets are defective and largely shaped by political instruments. The market in ag-

ricultural land – used to produce agricultural products – is defective due to the said distinctiveness of land, legal regulations and lack of competitiveness against other production applications in some locations (suburban areas, attractive tourism destinations, etc.). Agricultural rent is clearly defeated by business rent. The market in land for non-agricultural activity does not face such stringent limitations on the prices of products, which results in a greater potential of including the costs of land purchase prices and then implementing ground rent. The market of land for ecosystems is still poorly-developed – made up mainly of public institutions. This issue requires separate treatment and further research. In particular, this is about financial support of regeneration or at least preservation of natural assets, including landscape assets, so that the users of the land could take advantage of environmental payments and landscape payments.

The issue of shaping progress. The previous progress formula, which in industrial agriculture was mainly based on the maximised use of non-renewable sources (chemisation, mechanisation) to multiply the private economic profit of a decreasing number of farmers (concentration, specialisation), without respect for the environment and rights of others, is being questioned. The new formula of progress requires the replacement of industrial intensification with agrobiological intensification, taking advantage of natural laws and existing unlimited resources: solar energy and knowledge, which constitutes not only a renewable but also positively reproducible resource. In the past a significant role was played by biological progress, although it was being superseded in appraisal (evaluation) by technological and organisational progress. For some time already biological progress has been returning to pole position, becoming one of the most important driving forces in agricultural development.

Currently, genetic progress is led by biotechnology and genetic engineering research. The evaluation of the progress created by such research spurs fierce debate. Whatever the direct influence of biological progress achievements – **GMO** – on food safety and the environment (ecosystems), economic results are important, especially the division of economic benefits. Experience to date has shown that these profits go to corporations, while they are not shared by agriculture, only some farmers at best.

Besides biological progress, a significant influence on agriculture and rural communities at large is exerted by technological progress in transportation, which creates a chance to overcome geographical and information isolation. Three elements are of particular significance here: human capital, technical infrastructure, and adequate financing. A particularly important role is played by the so-called social capital, covering institutions, norms, developed ties, etc. In this type of progress, the extremely rapidly developing use of the Internet

provides enormous opportunities, facilitating self-organisation among farmers, access to market information and direct contact of farmers with consumers, as well as the development of new types of activity.

Progress in agrotechnics is also important. Methods and techniques which provide an alternative to long-standing practices in crop farming are very promising. One example of this is the statutory simplifications (zero-tillage, reduced tillage, direct drilling). The experience of countries in which such technology has been used (with the global acreage of ca. 100 million ha) points at numerous benefits, both economic and environmental.

8. Political recommendations

The strategic direction of agricultural development should be adjusted to the overall vision of agriculture. This vision should be based on the idea of sustainable development, which sets the direction towards **a model of socially sustainable agriculture. Such a model should form a basis for the national agricultural and rural policy.** This choice is increasingly conditional on the course of events in the entire European Union and phenomena on the global market. A realistic vision must take into account the objective motives represented by farms in their economic activity, i.e. striving to maximise profit/income. This criterion of development on the microeconomic scale is a fact – and that is very good, because it constitutes, irrespective of how it is perceived from the point of view of ethics, a foundation of the efficiency of market mechanisms and economic progress. In such a situation the market mechanism launches and drives forward the so-called technological treadmill, which covers the processes of specialisation, production concentration (production scale) and spatial concentration and intensification through the use of industrial inputs based on depleting natural resources. In consequence, there is an improvement of the efficiency of inputs, which leads to a growing supply of agricultural products. Yet it also has its disadvantages in the form of externalities – negative – production surplus and positive – production shortage. Only a *thin red line* separates the economic effects from environmental and social impacts. Reaching the convergence of the results of the activity of market mechanisms (using the microeconomic criterion by economic entities) with the desired state, arising from the application of the macroeconomic (social) criterion, requires the establishment of boundary conditions for farms. **Political instruments should ensure the said convergence by internalising the externalities in prices of agricultural products or, in the case of negative externalities (external costs) – administrative regulations (e.g. fees for using non-**

market environmental resources) and in the case of positive externalities (public goods) the payment for them.

In practice, however, in the case of Polish farming, in the foreseeable future a dual development road will be characteristic, based on the fact that some farms will adopt production methods ensuring high economic effectiveness while respecting only the basic requirements of environmental protection, whereas others will adopt more environment-friendly methods, allowing them to take advantage of their environmental and socio-cultural assets.

Coordinates for agricultural development. Agricultural development in the future will run along three coordinates – an increase in production, environment protection, and competitiveness. This will serve as a basis of a new paradigm which has to answer the fundamental question: how to retain a competitive and economically viable agriculture, while, at the same time, satisfying the need (demand) for other functions. Competitiveness in this triad of objectives is key in such market economy conditions. In this situation a question may be raised: which conditions should be met so that the socially-sustainable agriculture show indications of improving the competitiveness of agriculture? **The dilemma is whether to focus on niche (but increasingly important) markets or mass products.** Niche products become mass products on the global market. Food quality is becoming more and more significant marketing-wise, as in rich countries food is no longer just a necessity, but a consumer good, which should meet the highest standards of quality. If so, then **rather than participation in a race of industrial farming, which is doomed to fail, and above all contradictory with the concept of sustainable farming, the latter model is a better choice.**

Instruments in the Common Agricultural Policy (CAP). The European Union started adjusting CAP instruments to support sustainable farming. This is a response to the increasing evaluation of non-production functions and new agricultural policy objectives. This policy switches the direction towards sustainable agriculture. This change of direction in CAP was started by Mc Sharry's reform, and became intensified by Agenda 2000 and then the reform of 2003. In the prospect of the next EU budget-planning period, i.e. after 2013, one may expect a further and significant shift towards sustainable agriculture – incorporated in the concept of the sustainable development of rural areas. Greater determination is needed in this respect. Individual instruments and support programmes (measures) should be evaluated in the aspect of their influence on the sustainable agriculture model and the sustainability of rural areas. Such evaluation is a difficult task, as the individual instruments or measures often cannot be attributed to that or other model.

Shifting the focus of CAP is not simple due to the so-called capitalist treadmill, i.e. the spiral of competitiveness – production surplus on the global market → competitive pressure → concentration and consolidation → more and more powerful international corporations (controlling product markets) → less and less farmer decision potential → a decreasing share of agriculture in the final price of food products. This sets the dominating trend of development, i.e. the pursuit of faster economic growth, evaluated with the GDP, which occurs through heightening the intensity of farming to maximise economic profits. A new element in this process is a slight switch of focus from capital intensification (in the conventional understanding) to taking advantage of knowledge. On a global scale, the intensification of agriculture is still followed by greater consumption of natural resources, creating many new social problems. The European Union has particular moral responsibility for the protection of global public goods. This calls for agreement on political objectives on protecting the global ecosystem and the rules for using it *ergo* global governance. There is hardly any chance for such governance at this point. **The CAP objectives (the European agriculture model) should therefore be incorporated in the mechanisms of agri-food products exchange on the global market, by using environmental and quality standards.** In the conditions of unconditional liberalisation, the European Union will be forced to compete according to rules which are contradictory to sustainable development.

The fundamental requirement of sustainable agriculture. The choice of a strategic direction – sustainable agriculture – requires the adoption of actions with various time horizons. The first step should be to take action leading to the preservation of the agro-ecosystem's capabilities, i.e. the regeneration of soil fertility. **Ensuring long-lasting soil fertility is one of the main features of sustainable agriculture on the farm level.** To preserve the desired soil characteristics it is essential to apply multifaceted crop rotation using papilionaceous plants and after-crops for green manure.

The size of agricultural land, adjusted for soil fertility determines the potential extent of creating agricultural plant biomass. That is the reason for the absolute need to maintain the fertility of soils and conduct economical administration of agricultural land, including handing it over for other purposes, particularly for residential housing development, commercial facilities, and technical infrastructure. Unfortunately, the protection of good quality agricultural land is too weak, it is not protected by proper spatial planning and cases of taking high quality agricultural land for non-agricultural purposes are not altogether uncommon. And we have few such areas. The squandering of agricultural land is significantly facilitated by the odd Act on automatic "de-agrarisation" of land, which can exacerbate

the pathologies of spatial planning. **Preserving the regeneration of ecosystems requires the imposition of boundary conditions on the market mechanism, and more precisely on the actions of economic entities.** Of essential significance to farms is environmental order. To this end one needs to use the "carrot and stick" approach combining administrative instruments (bans, dictates) and economic instruments (incentives). A farm should use technologies that contribute to the regeneration of soil fertility and allow achieving a positive energy balance. The possibility of obtaining state subsidies (from public funds) should be conditional on meeting these requirements and fulfilling the animal welfare rule. However, achieving economic viability, understood as obtaining income from a farm, allowing development investments and a parity payment for labour, should be related to farms focused on market production and constituting the main subsistence of the farm user and his or her family. As to entire agriculture, there is a need for a holistic approach – in all its complexity. This concerns farms in their structure and diversity (sustainable farms, only environmentally sustainable farms, non-sustainable farms, and certain other types of farms, such as organic farms, integrated technology farms), as well as spatial and landscape elements (forests and forestations, lakes, ponds, forestations, natural monuments, ecological wastelands, etc.). This diversity should find reflection in the instruments of agricultural policy. It is in the context of this diversity, while also taking into account the exogenic conditions for agricultural development, that decisions on the support for conventional (industrial) farming or alternative (sustainable) farming, and large-area or family farming should be made. **Public funds support should increasingly apply to alternative and family farming.**

The agri-environmental programme. The agri-environmental programme was defined to protect environment, natural, and landscape assets. Specifying the amount of compensation for loss of profit due to the implementation of such packages and the amount of bonus plays a key significance in this respect. According to preliminary estimates the promotion of good agricultural practices itself within the agri-environmental programme or in less-favoured areas is connected with a 15% decrease in the farm's standard gross margin. Substantial effort is needed to extend the existing databases with data from farms that could be used to estimate the compensation amounts due to farmers for protecting environmental, natural, and landscape assets for public benefit, including payers of the tax, which is a form of financing of the agri-environmental programme. The downside of implementing this programme was the low number of agri-environmental advisors, as there are only about 2 thousand of them, in comparison with 1,430 thousand farms exceeding the area of 1 ha, participating in support programmes within CAP. It should be noted that a farmer entering the programme should prepare

a detailed agri-environmental programme for the entire farm and have it confirmed by an advisor. It would seem that **the agri-environmental programme should be extended with packages protecting and increasing the fertility of soils and water balance.**

Progress. To date, the majority of public funds, not to mention private funds, goes to create and popularise progress aimed at multiplying the profit of economic entities – in this case entities related to agriculture and, to a lower extent, farms. An important characteristic of this progress is increased consumption of the depleting natural resources. This supported a technological treadmill, but also magnified the threats arising from the depletion of natural resources and the capacity of the natural environment. But at the same time, **the main direction of progress should be based on the increased knowledge of the capabilities of using more solar power in biomass creation, with the use of natural laws**, without limiting oneself to genetics, while giving up chemical and artificial substances. It is important that scientific research should pursue further knowledge of Nature, and not the creation of an artificial world. The knowledge thus accumulated, along with a system of values, should lead to an agriculture that is friendly to Nature – green. We need not passively emulate the way already taken by developed countries. As Aristotle said, even God cannot change the past – but the future is for us to shape.

Climate change is more and more noticeable. The extent of its impact will be conditional on the adaptation mechanisms and mitigations introduced. It is vital to increase so-called small-scale water retention (more soil retention through a changed land use structure) and hydrotechnical retention (accumulating excessive outflows in reservoirs). In all sectors it is necessary to improve the effectiveness of water consumption (water saving). To make counteracting threats and taking advantage of opportunities possible, it is necessary to verify the strategy for the administration of agriculture, to lay out new directions for development and to prepare an appropriate set of instruments. Not taking into account the impact of climate change may intensify the degradation processes of agricultural habitats, worsen the economic results of agricultural activity and exacerbate social problems in the agricultural sector.

Spatial planning. Reducing the chaos in spatial planning, which has extensive economic, environmental and social results, requires including the entire space in land development plans, placed in a hierarchical structure, and firmly established. Such plans should precisely delimit land serving various functions: residential, infrastructural, industrial, services, agricultural, environmental, and other. Spatial planning constitutes a very weak link in the sustainable development of a country, including rural areas. Unfortunately, despite the concept of land development and a large number of documents planning and determining

the directions for the growth of agriculture and rural areas on a general scale (such as the Strategy for Agriculture and Rural Areas, Consistent Structural Policy for Agricultural and Rural Development, Rural Development Plan, National Strategy Plan for Rural Development, and other), the chaos in rural land development is advancing – also due to agriculture. **The hierarchical structure of ecosystems indicates that land development should not be left to communes alone, but should take into account the needs of ecosystems. More EU funds should go to landscape protection and spatial planning.** At the same time, the National Strategic Reference Framework 2007-2013 only points out the need to provide equal development opportunities and support structural changes in rural areas, including by: new economic investments and the development of entrepreneurship and technical infrastructure, as well as better transport connections. Such measures are absolutely necessary but they make the impression of disharmony in the rural area. That is why they have to be preceded or accompanied by appropriate planning work defining the optimum and least conflicting transformations of rural areas. National Plan for Rural Development 2007-2013 also draws attention to this matter in the following fragment: *Besides economic functions, an equally important aspect in the development of rural areas in Poland is their role in preserving the landscape and natural assets – a good ecological condition of water and soil, the richness of habitats and biodiversity, as well as the cultural heritage of rural areas.*

Shaping the agricultural-rural landscape. The Nature Conservation Act formally authorises the conservation of afforestations, but secondary legislation is lacking on issues of technical and natural conditions, establishing buffer strips and roadside forestations, and records on co-financing afforestation activities in agricultural-rural programmes implemented in Poland. **The problem is the regulation of the legal status of afforestations, the determination of sources and rules for financing, as well as compensations for them as elements of environment protection of public significance. There is a need for integrating afforestation programmes with the National Woodland Extension Programme and the agri-environmental programme.** To set the compensation for excluding agricultural land for a buffer strip it is proposed to use payment according to the ground rent rates. To this end, executive guidelines on managing agricultural property of the State Treasury to the said Act prepared by the Agricultural Property Stock of the State Treasury (1998) could be used. The annex to those guidelines sets out a table of minimum rates of ground rent. The amount of the minimum rent, expressed in decitonnes of wheat, depends on the tax district in which the farm is located and the class of agricultural land (arable land and grassland) of the farm.

Policy on nutrition. Food plays a significant role for the state of health of the population. Three elements are key in this respect, namely: safe food products, consumer awareness, and rules regulating the processes of producing food and making it available to consumers. The agricultural and food sector is of major importance for the first element. Agricultural policy should not depart from the goals in the field of healthy nutrition. With reference to the second element, it is about extensive education on the importance of nutrition (diet) in maintaining a good state of health, the role of food quality, food culture, and food safety. In relation to the third element, it is about effective quality control systems for food products, legal regulations on the production and turnover of food products, provisions eliminating advertising that promotes food products of questionable quality, particularly when addressed at children. Unfair advertising practices should be eliminated, especially false advertising.

Harmony in political actions should be pursued in the fields of food production, nutrition, health promotion and quality of the natural environment.

Local markets – viability of rural areas. Ecological farms which are relatively less often oriented towards production for their own consumption purposes, i.e. self-supply, and more often for the needs of the local market. This supports the hypothesis on poorly-developed "wholesale" sales outlets of ecological agriculture products. Previous initiatives advocating traditional and regional products (exhibitions, festivals, the "Our Culinary Heritage" contest) should be backed by an information and promotional campaign. To this end a CAP instrument allowing the co-financing of promotional measures should be used. The main objective of such a campaign should be to inform consumers about the benefits of choosing such food, as well as to make producers aware that producing traditional and regional goods may bring many measurable profits.

Official statistics has at its disposal a relatively extensive body of data, which may be used directly or indirectly to assess the sustainability of agriculture in macro-scale. However, the information (data) resources are scattered (managed by various institutions), not fully recorded (which means there is no comprehensive information on those resources), and frequently incoherent as regards methodology of creation and description. It is therefore advisable to combine into a single coherent system all the individual information subsystems managed by such institutions as the Central Statistical Office (GUS), the Ministry of Agriculture and Rural Development (MRiRW), the Agency for Restructuring and Modernisation of Agriculture (ARiMR), the Agricultural Market Agency (ARR), Agricultural Social Insurance Fund (KRUS), the Institute of Agricultural and Food Economics – National Research Institute (IERiGŻ-PIB), the Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG-PIB), and others.

III

FOOD QUALITY AND FOOD SAFETY AND CONSUMER HEALTH

1. Introduction

In the contemporary world, food quality and safety is a matter of special concern for the European Union Countries, including Poland. The occurrence of undesirable substances in agri-food products could pose a risk to consumer health. The identification of hazard areas in the whole agri-food chain (production, processing, warehousing, distribution, sales of food products) is the basis of food safety.

The crises in the food sector which took place in recent years caused that the consumers have lost confidence in the quality and food safety. Against this background, the European Union has developed a comprehensive strategy aimed at rebuilding consumer trust in food they consume. It is simultaneously aimed at ensuring high food standards, animal health and welfare and plants' health. These standards are applied to food produced in the European Union, as well as imported ones.

From the consumer's perspective, food safety is the most important quality determinant and therefore food law refers to this matter in detail. The law requires the public authorities of the EU member states to undertake various measures in the area of public health and protection of consumer's interest through, e.g., supervision over safety of food and nutrition.

Four Inspections supervise food safety in all links of the agri-food chain in Poland (1) General Veterinary Inspectorate, (2) Main Inspectorate of Plant Health and Seed Inspection, (3) Agricultural and Food Quality Inspection and (4) Chief Sanitary Inspectorate. General Veterinary Inspectorate, Main Inspectorate of Plant Health and Seed Inspection and Agricultural and Food Quality Inspection are under the authority of the Ministry of Agriculture and Rural Development, whereas Chief Sanitary Inspectorate is under the authority of the Ministry of Health.

Now, there is an ongoing debate on the consolidation of institutions operating under the authority of the Ministry of Agriculture and Rural Development and the establishment of the Food Safety and Veterinary National Inspection. Food safety supervised by numerous inspections impedes the proper monitoring of the agri-food chain. Although inspections are required to collaborate to ensure

food safety for their consumers, they often act ineffectively due to differences in their structures and competences.

The implementation of a uniform and integrated monitoring system for whole agri-food chain (from field to table) would ensure better quality and food safety, and consequently the protection of consumer health and life, as well as their increased trust in Polish food. The establishment of one Inspection supervising food safety would facilitate the flow of information and improve the effectiveness of prompt reactions to irregularities. Food control would be supervised by one institution.

The European Food Safety Authority (EFSA) is responsible for supervision over food safety in the European Union.

2. The relationship between food, nutrition and human health

Health is a prerequisite for the achievements of human beings. A healthy human is better equipped for self-fulfilment and satisfaction from performing social roles. The World Health Organisation has defined health as *state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*[85]. According to this definition, health problems are considered in the general perspective and concurrently encompass many aspects of correlations with different factors specifying the state of health.

There are a few concepts systematising these factors by different criteria. The most important among them is *the health field* concept, formulated by Lalonde, categorising factors vital to human health in four fields (1) the biology field – encompassing biological factors, mainly genetic factors, (2) the environmental field – factors characterising the natural environment of a human being, namely water, air and soil purity, wholesomeness quality of food as well as proper housing conditions, and safe schools and workplaces, (3) the health care field – encompassing aspects relating to health care resources and organisations, and (4) the lifestyle field, i.e. conscious behaviour favouring human health maintenance and protection (a bad state of health results from the conscious action of the human being)[86].

Lifestyle is an aspect influencing human health to the largest extent (behaviour field). Lifestyle encompasses physical activity, proper nutrition, personal hygiene, coping with stress, substance abuse – tobacco, alcohol, drugs and psychotropic substances, as well as periodic, prophylactic testing. Lifestyle in-

[85] *Constitution of the World Health Organisation* (2006), Basic Documents, Forty-fifth edition, Supplement, October.
[86] M. Lalonde (1974), *A New Perspective on the Health of Canadians – a working document*, Minister of National Health and Welfare, Ottawa.

fluences human health in about 50%. Genetic and environmental factors affect human health in about 20%. To the least extent, only in about 10%, human health depends on health care[87]. This means that at least 50% a human being alone decides about your health.

Proper nutrition being a prerequisite of human development, physical fitness, intellectual development, well-being and a good state of health is one of the most important aspects determining human health, which is proved by numerous scientific researches. *Proper nutrition means the consumption of the right quantity of nutrients of adequate caloric and nutritional value conditioning the maintenance of the proper weight and normal condition. Therefore, food must correspond to real nutritional needs taking into consideration the age of the human being, gender, physiological condition and type of professional activity*[88].

Improper nutrition increases the risk of chronic non-communicable diseases, commonly known as diet-related diseases, e.g. cardiovascular diseases (arteriosclerosis, infarctus cordis, arterial hypertension, brain stroke), cancerous diseases (bowel cancer, stomach cancer), digestive diseases (gastric and duodenal ulcers, cirrhosis, decay, cholecystolithiasis), non-insulin-dependent diabetes, overweight and obesity, as well as osteoporosis[89]. These diseases pose a serious risk to the health and life of the population. Cardiovascular diseases and cancers are the main reason for deaths among citizens of the European Union.

Health problems result from both the over-consumption of food and malnutrition, causing specific health diseases originating from the deficiency or surfeit of energy and nutrients (tab. III.1).

Human health depends not only on high quality rations of food, but also on the quality of food. Apart from nutrients, food is composed of other substances, e.g. food preservatives, antioxidants, emulsifiers, stabilisers, colouring dyes, heavy metals, nitrates, nitrites and others that may pose a risk to health. Consequently, the consumption of highly-processed food composed of these substances has led to the emergence of food allergies which are a major contemporary problem among the population[90].

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[87] M. Lalonde has presented percentage estimates that are not considered as scientifically precise data, and only inspire decisions taken by politicians responsible for health issues.

[88] Ś. Ziemlański (1998), *Zalecenia żywieniowe dla ludności w Polsce,* IŻŻ, Warszawa.

[89] According to estimates of World Health Organisation up to 70% of diseases result from improper nutrition.

[90] A. Gronowska-Senger (2009), *Żywienie a zdrowie społeczne w perspektywie XXI wieku* [w:] *Żywienie człowieka a zdrowie publiczne*, ed. J. Gawęcki, W. Roszkowski, PWN, Warszawa, p. 394.

Table III.1. Correlations between certain diseases and improper nutrition

Malnutrition	Entity disease	Over-consumption
Calcium, potassium →	hypertension	← salt
Fluorine →	decay	← sugar
Iodine →	goitre	
Magnesium, antioxidant vitamins →	arteriosclerosis	
	breast cancer	← fats
EFAs [a] →	heart diseases	← saturated fatty acids, cholesterol
	liver disorders	← alcohol
Vitamin C →	stomach cancer	← salt
Fibre →	cholecystolithiasis	← energy, sugar, fat, alcohol
	diabetes	← energy, sugar, fat, alcohol
Fibre, antioxidant vitamins →	bowel cancer	← fats
Calcium, fluorine →	osteoporosis	
Vitamin D →	halisteresis	
	arthritis	
Ferrum, folic acid →	anaemia	
Vitamin A →	blindness	

[a] EFAs Essential Fatty Acids

Source: Based on [Gronowska-Senger, 2009].

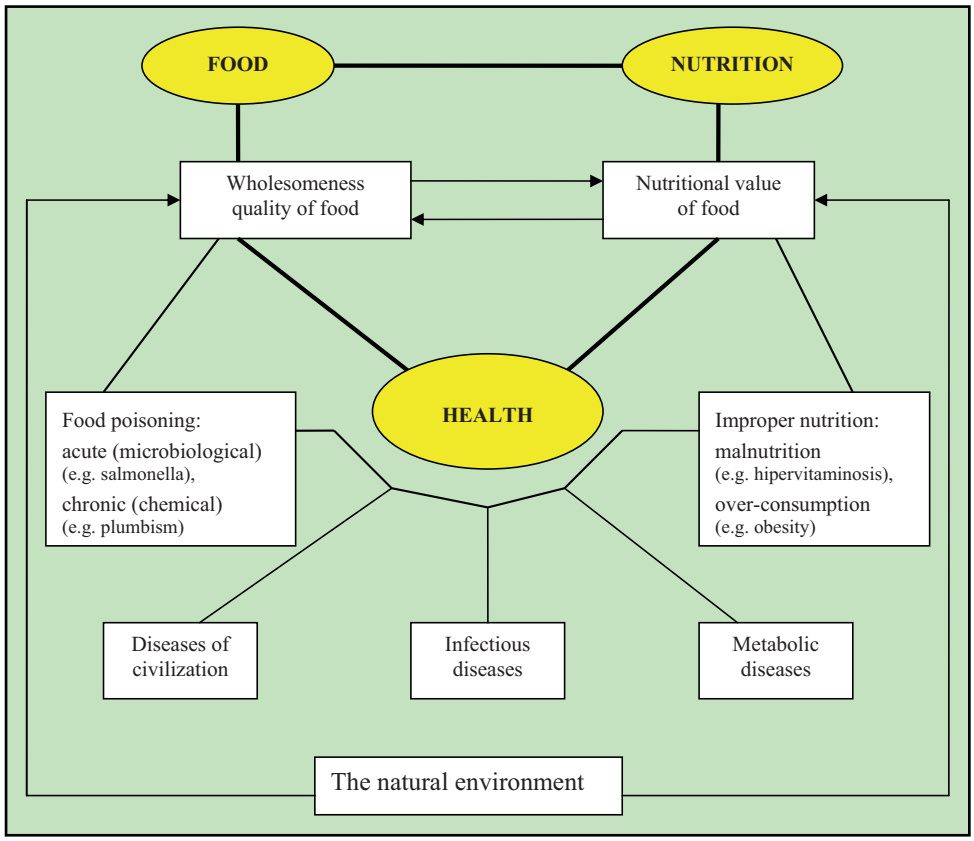
For centuries, humans were interested in the relations between human food and health. Even the most nutritional product consumed excessively or inadequately set with other substances may be harmful. That is why the third important aspect was added to from food and health, namely nutrition.

The relationship between food, nutrition and health, according to the current knowledge is shown in Figure III.1.

The centre of Figure. III.1 depicts two parameters that may be assessed and mindfully shaped. The first is the wholesomeness quality of food, encompassing mostly its widely interpreted harmlessness, depending mainly on the

sanitary-hygenic aspects of production, processing and trading. The wholesomeness quality of food is determined by the content of natural toxic and antinutritive substances, environmental and technical pollutions, and bacterial pathogens, parasites, etc[91].

Figure III.1. Relationship between food, nutrition and health



Source: Based on [Kompendium wiedzy o żywności, żywieniu i zdrowiu, 2004].

Food contaminants may be natural (e.g. aflatoxin and mildew peanuts, ergot, mycotoxins, ochratoxin, botulin and botulism) or produced by humans (e.g. dioxins). People consume food routinely and seldom think about what it might contain (Fig. III.2). This indifference may be disturbed by food poisoning, most often caused by bacterial contamination, although similar symptoms may result from the presence of other substances, e.g. metals, as it was in Camel-

[91] *Kompendium wiedzy o żywności, żywieniu i zdrowiu* (2004), ed. J. Gawęcki, T. Mosso-Pietraszewska, PWN, Warszawa, p.7.

ford[92]. In the case of *Salmonella* or *Campylobacter* bacteria poisoning, the symptoms may be highly unpleasant and provoke serious consequences. These bacteria cause digestive infections[93].

The second parameter under assessment is the nutritional value of food (ration) informing about the content of substances necessary for the human organism, their mutual proportions, and bioaccessibility. Both parameters mentioned, e.g. the health quality and nutritional value of food, are correlated. On the one hand, an inadequate supply of nutritional substances increases the system's sensitivity towards harmful substances and pathogens; on the other hand acute and chronic food poisoning worsens the utilisation of nutritional substances and causes malnutrition.

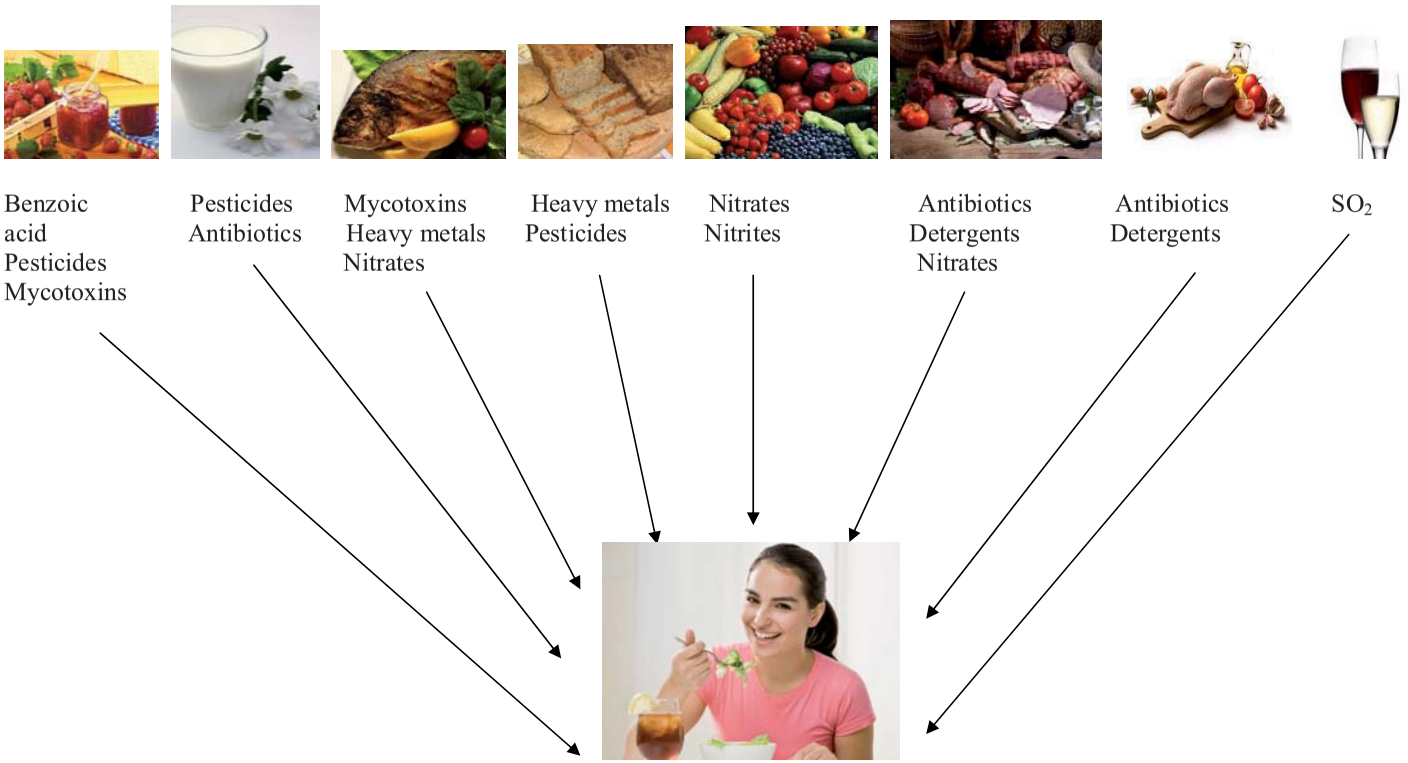
Knowing about correlations between food, nutrition and health is the basis of rational nutrition. Nowadays, rational nutrition is defined as nutritional habits congruent with the recommendations of nutritional science, consisting of the planning of meals according to nutritional standards, as well as tables of nutritional value of food, taking into account genetic, social and cultural predispositions. The understanding of the human genome and the dynamic development of molecular biology tend to show that genetic predispositions will in the future determine rational nutrition to much larger extent than now. This is proved by, among other things, the establishment of *The Centre for Human Nutrigenomics* at Wageningen University in the Netherlands[94].

[92] In July 1988, 20 tonnes of aluminium sulphate was accidently dropped into a tank of water previously treated for drinking by people. As a result, the residents of Camelford (Cornwall) received potable water contaminated with aluminium and highly acidified (pH 3.5÷5). Communications of information about water pollution and the removal of the cause was delayed. The aluminium concentration in water was up to 320 mg/L, and different metals (copper) penetrated pipelines, due to water acidity. Initially, the residents complained about the improper taste of the water, and later on suffered from different symptoms: digestive disorders, skin rash, articulation pain, gullet burning sensations and amnesia. Animals that were in contact with the water, mostly fish, died. Aluminium is the third most common earth element, but its harmful effect causing brain and bone damage as well as anaemia is known.

[93] J. Timbrell (2008), *Paradoks trucizn. Substancje chemiczne przyjazne i wrogie*, Wydawnictwo Naukowo-Techniczne, Warszawa, p. 240.

[94] *Kompendium wiedzy o żywności, żywieniu*…, op. cit., p. 8-9.

Figure III.2. The accumulation of foreign substances in food and human body



People consume food routinely and rarely think of what it may contain

3. Food quality and safety

3.1. Elements determining food quality

In the etymological sense, quality is an exact translation of the Latin word *qualitas*[95]. In many languages, the word "quality" maintained a sound close to the Latin original (e.g. in English – *quality*, in French – *qualité*, in German – *die Qualität*).

There are numerous definitions of the "quality" concept in literature – of a philosophical, technical, and commodity nature, as well as wordings of the consumer definition type. J. M. Juran has cited numerous meanings of the "quality" word used as related to quality control:

- Quality – *the extent to which a particular product fulfils the needs of a given buyer (market quality)*.
- Quality – *the extent to which a product class is potentially able to ensure consumer satisfaction (in this sense it is sometimes identified with a type)*.
- Quality – *the level of the product consistency with a model, standard or adequately-defined requirements (compliance quality)*.
- Quality – *the extent to which a consumer considers a particular product as a priority against another one as a result of comparative tests (preference quality)*.
- Quality – *a property or set of separable properties (important for a given product): manufacture, appearance, consistency, taste, smell, etc. (quality characteristics)*[96].

From the food quality control perspective, the most useful definition among those cited is the one characterising the quality concept by the enumeration of its properties. Food quality is undoubtedly a comprehensive notion encompassing many collective and individual properties. All important properties should be exactly specified and logically systematised for the exact presentation of controlling tasks[97].

The definition of food quality has been amended many times. The course of the shaping of the quality definition from Plato's to the contemporary era may be encountered in many works, including the study by A. Kowalska[98].

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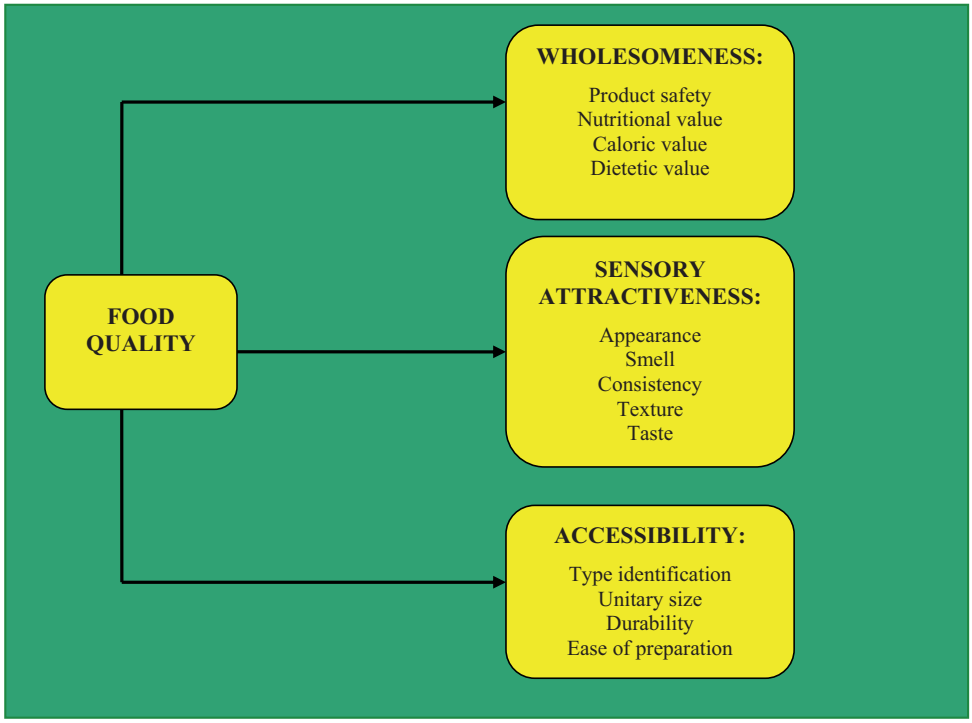
[95] K. Kumaniecki (1979), *Słownik łacińsko-polski*, PWN, Warszawa, p. 411.
[96] J.M. Juran (1962), *Quality control handbook*, New York-Toronto-London: McGraw-Hill, cited by N. Baryłko-Pikielna (1975), *Zarys analizy sensorycznej żywności*, Wydawnictwo Naukowo-Techniczne, Warszawa, p. 297-298.
[97] N. Baryłko-Pikielna (1975), *Zarys analizy sensorycznej*…, op. cit., p. 298.
[98] A. Kowalska (2010), *Jakość i konkurencyjność rolnictwa ekologicznego*, Difin, Warszawa, p. 15-21.

The contemporary definition of food quality originates from the definition formulated by C. Szczucki in the 1970's. C. Szczucki has formulated a definition of quality, referring only to meat products: the *quality of meat products – a grading of wholesomeness, sensory attractiveness and accessibility in the wide, consumer and semantic sense, important only within the limits of abilities marked by raw products, technology and the price of a given product*[99].

Figure III.3. illustrates the definition of quality. According to proposed definition scheme, each relevant qualitative property of each food may be categorised in one of three basic groups, i.e. wholesomeness, sensory attractiveness and accessibility. In each of listed groups, we may enumerate many individual properties that may be subordinated to separate assessment.

Figure III.3. The components of food quality



Source: Based on [Szczucki, 1970 and Barylko-Pikielna, 1975].

[99] C. Szczucki (1970), *Zakresy znaczeniowe podstawowych pojęć w kontroli jakości produktów mięsnych*, „Gospodarka mięsna", nr 1, p. 5.

Originally, the definition formulated by C. Szczucki was related only to meat products. However, it was generalised by N. Baryłko-Pikielna and broadened to all food products in the following wording: the *quality of food a grading of wholesomeness, sensory attractiveness and accessibility relevant within limits marked by raw products, technology and the price of a given product*. One should pay attention to the second part of this definition, stressing that the concept of quality or the qualitative standard of a given product is not an absolute notion, but a relative one marked by limits cited in the definition. These limitations seem to be particularly important when defining the rules of assessment for the purpose of quality control and preparing plans and definitions of detailed evaluations[100].

3.1.1. Wholesomeness

The widely-understood wholesomeness of a food from the nutritional perspective is composed of:

1. **Product safety** – the lack of any hazards of a chemical, microbiological, parasitic, mechanical or radiation nature after a single or prolonged consumption of a product; the last reservation relates to hazards posed by factors of small quantity, but accumulated in the human body, such as pesticides.
2. **Nutritional value** – the ability to deliver to human organism valuable support material, namely, most of all, balanced protein and bio-regulators, mainly vitamins, minerals and microelements.
3. **Caloric value** – the ability to deliver to the human body an adequate quantity of energetic material.
4. **Dietetic value** – the ease and extent to which human organism is able to use nutrients of a product[101].

Food safety is the most important feature of quality considered by the consumer; so food law regulates this issue to ensure the consumer that food purchased complies with all expectations in terms of safety.

According to the Act of 25 August 2006 on the safety of food and nutrition, *food safety shall be interpreted as a set of general conditions that have to be complied with, and referring in particular to (1) additives and flavours used, (2) the levels of contaminants, (3) the residues of pesticides, (4) food irradiation*

[100] N. Baryłko-Pikielna (1975), *Zarys analizy sensorycznej*…, op. cit., p. 300.
[101] See: C. Szczucki (1970), *Zakresy znaczeniowe podstawowych*…, op. cit., p. 3-4; N. Baryłko-Pikielna (1975), *Zarys analizy sensorycznej*…, op. cit., p. 298.

condition, (5) organoleptic properties and activities that have to be applied at all stages of production and the food trade – to ensure human health and life[102].

The Codex Alimentarius Commission[103] plays an important role in activities carried out for food safety, and defines food safety as *a guarantee that food does not have a harmful impact on consumer health if it is produced and/or consumed according to its intended purpose.*

Food safety depends on its physical, chemical and microbiological purity. Health risks posed by food may have three basic sources:

- the presence of physical contaminants, e.g. glass, stones, metals, etc.;
- the presence of natural toxic or harmful substances in agricultural raw products, e.g. residues of chemicals (pesticides, herbicides, antibiotics, cleaning agents, heavy metals and substances that penetrated the food by accident);
- the presence of pathogenic microorganisms, their metabolites, viruses, bacteria, parasites, toxins, etc[104].

Food safety is hard to define and determine by health and anti-nutritive properties, including risks to consumer health and well-being, but also the accessibility and scope of affordable, inexpensive testing methods. Food safety – different criteria, different perspectives – physiological, diet-related, functional, microbiological, toxicological and sensory safety[105].

Physiological safety – food is composed of not only nutritive and building components, but is a source of biological activity precursors or active substances, the level of which is nowadays tested by genomics and gene expression, as well as proteomic, lipidomic and metabolomic stimulators or nutrigenomics.

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[102] Dz. U. z 2006 r., nr 171, poz. 1225.

[103] The Codex Alimentarius Commission is the most important international authority dealing with food safety, consumer health and the observance of fair practices in food trade. It was founded in 1963 in the framework of Common Food Standards Programme established by the Food and Agriculture Organisation of the United Nations (FAO) and the World Health Organisation (WHO).

Codex Alimentarius is a set of international food standards, practices, recommendations and guidelines used by public controlling authorities, the agro-food industry and scientific circles.

[104] R.I. Zalewski (2004), *Zarządzanie jakością w produkcji żywności*, Akademia Ekonomiczna w Poznaniu, Poznań, p. 259.

[105] M.W. Obiedziński (2011), *Obszary ryzyka w łańcuchu rolno-żywnościowym* [w:] *Z badań nad rolnictwem społecznie zrównoważonym [13]. Jakość i bezpieczeństwo żywności gwarancją zdrowia konsumenta*, ed. M. Kwasek, seria „Program Wieloletni 2005-2009", nr 8, IERiGŻ-PIB, Warszawa.

Diet-related safety – here we deal with the quality of raw products, the food chain in terms of its technological continuity and care about consumer health, and their examples include food allergies, celiac disease and diabetes.

Microbiological safety – issues relating not only to pathogenic microflora, but also to the balance in the microbiological ecosystem advantageous for the human system – synbiotics, probiotics and prebiotics, hence diet quality, dietetic habits, food technology and nutrition. It also includes activities aimed at immunostimulation, namely the impact on the morbidity and welfare of humans.

Sensory safety – often associated with sensory sensations, in particular taste and smell considered as equivalents of food naturalness and safety. This is not an absolute truth. The taste and smell of chemical compounds depend on their structure and not on their chemical source, so sensory properties may be modified by synthetic substances – one may want to hide the lower quality of food, or adulerate or fraud it.

Toxicological safety – often the simplified equivalent of food safety – the simplest to define – food free of toxic and anti-nutritive substances. Is it possible today to produce really safe food? – according to many scientists – no. The food chain is not static, and is characterised by dynamics of interactions and changes in components, while agricultural raw products are stored and processed. Potential chemical food contaminants may be divided in six groups:

1. Natural toxins: mycotoxins, biotoxins of marine fauna.
2. Environment contaminants, such as heavy metals, dioxins, furans and radionuclides.
3. Chemicals used in food processing that may contaminate food as a result of the leakage of lubricants, machinery damage, residues of cleaning agents and disinfectants.
4. Compounds and polymers migrating from materials in contact with food.
5. Residues of agri-chemical procedures, veterinary drugs.
6. Toxicants resulting from processing, in particular thermal procedures: acrylamide, furan, PAH's (polycyclic aromatic hydrocarbons), HAA's (heterocyclic aromatic amines) and others.

Food safety – the result of health and nutritive properties, ingredients and substances penetrating the food chain in the production and processing of anti-nutritive and toxic substances. Drawing on hazard analysis and complementing it – by risk and benefits assessment - as an instrument for analysing food safety and implementation in food safety management in food chain – is a natural consequence of the above.

3.1.2. Sensory attractiveness

The sensory properties of food, also called as organoleptic properties[106], are features perceived by the consumer as sensations activated by the influence of food on the senses (sight, smell, hearing). These determine decisions on buying particular food products taken by the majority of consumers.

The sensory attractiveness of a product encompasses the following properties: appearance, smell, consistency (sum of tactile sensations) and texture (the sum of visual sensations relating to micro- and macroscopic details in the internal composition of products)[107]. These distinguishing features are considered in the first place and to large extent to be decisive for purchase and consumption of a product[108].

Appearance – the sum of visual sensations referring to shape, size, colour, gloss, surface structure and possibly quality of direct packing (e.g. meat products casings). The sum of these properties should form an integrated whole, the aesthetics of which proves the carefulness with which a given product was produced.

Smell as a sum of external olfactory sensations provoked by the usage of a given basic raw product, raw products or accessory additives and possibly spices, including those originating from a given technological process (e.g. thermal processing in an open or closed system, chemical or mechanical processing, preservation by means of biological or chemical methods, etc.).

Consistency as a sum of tactile sensations specifying different rheological properties (e.g. hardness, elasticity, plasticity, viscosity, greasiness, liquidity, etc.). Mostly, it is evaluated by the type and grade of deformations caused by moderate force, usually hand or finger pressure.

Texture as a sum of the visual sensations relating to the micro- and macroscopic details of the internal structure of products and colour dependant on the raw product used, and the technological procedure applied in the production process.

Taste, as a sum of the flavour-tactile sensations perceived at tasting. The last property is the most closely related to the general impression caused by the assessed product, and has a strong impact upon the psychological and physiological aspect of appetite and food consumption.

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[106] According to the Act on food and nutrition safety, organoleptic properties is a set of features encompassing taste, smell, appearance, including colour and texture, food that may be separated and evaluated with human senses (Dz. U. z 2006 r., nr 171, poz. 1225).
[107] D. Kołożyn-Krajewska, T. Sikora (2010), *Zarządzanie bezpieczeństwem żywności. Teoria i praktyka*, C.H. Beck, Warszawa, p. 17.
[108] R.I. Zalewski (2004), *Zarządzanie jakością w produkcji*…, op. cit., p. 37.

3.1.3. Accessibility

Accessibility is the third group of the qualitative properties of food. Accessibility encompasses the following properties: type identification, unitary size, durability and ease of preparation.[109] Consumers tend to pay more attention to these properties of food.

Type identification – the specificity of the appearance and labelling visible at first glance, thanks to which not only a commodity expert, but also a consumer is able to differentiate product type, as well as its quality class. Any substitutes, exchangeable recipes, similarities and trade permits of one quality class and the price of bad, average and good products, violate the consumer's right to informed choices fulfilling individual preferences.

Unitary size – a property defining the quantitative product adjustment to a buyer.

Durability – as a grade of protection against disadvantageous changes in quality under specific conditions of transport and storage. The more durable the product (e.g. due to the application of adequate, deaerated packaging) the more accessible to the buyer, i.e. to large extent protected by the producer.

Ease of preparation – as a sum of product properties important in terms of rationing convenience, cooking, preparation for consumption and consumption as such. It refers to properties such as divisibility, maturity, easy packaging removal, size and section shape, slice thickness and others.

***

Food quality and safety are closely related. Food safety is included in the notion of *quality.* However, considering the fact that this field is legally regulated, *food safety* is differentiated in both literature and legal Regulations. The remaining food quality properties are a matter of consumer acceptance. Therefore, food producers have to observe legal requirements on food safety and consumer expectations towards the remaining properties of quality. The observance of ethics in the food industry is definitely an extremely important issue[110].

The most important aspect of food quality is to ensure food safety. According to G. Taguchi, quality depends on a loss undergone by the product since it was introduced onto the market. According to the so-called quality loss function, if the loss is small quality is high. For food, losses are to be borne by the consumer (from the consumer health and life perspective), the producer (the costs

[109] C. Szczucki (1970), *Zakresy znaczeniowe podstawowych*…, op. cit., p. 3-4.
[110] *Jakość i bezpieczeństwo żywności wyzwaniem XXI wieku* (2010), ed. T. Sikora, Polskie Towarzystwo Technologów Żywności, Wydawnictwo Naukowe PTTZ, Kraków, s. 7.

of complaints, returns, utilisation, repeated testing, loss of consumer trust) and the whole economy (e.g. losses resulting from the breakdown of the European beef and pork market as a consequence of BSE and FMD detection)[111].

3.2. Factors determining food quality and safety

The quality of agricultural raw products of plant and animal origin, as well as processed food, depends on many factors present in the human environment, acquisition terms and processing, as well as food law and the control and certification system. All these are illustrated in Figure III.4.

The natural environment of a human being consists of water, soil and air. The most important sources of pollutants for the natural environment include industry, motorisation and agriculture.

Among the basic atmospheric air pollutants, the following should be enumerated: carbon dioxide – CO_2, sulphur dioxide – SO_2, ashes and nitrogen dioxide – NO_2. Recently, air pollution caused by aromatic hydrocarbons, especially benzopyrene, is becoming more and more important. Benzopyrene is considered as a carcinogenic substance. It is mostly present in waste gasses and particles formed in the process of tyres and asphalt surface abrasion.

The natural environment is of great significance for both wholesomeness quality of food obtained in a given territory (e.g. lead or cadmium contamination), and to its nutritive value (e.g. content of iodine or magnesium)[112].

Apart from atmospheric air and water contamination, human activity also results in soil contamination worsening the soil's nutritive value, increasing the content of toxic metals in soil preparation, and the loss of nutrients such as potassium, calcium, magnesium. As an effect, soil becomes uncroppable, and if it is cropped, the products are less valuable or even harmful. Scientists have proved the limits of soil contamination, and exceeding them may irreversibly destroy earth ecosystems. This transformation causes disturbances in numerous basic biochemical processes in the human body. They may be harmful to energy production, and cause breathing and digestion malfunction, and cancer diseases, as well as defects in valuable tissues such as bone marrow[113].

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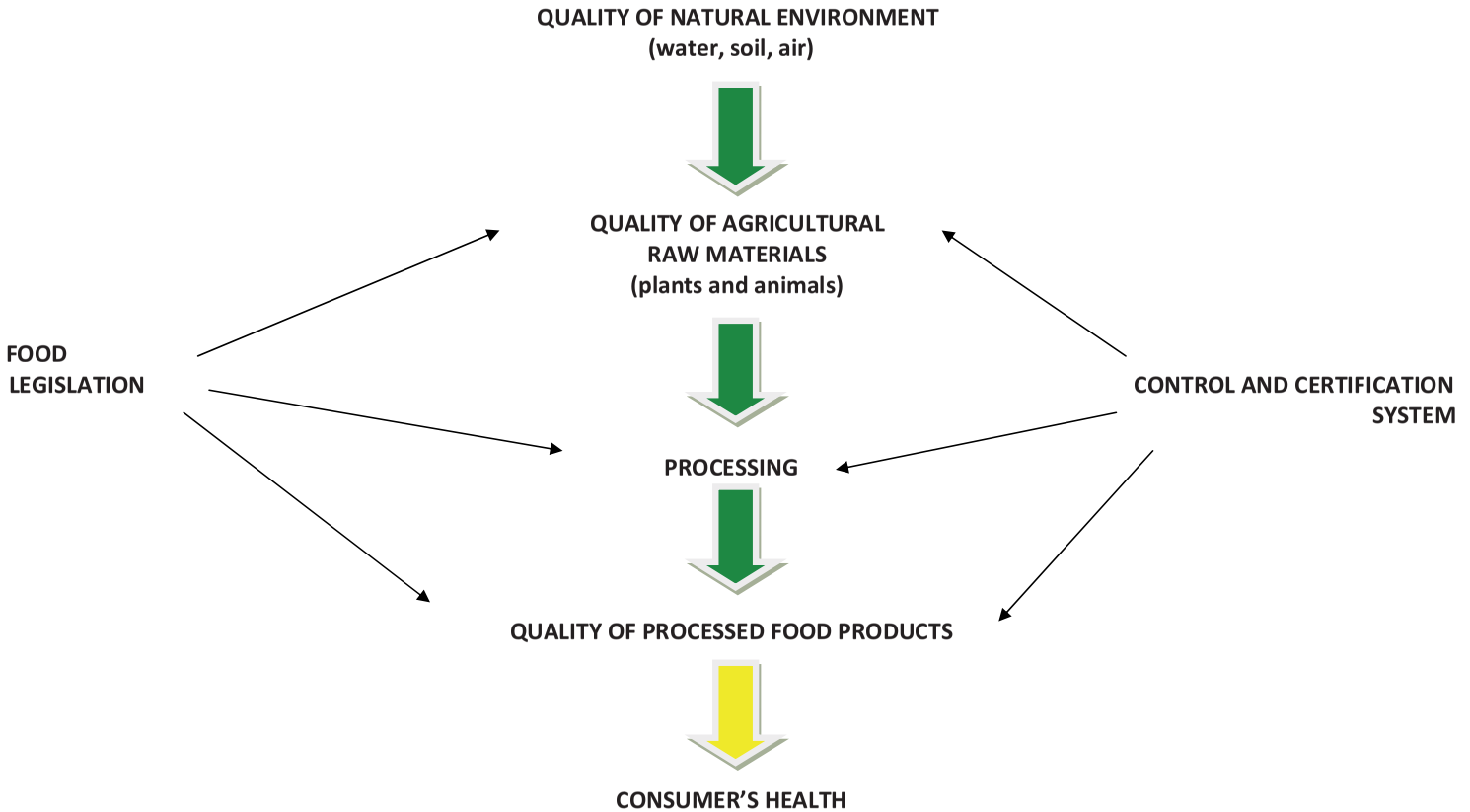
[111] M. Wiśniewska (2005), *Od gospodarstwa do stołu. Organizacja i zarządzanie jakością oraz bezpieczeństwem produktu żywnościowego*, Uniwersytet Gdański, Gdańsk, p. 20-21.
[112] *Kompendium wiedzy*…, op. cit., p. 7.
[113] See: H. Maciołek, D. Łukomska (2006), *Postępująca degradacja środowiska przyrodniczego* [w:] *Środowisko przyrodnicze a zdrowie człowieka*, ed. H. Maciołek, Akademia Świętokrzyska im. J. Kochanowskiego w Kielcach, Instytut Ekonomiki Agrobiznesu z Informatyką Stosowaną, Piotrków Trybunalski, s. 46.

Figure III.4. Factors influencing quality of plant and animal agricultural raw materials and processed food products



An excessive amount of nitrogen delivered to the soil in nitrogen fertilisers results in a higher level of nitrates in plants. Those stored at room temperature and under the influence of bacterial pathogens change into nitrites. Nitrites in vegetables can cause poisoning particularly dangerous for infants. They contribute to the formation of the so-called bad hemoglobin, namely methemoglobin. Red cells with methemoglobin are deprived of the ability to transport oxygen in blood. The excess of nitrates and nitrites in food leads to the formation of carcinogenic substances – nitrosamines. Similarly, the excessive use of phosphatic fertilisers results in too-high consumption of phosphorous, harmful for calcium metabolism, leading to the excessive expulsion of calcium from the organism[114].

Agri-food products transport harmful substances, namely contaminants. The majority of natural contaminants are produced by microorganisms such as bacteria and fungi.

The quality and safety of food must be ensured in the whole agri-food chain. For plant production, not only growing conditions (the selection of plant type, soil conditions, greenhouse conditions, pesticide utilisation, the impact of weather and seasons), but also the harvesting conditions of plant raw products (the harvest period, the machinery used) are important. Growing and harvesting conditions have an impact on the chemical composition and nutritive value of fresh or processed plant products, their organoleptic properties (taste, smell, texture and colour), the content of natural contaminants, anti-microbiological features and antioxidants. The following are important for animal production: nutrition type, animal life conditions and health, transport conditions (stress) and slaughter (hygiene). These factors have an impact upon the quality and safety of meat and meat products[115].

The physical properties of produced food are determined by storage and distribution conditions. At this stage, the following are of significant importance for the qualitative properties of food: the limited number and severity of impacts in transit (e.g. soft fruit), adequate temperature, storage time, the humidity and composition of air, manual processing conditions, hygiene, and the use of plant protection products. Applied processing techniques also have specific qualitative effect on food[116].

From the consumer's perspective, food safety is the most important property of quality; therefore food law provides detailed regulations on this matter.

[114] Ibidem, p. 43.
[115] P.A. Luning, W.J. Marcelis, W.M.F. Jongen (2005), *Zarządzanie jakością żywności,* Wydawnictwo Naukowo-Techniczne, Warszawa, p. 50.
[116] A. Kowalska (2010), *Jakość i konkurencyjność*…, op. cit., p. 29.

The provisions of the law require public authorities in EU countries to undertake measures in the area of public health and protection of consumer interest through, e.g., supervision over food and nutrition safety.

The Green Paper from 1997 prioritises health protection in terms of food consumption at all times, not only under hazardous circumstances. The most important objectives of the food law are:

- to ensure a high level of public health and consumer protection,
- to ensure the free movement of food in the Community,
- to found food law on scientific evidence and risk analysis,
- to ensure the competitiveness of the European food industry,
- to vest the basic responsibility for food safety with producers, industry and suppliers – under the HACCP system (Hazard Analysis and Critical Control Point), supported with a mechanism for an effective, official control,
- to ensure the consistency and rationality of the law, and that it is user-friendly, and established under the procedure of public consultations with all stakeholders[117].

Regulation (EC) No. 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, is the most important document in food law.

This regulation considers consumer health and life protection as the primary objective (food safety). Other objectives of the food law binding in the European Union (the Community and national level) include economic consumer protection as well as fair trade practices referring to food. Food law also focuses on environment protection and animal welfare[118].

The Act of 25 August 2006 on food and nutrition safety with subsequent amendments[119] is the most important among the national regulations forming the entire food law. The law specifies the requirements and procedures necessary to ensure food and nutrition safety, in accordance with the provisions of Regulation (EC) No. 178/2002.

The food control and certification system assures the consumer that the food available on the market is produced according to the valid provisions, and is free from any physical, chemical or microbiological contaminations.

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[117] M. Korzycka-Iwanow (2007), *Prawo żywnościowe. Zarys prawa polskiego i wspólnotowego*, Wydawnictwo Prawnicze LexisNexis Warszawa, p. 41-42.
[118] Ibidem, p. 20-21; 80-81.
[119] Dz. U. z 2006 r., nr 171, poz. 1225.

An ongoing control over presence of harmful substances, as well as pathogenic parasites, bacteria, viruses and prions, is the basic measure that ensures food quality and safety. Repeated improvements in research methods and food control programmes significantly limit consumer risk. Thanks to the development of modern analytical techniques, it is possible to identify many ingredients on the level of nano- and pictograms in one kilogram of a food product[120].

The certification system assures consumers that they receive high-quality food. The identification of the origin of agri-food products – from the production of a raw product on a farm to the final, processed food products – is the most important element in this system. Traceability means identifying and tracking food, fodders, food-producing animals or substances to be incorporated in, or added to, food and fodders at all production, processing and distribution stages.

The main aspects of traceability are described in Regulation (EC) No. 178/2002 of the European Parliament and Council. According to this Regulation (EC):

1. The traceability of the origin of food, fodders, food-producing animals, and any other substance intended to be incorporated into food or fodders shall be established at all production, processing and distribution stages.

2. Food and fodder business operators shall be able to identify any person from whom the food product, the fodder, the food-producing animal, or any substance intended or expected to be incorporated into a food or fodders, has been supplied to them.

3. For this aim, such operators shall have adequate systems and procedures in place, allowing this information to be made available to competent authorities on demand.

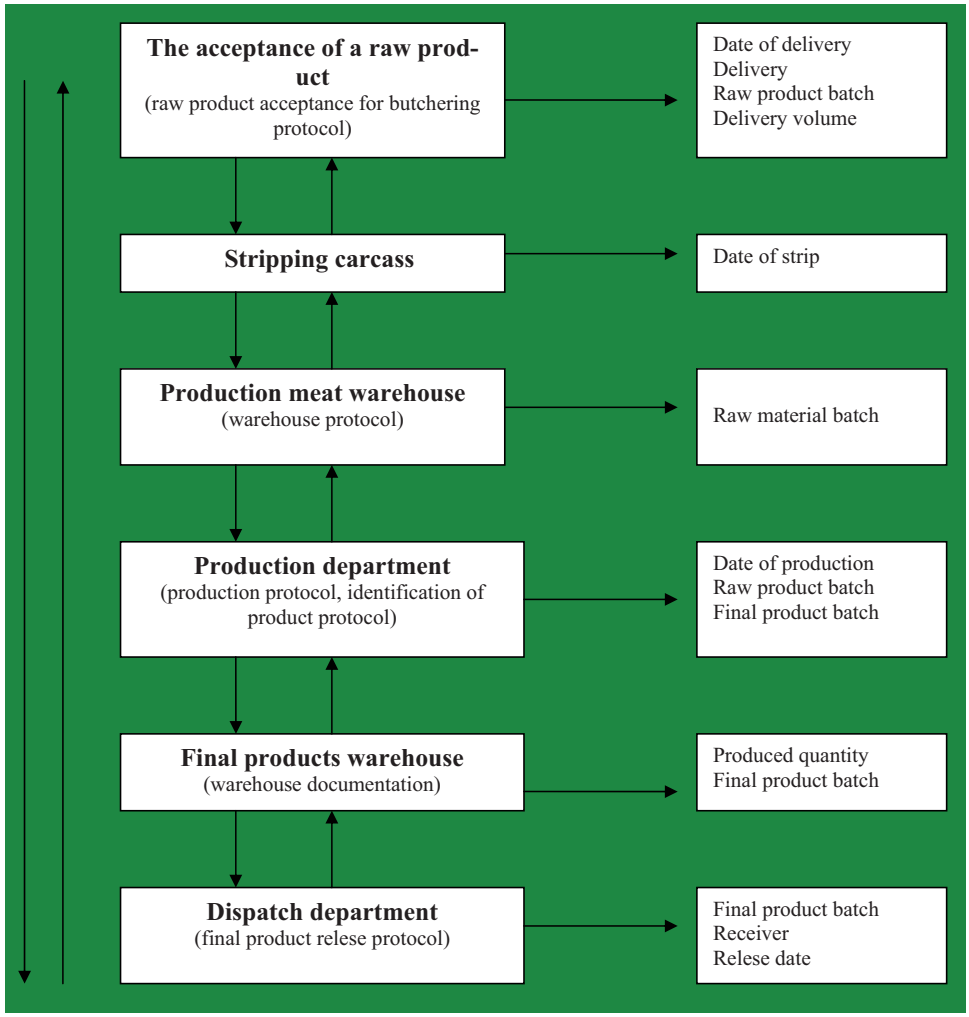
4. Food and fodders business operators shall have adequate systems and procedures in place, to identify the other businesses to which their products have been supplied. This information shall be made available to competent authorities on demand.

5. Food and fodders which are placed or are likely to be placed, on the Community market shall be adequately labelled or identified to facilitate its traceability, through relevant documentation or information in accordance with the relevant requirements of more specific provisions [121.]

The scheme of traceability from raw product to final product, and vice versa, is given on Figure III.5.

[120] J. Żmudzki, J. Osek (2009), *Kryteria gwarancji bezpieczeństwa i jakości żywności pochodzenia zwierzęcego*, I Congress of Agriculture Sciences, Puławy, p. 28.
[121] Regulation (EC) no 178/2002 of the European Parliament and Council.

Figure III.5. A scheme of traceability from raw product to final product and from final product to raw product



Source: Based on [Ziółkowska, Kijowski, 2010].

The continuity of the flow of information in the production chain during transferring, combining or dividing a batch of raw products, semi-products or additives, is the most important aspect of traceability. If the whole batch of raw products is transferred, the lot number is changed if any ingredients are added to the whole batch, but if many raw products have to be combined or divided, the new batch or batches have to be labelled[122].

[122] O. Szulecka, P.J. Bykowski (2008), *Identyfikowalność produktów rybnych*, Morski Instytut Rybacki w Gdyni, Gdynia, p. 69-70.

A traceability system contributes to the ensuring of food safety in terms of health, and facilitates the achievement of the following objectives:

- documenting the product history or origin,
- withdrawing certain products from sale or trade,
- identifying the authorities in charge,
- facilitating the verification of a particular product information,
- communicating information to the relevant shareholders and consumers[123].

4. Consumers of the 21st Century

4.1. Consumer food preferences

Modern consumers, i.e. the consumers of the 21st Century, are becoming more and more aware of issues relating to the quality of agri-food products consumed.

Judging a product before buying it, the 21st Century consumer pays attention to three basic properties behind food quality, namely the wholesomeness properties (including food safety and nutritive, caloric and dietary values), sensory attractiveness, and accessibility. Therefore, from consumer's perspective, food quality is the result of high nutritive value, sensory properties (tastiness, colour, mellowness) and those determining the culinary usefulness of food.

The list of food properties that have impact on the way of perceiving its quality and determining consumer preferences is given in Table III.2. The reference table presents the food quality concept according to which agri-food products as such are of no quality, but they possess physical properties that the consumer perceives as qualitative. These are the intrinsic features of a food product, namely safety, nutritive value, sensory properties, validity date, use comfort and reliability. The external qualitative features of a food product may not have a direct impact on its physical properties, but they may be important for consumer acceptance. The externalities include production parameters, the environmental impact and marketing. Marketing efforts (e.g. communications through evaluation, marking, labelling) determine the external qualitative properties influencing the expectations as to quality and consumer trust and then on positive quality perception[124].

[123] J. Kijowska, R. Cegielska-Radziejewska (2006) *HACCP, ISO 22000, zagrożenia żywności, funkcjonowanie, audytowanie i certyfikowanie systemu*, Akademia Rolnicza im. A. Cieszkowskiego w Poznaniu, Poznań, p. 30-56.
[124] A. Kowalska (2010), *Jakość i konkurencyjność w rolnictwie*…, op. cit., p. 26.

Table III.2. The qualitative properties of food decisive for consumer choice

Property	Property-specific semantic scope
	Intrinsic qualitative properties
Safety and Health-related aspects of a product	Belief in high hygienic and microbiological quality as well as trust towards a product and producer. Product protected against spoiling. Products having a positive impact on health, e.g. margarine with a lower content of cholesterol, coffee with lowered content of caffeine, yoghurt containing live bacteria cultures. Food produced by means of ecological methods.
Sensory properties	Tastiness, smell, colour, appearance, texture, sound (e.g. chips crunching). Ability to fulfil individual taste and preferences in the area of organoleptic values.
Durability	Date to which a food product maintains its full sensory values and may be consumed safely.
Reliability	Compliance of a product description with its real composition. Usefulness of a product for consumption in the presumed validity period and under proper storage conditions.
Functionality	Scope of application, use comfort, consumption comfort (divisibility, dosing, freezing option or heating, processing easiness).
	External qualitative properties
Production characteristics	The manner in which a product is produced (conditions of growing and harvesting of plant products, animal production conditions, food processing conditions, etc.), e.g. eggs from caged hens, barn eggs, free-range or organic eggs.
Environmental and ecological aspects	Consumer belief that product processing and use does not cause any negative effects for the environment or produces negative effects less than for different, similar products. Belief that a product was produced without chemical agents, in a clean environment.
Innovativeness	Grade of product modernity, e.g. GMO, probiotics, functional food. Compliance with technical progress in a household (e.g. the possibility of processing in microwave oven). Products packed in a manner facilitating sterile dosing, economical use, storage and carrying (e.g. multiracks for drinks with a grip, sausages in unitary packing).
Exclusivity	Prestige of a buyer relating to ownership of an elite product. Product consumption in an elite environment, e.g. consumed by rich persons, organisations and groups (e.g. caviar, game, labelled annual wines). Products of a limited series produced occasionally and for selected receivers, products packed and exhibited in an exclusive way.
Brand as a quality guarantee	Consumer belief in the high quality of a product (also a new one) referring to trust in a given brand. Ennoblement of a buyer because of a product produced by a well-known producer or sold in well-known trade centre or elegant kiosk, e.g. luxury cheese in Harrods.

Table III.2 cont.

Property	**Property-specific semantic scope**
Presentation	Form in which a food product is presented (aesthetics of the environment, proper lighting, form of promotion, including tasting). Adequate and convenient way of delivery of a product to consumer's house, e.g. packages with organic agricultural products, purchases from Internet grocery stores. Quality labelling, quality marks. Packaging.
Purchase cost	Food of a higher price may be perceived as a product of higher quality, which is often related to the use of more expensive raw products of better quality. High purchase cost is often related by a consumer to the good origin of a product and high quality of ingredients, including packaging.
Availability	A given product may be bought in both the material (financial) and physical sense (accessibility on the market). Contact with a producer and placement of complaint is possible. Information about the product and producer given. Information about product preparation given. Fast and prompt delivery.
Additions	A set of secondary or additional features of a product, e.g. bonus for chips in the form of stickers depicting favourite cartoon characters, bonus for a wine in form of spice and mull wine recipe. Product sold with a cup for tea, recipe book, kitchen apron, etc.

Source: [Kowalska, 2010].

A number of information about the food-related hazards on human health and life, that emerged at the end of the previous century and at the beginning of 21st Century, including about the so-called food affairs (e.g. BSE, FMD, glycol in wine, dioxins in feed and food, melamine in milk from China, *E. coli* bacteria) have made the modern consumer more cautious about any aspects referring to food quality and safety.

Therefore, more and more often consumers select agricultural products and food of not only high quality, but also having certificates proving their origin. In this way, they want to make sure that the food consumed is safe. Considering the great choice of food launched onto the market, the consumer expects information about the quality and origin of an agricultural product or food.

The growing awareness and knowledge among consumers on the interrelation between food and health is reflected by higher demand for high quality food products resulting from special methods of processing, exceptional composition and defined origin. Richer consumers tend to revert from the consumption of food originating from mass production and prefer regional, traditional, and organic products.

Because of the increased awareness of hazards on health and food safety among European consumers, fulfilling higher expectations in this field should be one of the greatest challenges for the agricultural production and food industry.

The widest possible application of an integrated management system is the basic way to acquire safe food. This system, through particular elements of technology, favours the concept of sustainable agriculture[125]. At the national level, the main features characterising sustainable agriculture are:

- the rational use of agricultural production space and maintenance of soil production potential;
- ensuring the food self-sufficiency of the country (net);
- the production of safe food;
- the production of raw products of quality parameters that consumers and industry expect;
- the limitation or elimination of hazards on the natural environment and care about biodiversity;
- gaining profits from agriculture ensuring remuneration for labour comparable with different economy sectors and funding for modernisation and development[126].

4.2. Food Quality Systems

The Common Agricultural Policy is meeting consumers' expectations halfway; its aim is not merely to provide a sufficient amount of food but to provide high-quality food, while also ensuring a stable agricultural income. The food has to be produced in a sustainable way, in accordance with the provisions on environmental protections, water resources, animal welfare, plant health, and public health.

Apart from its productive function, the Common Agricultural Policy attaches great importance to the social functions of agriculture. It promotes a sustainable and competitive model of agriculture which cares for the quality of agricultural products, environmental protection, and the preservation of the countryside's cultural heritage.

The changes done in respect of the CAP aim at:

- giving more serious consideration to the expectations of European consumers concerning the quality of agri-food products;
- allowing farmers to freely choose the direction of their production;

[125] *Zrównoważone rolnictwo a bezpieczna żywność* (2008), ed. E. Cieślik, Polskie Towarzystwo Technologów Żywności, Wydawnictwo Naukowe PTTŻ, Kraków, s. 5.

[126] S. Krasowicz (2005), *Cechy rolnictwa zrównoważonego* [w:] *Koncepcja badań nad rolnictwem społecznie zrównoważonym*, ed. J.St. Zegar, seria „Program Wieloletni 2005-2009", nr 11, IERiGŻ-PIB, Warszawa, p. 25.

- paying subsidies regardless of the volume of production, which will improve competitiveness and boost the market orientation of agricultural producers, and at the same time will provide a stable income for farmers;
- protecting the environment;
- ensuring food safety;
- taking care of the health and welfare of animal farming;
- improving the rank of the development of country areas in respect of agricultural output support policy, by shifting some of the resources from the "first pillar" (direct payment) to the "second pillar" of the CAP (the countryside's development);
- developing the production of organic food;
- creating a new policy for food quality.

The Common Agricultural Policy contributes to the improvement of food quality through:

1. Food quality systems - national and Community level.
2. Support for agricultural producers, motivating them to improve the quality of their products.
3. Encouraging farmers to follow a farming system that doesn't support the quantity of products, but their quality.
4. Support for publicity promotion and informative actions directed at both producers and consumers.

The Common Agricultural Policy meets the expectations of European consumers who pay more attention to the quality of food. High-quality products are produced in accordance with the principles regarding environment protection, plant health, as well as animal health and welfare. European high-quality food is the main value of the EU agriculture, and it is crucial to the creation of the cultural identity of nations and regions.

4.2.1. European Food Quality Systems

One way of implementing the European food quality policy is to award the emblems confirming the high quality of the agricultural products and food coming from specific regions and produced in a traditional way.

The following European product certification and labeling systems were implemented in order to distinguish high-quality food:

1. The certification and labeling system for high-quality food with characteristic features resulting from traditional ingredients, method of producing or place of origin:

Traditional Specialty Guaranteed (TSG)

Protected Geographical Indication (PGI)

Protected Designation of Origin (PDO)

Three European Union schemes inform the consumer about the specific character and uniqueness of the food and they guarantee high quality. The quality of these products results from:

- traditional production methods – for the Traditional Specialty Guaranteed.
- a close connection between the quality and place of origin of products – for the Protected Geographical Indication and Protected Designation of Origin.

European schemes are not equal to the monopoly granted by patent protection. The product doesn't become the property of certain producers but is protected as a common good. No one can be an exclusive owner of national tradition or the climatic conditions of a certain region, or recipes improved through-

out generations. However, such products can be protected because of their unique features. What is protected is their brand, together with a specific recipe which guarantees a unique taste[127].

Many advantages result from the protection and promotion of quality systems:

- they guarantee the origin and method of production;
- they advertise the product; giving information about its additional value;
- they promote rural farms that produce high-quality products by protecting genuine brands against dishonest forgeries;
- they improve the attractiveness of rural areas.

2. The certifying and labeling system for food coming from organic farming.

European Ecolabel – Organic Farming

The focus of organic farming is not only on the production of food with high-quality parameters in a sustainable natural environment, but also on the protection of the entire environment in which farming operates, as well as animal welfare. Farmers and organic food producers can use the European Ecolabel only if 95 per cent of the ingredients of their product are produced by ecological means and the product was supervised during the production process.

The European Union guarantees the reliability of organic products regardless of their place of production. A product is clearly labelled (the name of the producer and the processor or seller, together with the name and code of the certifying unit).

4.2.2. National food quality systems

The EU law enables the creating of national food quality systems. The following systems have been launched in Poland: the "Quality Tradition" System, the Integrated Production, Pork Quality System – PQS, the Quality Meat Program – QMP and the Quality Assurance for Food Products – QAFP.

[127] *Oznaczenia geograficzne, nazwy pochodzenia oraz gwarantowane tradycyjne specjalności w Polsce 2008* (2007), MRiRW, Warszawa, p.7.

"Quality Tradition" System

"Quality Tradition" System distinguishes high-quality food products, particularly traditional ones. It is the first national food quality system created by producers in order to mark out and promote food products.

Food products distinguished with the emblem "Quality Tradition" come from organic farms or farms following Good Agricultural Practice and Good Breeding Practice, excluding GMO. Materials used in production have to be entirely identifiable.

The Integrated Production System

Integrated Production (IP) is a modern food quality system which makes a sustainable use of technical and biological progress in farming, plant preservation, and fertilisation, focussing on environmental protection and human health.

Products with the IP logo assure consumers that the amount of pesticides, heavy metals, nitrates, and other harmful substances in the crops does not exceed the acceptable level. At the same time, they assure that the environmental resources were used in a sustainable way.

Following the IP system in a holding is extremely important in case it is necessary to confirm the requirements regarding food safety. It is relevant to the sales on the national market and also for the export of plants and plant products (especially fruit and vegetables) to the Russian Federation. With regard to the IP system, it is possible to go into production according to Russian standards. Es-

sential elements in such a case would be special programmes for plant preservation formulated by the Research Institute of Horticulture in Skierniewice.

The Pork Quality System

Pork Quality System (PQS) is a complex system for producing high-quality pork meat. Its goal is to produce lean meat, not fatty, preserving important parameters of meat quality, maintaining its cooking and processing usefulness, and preserving the attractiveness of its look and taste for consumers.[128]

The Pork Quality System embraces the whole production chain – from animal breeding, husbandry, pre-slaughter handling, and slaughter, to processing and distribution. The standards of procedure at every level of the production chain affect the final quality of the product and guarantee the highest quality of pork meat.

The Pork Quality System is transparent and it assures complete identification of the final product – from a batch of meat leaving a meat cutting plant to the herd of pigs from which the meat was taken.

The breeders and producers of pigs, together with the meat processing companies which meet the PQS system requirements, will obtain a declaration of conformity which proves the conformity of the production with the specification; it also enables them to use the Pork Quality System PQS logo. The logo assures the consumer that the product has fulfilled strict quality criteria.

The PQS system is open to all producers, and taking part in the scheme is voluntary. It means that every participant in the production chain can join the system if he/she guarantees following the rules at every step of production.

The production of pork following the PQS system, is carried out in accordance with binding regulations on animal health and welfare, public health, and environmental protection.

[128] Pork Quality System was created by the Polish Association of Breeders and Producers of Pig ”POLSUS” and the Association ”Polish Meat”.

The Quality Meat Program

The Quality Meat Program (QMP) provides consumers with an assurance and a basis for greater trust in the quality of Polish beef. Beef meets the expectations of consumers because of its properties - succulence and tenderness.

QMP is the only system ensuring quality in Poland, based on standards of the production of fodder and livestock, meat production and control, transport, and control prepared by an independent unit, and aimed at ensuring the best quality of beef meat. The system is open to all cattle producers, fodder producers, livestock carriers, and meat processors who undergo the control of the independent certifying unit.

Beef labeled with the "System QMP" logo is produced in a holding such a way as to achieve higher succulence and tenderness than is obtained according to the current and common standards of trade quality on the Polish market. QMP standards were created in order to achieve higher trade quality than the one present in the whole production and processing chain.

The Quality Assurance for Food Products System

The *Quality Assurance for Food Products* certificate (QAFP) guarantees the best quality at the production stage and at slaughter, and it proves that the quality control has covered both the breeding of animals and their selective choice. The products labeled with the QAFP emblem are produced in such a way as to obey technological rules and follow food safety supervision systems.

The Quality Assurance for Food Products System is a quality system including norms for pork meat (ham, pork loin, pork neck), poultry meat (chicken breast, turkey breast), and the meat of the Polish young oat goose.

The Quality Assurance for Food Products System QAFP compiles clear rules for every subject responsible for each link in the production chain, bringing certain advantages:

(1) breeders get the chance to acquire a higher price for their livestock and to maintain the quality of production;

(2) producers are able to improve their reliability, thus becoming more competitive;

(3) distributors attract consumers willing to pay more for high-quality products with the Premium emblem;

(4) consumers acquire a nutritious ingredient for their meals.

Other products unique distinguishing marks

Mark "Know Good Food" is awarded only to those products which meet the most criteria of the Scientific Committee on the Quality of Food Products Try Fine Food Programme. This mark is given to the product for a period of three years. This ensures that the high level of quality and reliability of marked the origin of raw materials.

Designation of agricultural and food products with the mark "Know Good Food" helps consumers to choose products of high quality. At the same time, the objective of the community food policy which is to extending the area of high quality and variety of food within on the internal EU market.

Currently the level of knowledge of both consumers and producers is too low for them to realize the advantages to the producers and the guarantees to the consumers resulting from the existing producing systems and the control of high-quality food products. As a result, the demand and supply for products awarded either confirming the quality products, is still low.

4.3. Information and Promotion

Information and promotion are targeted at consumers in order to present the unique characteristics of high-quality products and prove the advantages coming from their consumption. These measures indirectly influence an increase in demand for products participating in food quality systems. Enlarged demand can positively influence the activation of producers and the increase in employment in rural areas.

Recognizing the meaning of the high-quality food production sector, the European Union for several years has been supporting groups of food producers in improving publicity and information. A food product which is not promoted will not enter the market. The aim of the EU measures is to:

- increase the demand for agricultural products and food included in the mechanism of food quality;
- expand consumers' knowledge about the advantages of products included in mechanisms of food quality;
- expand consumers' knowledge about mechanisms of food quality;
- support groups of producers, which affiliate entities taking active part in food quality systems.

4.4. The Quality Package

On 10 December 2011, the European Commission adopted the Quality Package, which proved that the European policy can be more efficient at publicizing the quality of food products. The two aims of the Quality Package are the quality assurance for consumers and a fair price for farmers. The Package, for the first time, gathers comprehensive solutions regarding certification systems, and definitions of the added value of agricultural products with certain characteristics, together with product norms. These solutions had been included in many separate legal Acts. Thanks to this Package the European Commission embraced all food-quality aspects – from minimum norms to very specific products[129].

The Quality Package is the first step in the reform of agricultural food quality policy. It is the result of three years of consultation with concerned parties. The package ensures the possibility of developing a more coherent quality policy for agricultural products. The European Commission has declared its willingness to prepare a detailed analysis of the problems faced by small producers in respect of participation in European quality systems and the difficul-

[129] www.ec.europa.eu.

ties in introducing products to the market, experienced by producers from mountainous areas.

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The third charter presents the survey carried out as a part of the research project entitled *Sustainable Agriculture versus Safe Food and Health* implemented under the theme of the *Competitiveness of Sustainable Agriculture*.

1. Human health depends not only on the high quality rations, but also on the quality of food products. Apart from nutrients, food is composed of other substances, e.g. food preservatives, antioxidants, emulsifiers, stabilizers, colouring dyes, heavy metals, nitrates, nitrites, and other components. These substances may pose a risk to consumers' health.

2. The most important aspect of food quality is to ensure food safety. The safety of a food product depends on its physical, chemical and microbiological purity.

3. Health risks in food have three basic sources: (1) physical contamination e.g. glass, stones, metals, (2) natural toxic or harmful substances in agricultural raw products, e.g. the residuals of chemical compounds - pesticides, herbicides, antibiotics, detergents, heavy metals, and substances which got into the food by accident, (3) the existence of pathogenic microorganisms, viruses, bacteria, parasites and their metabolites.

4. Recognizing risk areas in agri-food chain (farmers-producers-processing-distribution-consumers) will contribute assuring food safety, which is one of the main aims of national food policy.

5. The main factors influencing the quality and safety of agri-food products are the environment (the quality of soil, water, and air), the quality of ingredients (plants, animals), processing, distribution, food legislation (both national and European), as well as food control and certification systems.

6. The food control and certification system assures the consumer that the food available on the market is produced according to the valid, and is free from physical, chemical and microbiological contamination.

The identification of the origin of agri-food products – from the production of raw product in an agricultural holding to the final processed food product – is the most important aspect of the certification system.

7. There are four types of inspection that supervise food safety in Poland at every link in the agricultural and food chain: Generally Veterinary Inspectorate, Main Inspectorate of Plant Health and Seed Inspection, Agricultural and Food Quality Inspection, and Chief Sanitary Inspectorate.

8. In the EU supervision over food safety is performed by the European Food Safety Authority. Each member country of the EU has its own food safety system.

9. Judging a product before buying it, the 21st Century consumer pays attention to three basic properties behind food quality, namely wholesomeness properties (including food safety and nutrient, calorific and dietetic values), sensory attractiveness, and availability. Therefore, from the consumer's perspective, food quality is the result of a high nutritive value, sensory properties (tastiness, colour, succulence) and determinants of the culinary usefulness of food products.

10. A number of information about the food-related hazards on human health and life, that emerged at the end of previous century and at the beginning of the 21st Century, including the so-called food affairs (e.g. BSE, FMD, glycol in wine, dioxins in feed and food, melamine in milk from China, *E. coli* bacteria) have made the modern consumer more cautious about any aspects referring to food quality and safety.

11. Therefore, more and more often consumers select agricultural products and food not only of high quality, but also having certificates proving their origin. In this way, they want to make sure that the food they consume is safe.

12. In order to ensure high-quality agri-food products the European Union regulates food quality with special systems: (1) a certifying and marking system regarding high-quality products with characteristic features resulting from traditional ingredients, way of production, or place of origin. These include: Traditional Specialty Guaranteed (TSG), Protected Geographical Indication (PGI), Protected Designation of Origin (PDO) and (2) a certifying and labeling system concerning products coming from organic faming.

The EU law enables the creating of national food-quality systems. In Poland there the following systems have been launched: "Quality Tradition" System, Integrated Production – IP, Pork Quality System – PQS, Quality Meat Programme – QMP and Quality Assurance for Food Products – QAFP.

Both national and European systems aim at facilitating consumers' conscious choice. Unfortunately, both consumers and producers lack have knowledge of the existing production systems and high-quality food production control systems, together with the guarantee they provide to consumers, or the advantages to the producers. As a result, the demand and supply for the products awarded with quality emblems is still low.

13. European food-quality policy assures consumers that the food they buy is of high quality and that it was produced in a traditional way.

14. European food quality policy focuses on the promotion of diverse agricultural production and the protection of product names from abuse and forgery by awarding products with special emblems. The certificates confirm the

unique features of agricultural and agri-food products which are connected with geographic origin or local tradition.

15. The protection and promotion system for regional and traditional products is the most important factor influencing the balanced development of rural areas and the realization of the assumptions of the "second pillar" of the Common Agricultural Policy. It contributes to the diversification of employment in rural areas, creating non-farm sources of income in the countryside and increasing the earnings of agricultural manufacturers. Because of preventing from desolation, these factors have immense meaning for remote areas and regions with unfavorable farming conditions. The protection and promotion system concerning regional products also protects the cultural heritage of the countryside, which contributes to the attractiveness of farming regions and development of farm tourism and rural tourism.

16. The quality policy is inseparable from the Common Agricultural Policy, which means that the development and determination of the policy regarding geographical emblems will have a crucial meaning for balanced and competitive European farming.

17. The growing awareness of European consumers triggers the necessity to meet continuously growing expectations in respect of food hazards and food safety and it should be one of the most important challenges faced by the agricultural production and food industry.

The underlying way to achieve safe food is to expand the use of integrated farming systems. That system favours the concept of sustainable agriculture through individual elements of its technology. Sustainable agriculture offers food produced with minimal use of fertilizers or pesticides. It is directed towards the exploitation of soil which does not destroy its natural resources but allows the satisfying of the basic needs of next generations of producers and consumers.

18. Introducing sustainable agriculture model that allow for producing organic food, based on traditional technologies, and regional food, i.e. the so-called increasingly popular niche food, provides an opportunity for Poland to achieve its competitive supremacy on the global market.

IV

THE PRODUCTIVITY AND SUSTAINABILITY OF AGRICULTURE FROM THE DEVELOPMENT STRATEGIES PERSPECTIVE

1. Productivity as an element of sustainable agriculture performance measurement

The issue of efficiency is one of the basic problems discussed in economic science. The basic measures of the efficiency of economic processes relate to the level of productivity of entities, sectors or national economies. In studies on the agricultural sector, comparative research and research on the pace of changes in productivity should be interpreted as the most important ones. Comparative research refers here to the issue of the competitiveness of sectors or entities operating in agriculture. These comparisons most often result in the identification of productivity leaders and the definition of factors determining their privileged position. On the other hand, research on the pace and direction of changes in productivity serve as an assessment of investment impact, as well as processes in the economic environment on the results of analysed entities. From this perspective, research on productivity development is of key significance for the process of shaping policies aiming at stimulating economic growth.

Productivity is one of the groups of measures traditionally linked with marketable goods and services. However a growing interest in the provision of sustainable non-market commodities provision, as well as the understanding of the impact of negative externalities on public welfare, advocate a revision of productivity valuation. The first case deals mainly with public goods related to type of natural resources. Dynamic economic development, including agriculture, turned out to have a negative impact, particularly on the natural environment. This negative impact is directly linked with the development model based on the intensive utilisation of natural resources. The general model of global agricultural development prefers transformation of peasant agriculture towards farming, and then agribusiness enterprises in line with economic growth[130]. These transformations are to be linked with the process of the industrialisation of food production. However the high efficiency of the industrial food economy is of a volatile nature, while the economic accounts ignores external costs related to the degradation of environmental resources and the negative impact on the

[130] F. Tomczak (2005), *Gospodarka rodzinna w rolnictwie. Uwarunkowania i mechanizmy rozwoju*, IRWiR PAN, Warszawa, p. 56-65.

society's state of health[131]. In the European food economy, this undesirable transformation of the food economy is accompanied by depopulation and depreciation of rural communities. This is equally as important as the negative impact of industrial agriculture on the socio-economic environment. The efficiency of the industrial food economy is similarly undermined in the field of food security. To a larger extent consumers of developed countries express interest in the quality and origin of food products from the perspective of their safety for human health[132]. This phenomenon is reflected in increased interest in regional and ecological products at the expense of mass-produced food.

The controversies discussed here, concerning the sustainability of the food economy based on the industrial model of agriculture development have resulted in increased interest in sustainable agriculture e.g. more friendly to the natural environment and consumers[133]. On one hand, the basic parameters of the sustainability of agriculture include the readiness to secure food deliveries, and on the other hand to ensure the sufficient living standards of communities involved in agricultural activity in the long-term perspective[134]. In the first case, of key importance is to maintain a sufficient level of production under the conditions of diminishing resources of agricultural land, in particular of the best quality, and growing difficulties in the acquisition of basic minerals necessary for the manufacture of artificial fertilisers. Consequently, the maintenance of the level of food production necessary for feeding the growing population of the world depends mainly on the increase of agricultural land productivity, which was traditionally achieved through production intensification. In the second case, the sustainability of agriculture is associated with an increase of agricultural population incomes and their living standards. The satisfactory level of incomes of the agricultural population is treated here as the basis for the sustainability of agricultural holdings.

The controversies described above put in question the potential for growth of the industrial model of agriculture. Therefore it has become necessary to search for alternative models for the development of agriculture that are compliant with the criteria of sustainable development. The concept of Sustainable Agriculture and Rural Development (SARD) is an example of formalised assump-

[131] P. Roberts (2009), *The End of Food. The Coming Crisis in the World Food Industry*, Bloomsbury, London – Berlin – New York, p. 220.
[132] *Z badań nad rolnictwem społecznie zrównoważonym [13]. Jakość i bezpieczeństwo żywności a zdrowie konsumenta* (2011), ed. M. Kwasek, seria „Program Wieloletni 2011-2014", nr 8, IERiGŻ-PIB, Warszawa, p. 33-34.
[133] J.P. Reganold, R.I. Papendick, J.F. Parr (1990), *Sustainable agriculture*, Scientific American, p. 112-119.
[134] G.W. van Loon, S.G.Patil, L.B. Hugar (2005), *Agricultural Sustainability. Strategies for Assessment*, Sage Publication, London p. 106.

tions for a sustainable model of agriculture[135]. The definition of sustainable development in opposition to the traditional sectoral approach is replaced by the comprehensive approach, including environmental, social and economic objectives. According to these assumptions, the SARD concept suggests an overall approach towards the development of agriculture promoting economic growth without the degradation of natural resources and the environment. In particular, SARD integrates the economic performance of agricultural activity with its impact on the natural environment. The efficiency of the agricultural sector is assessed here both from the perspective of raw materials for food production and industry, and the natural environment resources economy. Multiple effects of agricultural activity are assessed from the perspective of their ability to maintain production levels in future periods. A resolution of the contradiction between the dynamic growth in agricultural production in the short and longer terms is a characteristic component of the SARD concept. Namely new technologies that are safe for the environment and provide agricultural land productivity improvement are to secure food provision for the growing population while maintaining natural resources.

The sustainable development of agriculture from the perspective of satisfactory incomes for the agricultural and rural population provision is linked with the concept of multifunctional rural development[136]. In this concept, the sectoral approach (agriculture) has been replaced by the spatial approach (rural areas) as providing better utilisation of the resources of rural areas. Agricultural holdings are perceived from the perspective of commodity production and manager of the natural environment. The complexity of the functions of agricultural holdings is related to environmental, social and cultural functions of farms. This multifunctionality of agriculture and rural areas implies extended assessment of the efficiency of agricultural activity. Traditional assessment covering conventional agricultural production is combined with qualitative and quantitative indicators describing interactions between agricultural activity and the natural environment[137].

Differences between the level of development of western and eastern European agriculture are reflected in the level of employment in the agricultural sector. The issue of "agricultural overpopulation" in countries as Poland has a direct influence on the low productivity of labour in agriculture that is translated into, on aver-

[135] WCED (1987), *Our Common Future. The World Commission on Environment and Development*, Oxford University Press, Oxford, New York, p. 43.
[136] OECD (2001), *Multifunctionality. Towards an Analytical Framework*, Paris.
[137] J.D. van der Ploeg, D. Roep (2003), *Multifunctional and rural development: the actual situation in Europe* [in:] *Multifunctional agriculture: a new paradigm for European agriculture and rural development*, ed. G. van Huylenbroeck and G. Durand, Ashgate, Hampshire – Burlington, Graph 3.3, p. 45.

age, the lowest incomes of those working in Polish agriculture, as compared to EU agriculture[138]. The high level of employment in Polish agriculture is a consequence of non-rational development during the former period of a centrally planned economy and indicates the lost benefits linked to the insufficient utilisation of labour forces[139]. Therefore among the key elements of the assessment of the efficiency and sustainability of Polish agriculture is the allocation of human resources[140]. However, this process of transformation of Polish agriculture has a long term character which depends on the dynamic of general economy development.

The socially-sustainable agriculture development concept underlines the problem of rural labour resources that make it compatible with the state of development of Polish agriculture[141]. This concept, along with economic and ecological spheres, differentiates the social sphere, indicating the need for the adjustment of forms of agriculture to rural labour resources. As compared to different concepts of sustainable development in Polish agriculture, socially sustainable agriculture treats the utilisation of agricultural labour resources as an element of social governance [142]. Partial exclusion of this element from the economic sphere is justified through the prism of the inability of market mechanisms to promptly solve the issue of over-employment in agriculture. Simultaneously this approach indicates the need for the inclusion of external effects linked with both the ecological and socio-cultural functions of agriculture[143]. Limitation and support of the implementation of certain technologies in agricultural production are recognised as a solution to increase sustainability in all spheres. Therefore specification of production restrictions implies the need to modify conventional economic assessment of agricultural activity and of its efficiency. However the assessment of the efficiency of agriculture from the perspective of the production of commodities as well as the generating of income at the micro- and macroeconomic levels is

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[138] Z. Floriańczyk (2006), *Polskie rolnictwo w Unii Europejskiej w świetle rachunków ekonomicznych dla rolnictwa* [w:] *Wyniki ekonomiczne polskiego rolnictwa w ujęciu europejskim i regionalnym*, ed. Z. Floriańczyk, seria „Program Wieloletni 2005-2009", nr 43, IERiGŻ-PIB, Warszawa, p. 39.

[139] A. Leopold (1997), *Rolnictwo w procesie przemian i rozwoju gospodarki*, PWN, Warszawa, p. 33-39.

[140] A. Stasiak (2000), *Możliwości wielofunkcyjnego rozwoju wsi polskiej na początku XXI w. – zróżnicowanie regionalne* [w:] *Możliwości wielofunkcyjnego rozwoju wsi polskiej w kontekście integracji z Unią Europejską,* ed. A. Stasiak, KPZ PAN, SGGW, Warszawa, p. 6-7.

[141] A. Woś, J.St. Zegar (2002), *Rolnictwo społecznie zrównoważone*, IERiGŻ-PIB, Warszawa.

[142] Matuszczak A. (2009), *Koncepcja zrównoważanego rozwoju w obszarze ekonomicznym, środowiskowym i społecznym*, Roczniki Ekonomiczne Kujawsko-Pomorskiej Szkoły Wyższej w Bydgoszczy, nr 2, Bydgoszcz, p. 138.

[143] J.St. Zegar (2011), *Konkurencyjność rolnictwa zrównoważonego. Zarys problematyki badawczej* [w:] *Z badań nad rolnictwem społecznie zrównoważonym [11]*, ed J.St. Zegar, seria „Program Wieloletni 2011-2014", nr 3, IERiGŻ-PIB, Warszawa, p. 19-20.

critical from the economic sustainability perspective. Therefore the assessment of the economic efficiency of agriculture should be expanded with assessment of productivity in the ecological and social spheres of sustainability.

The research on the sustainability of Polish agriculture indicates links between the ecological and economic sustainability of agricultural holdings[144]. In particular, holdings sustainable in terms of ecology were characterised by income on at least a par more frequently than conventional ones. At the same time, the improvement in the technical infrastructure of rural areas observed in recent years, and the level of education of the rural population, are positive transformations in the social and economic sphere of the Polish rural areas. Despite these positive phenomena, the intensified process of globalisation and competition in agri-food markets is strengthening the preferences for the economic efficiency of agriculture as compared to other spheres of sustainability. Namely the globalisation process leads to improvements in economic efficiency and productivity that are based on market mechanisms, disregarding social and ecological spheres that are not the subject of market valorisation[145].

Measurement of agricultural productivity should therefore take into account market related activates as well as ecological and social spheres of sustainability. Such integrity can be achieved by joint treatment of the sustainability spheres stressing the limited ability of their mutual compensation. This rule means that the excess achievement of economic sustainability does not compensate for excessive exploration of environmental resources. From the Polish agriculture productivity assessment additional integration of the social sphere is required to provide an accurate background for the formulation of development policies.

2. Assessment of productivity versus sustainability of agriculture

Productivity and sustainability assessment is most frequently is conducted with respect to the macro- or microeconomic level nature of the investigated problem. In the first case, the agricultural sector is analysed; in the second, the productivity of individual agricultural holdings is investigated. Different approaches to productivity assessments are determined by the type of a process, the course and effects of which are monitored. Research on the productivity of the agricultural sector aims at monitoring the efficiency of the production of food and agricultural raw materials, in particular from the dynamic perspective. In this case, changes in productivity also reflect changes in the base of income

[144] J.St. Zegar (2009), *Z badań nad rolnictwem społecznie zrównoważonym [10]. Raport końcowy: synteza i rekomendacje*, seria „Program Wieloletni 2005-2009", nr 175, IERiGŻ-PIB, Warszawa.
[145] J.St. Zegar (2011), *Konkurencyjność rolnictwa…*, op. cit., p. 56.

generated by agriculture in relation to the whole national economy. Similarly, an analysis of changes in productivity at the level of the economy or regions is used for the assessment of the results of agricultural policies. An analysis of the dynamics of productivity change of agricultural sector is also used for monitoring production techniques development.

Research on the productivity of the agricultural sector in the context of sustainable agricultural production refers mainly to the economic sphere. Investigations made in this area relate mostly to results and expenditures registered in the economic accounts, i.e. being the subject of market evaluation. Similarly technical and economic indicators collected at the sector level do not take into account diversification of farms. As a consequence, the assessment of sustainability in the aspect of economic performance serves as a general indicator.

The research of the productivity of individual agricultural holdings is sensitive to farm diversification and aims at supporting the process of their management as well monitoring the effects of investments activities. In this case, comparing results and expenditures facilitates the technical assessment of the efficiency of applied production technology and the efficiency of agricultural holdings management. However the farm level investigations are burdened with events of fate that in agriculture are mainly linked with unstable weather conditions. Minimising the impact of fate on the productivity assessment is guaranteed by testing a group of holdings characterised by similar resources and operating in similar natural and economic conditions. Changes in the productivity of agricultural holdings support the analysis of the results of particular instruments of agricultural policy. Namely, instruments directly affecting production technology, inter alia forcing limitations in the application of the means of production related to the protection of the natural environment are critical from the sustainable agriculture concept perspective.

The measurement of the total factor productivity of all production factors is commonly applied in research on the efficiency of performance of the agricultural sector. The basic definition of total factor productivity corresponds to the relation of the sum of total outputs to the sum of total inputs used in the production process. The application of volumes instead of values in productivity measurement eliminates the impact of price changes. In such cases the measurement of total factor productivity refers to the technical efficiency of the production process and facilitates comparisons among its changes from the dynamic perspective. The most problematic issue related with total factor productivity assessment is related to summing all products and expenditures linked with production. In the case of agriculture the variety of production and inputs is represented with the use of values. Similarly this requires the identification and evaluation of all external results

accompanying agricultural activity. Various methods of evaluation of external results may result here in differentiated values of these results, and consequently influence the limited objectivity of research material[146]. Nevertheless, the testing of total factor productivity assuming the stabilisation of the level of external results may serve as an illustration of changes in the efficiency of management in agriculture in the economic and social spheres[147]. From the perspective of sustainable development, the explicit assessment of the increase of the total factor productivity of agricultural sector requires additional researches illustrating changes in the impact of agriculture on the ecologic and social spheres. Imperfections in the measurement of the efficiency on sector level with the use of total factor productivity include limited options for comparing it dynamics. In case of significant differences in the absolute level of productivity, stronger increase of productivity may not entail higher efficiency.

The measurement of productivity is in opposition to the measurement of the intensiveness of input utilisation. The testing of such indicators as capital intensity, land consumption and labour intensity facilitates the stipulation of trends of transformations in agriculture and the complementation of productivity testing[148]. Calculations of indicators for 1998-2004 for Polish agriculture showed an average improvement in the efficiency of the sector illustrated by an increase in the productivity of the basic production factors, or, conversely, reduction in the capital intensity of production. Improvements in agricultural productivity are usually linked with the application of more effective production techniques, rationalisation of expenditures or biological progress. The comparison of results in Polish agriculture with EU agriculture points to a worse utilisation of the basic production means[149]. In particular, in relation to the EU average, Polish agriculture is characterised by significantly lower land productivity and high energy intensity. Assuming that relatively worse an average natural conditions for agricultural production in Poland only partly explain lover productivity, we may expect improvement of it through changes in agricultural structure, intensified implementation of biological progress and energy saving technologies. Similarly, the high labour intensity of Polish agriculture as compared to the EU shows the need for the labour productivity as a condition for an increase in the incomes in agriculture.

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[146] G. Atkinson et al. (2004), *Framework for environmental accounts for agriculture*, DEFRA, London.

[147] J. Kalińska, W. Wrzaszcz (2007), *Produktywność polskiego rolnictwa w latach 1998-2006*, Roczniki Naukowe SERiA, t. 9, z. 1.

[148] J. Gomułka (2005), *Wyniki ekonomiczne polskiego rolnictwa w latach 2003-2004*, seria „Program Wieloletni 2005-2009", nr 12, IERiGŻ-PIB, Warszawa, p. 23-24.

[149] Z. Floriańczyk (2006), *Polskie rolnictwo w Unii Europejskiej*…, p. 32-34.

The method basing of set of indicators for agriculture performance is used, among others, for the evaluation of sustainability level of agricultural production systems at the European Union level in the framework of the IRENA programme (Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy)[150]. Although in this research the selection of indicators was subordinated to the availability of relevant statistics in different countries, the condition of results comparability was not fulfilled[151]. This is linked mainly with the general nature of "average data" representing agriculture on the level of individual Member States, therefore discarding internal distinctions among regions performance. In consequence, the average values do not exclude the existence of regions where defined standards are not met. Despite these shortcomings, the method based on indicators facilitates direct comparisons of characteristics describing individual areas of sustainability.

Together with methods based on indicators in research on the productivity of agriculture, non-parametric methods are utilised. Data Envelopment Analysis (DEA) is an example of the non-parametric method applied to the measuring of technical efficiency, also with reference to Polish agriculture[152]. Contrary to the total factor productivity measurement method, this method directly compares the results and expenditures of analysed entities indicating effectively-managed units, e.g. characterised by the highest efficiency of input utilisation. The frameworks of this method include Malmquist index enabling the calculation of the total productivity of all production factors[153]. The homogeneousness of the compared entities is one of conditions determining the efficacy of the application of the DEA method[154]. Homogeneousness refers here to the comparability of the production technology of the agricultural sector and similar structure of production input – output. For sectors characterised by strictly different structures of input, ranking them in terms of efficiency under the DEA method is inappropriate, due to calculation procedures. Through the integration of multiple results and expenditures, DEA analysis may be also modified in order to com-

[150] *Environmental statistics and accounts in Europe* (2010), Statistical Books, Eurostat, Publications Office of the European Union, Luxembourg.
[151] This problem will be discussed in the broader sense in a further part of this study.
[152] J. Ziółkowska (2009), *Determinanty efektywności technicznej obliczonej metodą DEA*, „Zagadnienia Ekonomiki Rolnej" nr 3, IERiGŻ-PIB, Warszawa.
[153] R. Färe, S. Grosskopf, M. Norris, Z. Zhang (1994), *Productivity growth, technical progress, and efficiency change in industrialized countries*, American Economic Review, Vol. 84, p. 66-83.
[154] A. Domagalska (2007), *Postulat homogeniczności jednostek decyzyjnych w metodzie DEA. Sugestie teoretyczne a wyniki symulacji empirycznych*, Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań.

plement the assessment of management efficiency with the ecological sphere[155]. In such a case, management results are broadened by the parameter of the costs of a negative impact on the natural environment.

Research on management efficiency, including the sustainability aspect conducted on the level of individual holdings, eliminates the above-mentioned problem of "average data". Here, the assessment of efficiency is the assessment of multidimensional evaluation, considering components of environmental sustainability[156]. The application of scales to individual parameters facilitates direct comparison among holdings and construing the ranking of their efficiency. The ranking of large-scale holdings is an example of the multicriteria assessment of farm performance. Experiences relating to the inclusion in ranking of elements of the assessment of the grade of the environmental sustainability of production proved the problem of the collection of the necessary information and perception of results. The worsening of the situation of a holding listed in the ranking due to harmful for environment structure of production was considered as information irrelevant for management. This was the direct effect of the higher importance of the current market assessment of management results than results not evaluated by the market. According to producers, the low importance of the sustainability of production results from the shifting of resulting, potential advantages over time. Particularly problematic seems to be the future evaluation of natural resources used in agricultural production[157]. Consequently, intervention aimed at the protection of the most precious resources used in agriculture is justified.

The utilisation of calculation data from the agricultural holdings of FADN (the Farm Accountancy Data Network) Network is common in research on the microeconomic level. The parameters of the efficiency assessment of agricultural holdings, directly linked with the economic sphere and indirectly characterising the impact of the holdings on the ecological sphere are used in this type of research. The possibility of making an assessment of the efficiency of management in individual groups of holdings and comparisons among particular states and regions is cited as one of the benefits of the utilisation of unified databases[158]. In the group of research based on data originated from the FADN, re-

[155] R. Färe, S. Grosskopf, C.A. Pasurka (2007), *Environmental production function and environmental directional distance functions*, "Energy", Vol. 32, No. 7, p. 1055-1066.
[156] A. Kagan, J. Kulawik (2011), *Ranking przedsiębiorstw (gospodarstw) rolniczych: istota, konstrukcja i kierunki analizy*, seria „Komunikaty Raporty Ekspertyzy", nr 550, IERiGŻ-PIB, Warszawa.
[157] A. Kagan (2011), *Oddziaływanie rolnictwa na środowisko naturalne*, „Zagadnienia Ekonomiki Rolnej", nr 3, p. 12.
[158] T. Sobczyński (2009), *Wpływ typu rolniczego na zrównoważenie ekonomiczno-społeczne gospodarstw rolniczych UE*, Roczniki Naukowe SERiA, t. 11., z. 1, p. 383-388.

search dealing with the problem of the sustainability of agricultural holdings with the use of non-parametric methods should be differentiated[159]. This type of research facilitates the indication of holdings technically effective considering the basic characteristics of ecological sphere. However, the utilisation of nominal values from FADN data is problematic in research on technical efficiency, which in conditions of fluctuation of prices has an impact on the assessment of management efficiency despite the technical efficiency direction election.

In the light of the cited examples, research on the comprehensive assessment of management efficiency in agriculture, especially in the context of sustainability, is the most useful. This complexity refers here to the combined consideration of different levels and structures of agriculture, as well as the parallel application of several research methods to verify the assessment of performance. The research of the economic results of milk farms conducted by Markus Hermann[160] is an example of the comprehensive assessment of the performance of agricultural holdings considering the level of their sustainability. In this research following parameters were assumed as the descriptive of inputs side:

- total labour input,
- energy consumption,
- inputs of the three basic fertilisers (nitrogen, phosphorus, potassium);
- acreage of agricultural land,
- volume of involvement in capital production.

It should be stressed that due to the fact that some inputs are registered only as estimates in the FADN system, they were converted into physical figures. The corrected net added value (S-WDN) was applied in the specification of the economic results of agricultural holdings. In this case, the adjustment of the standard category of net added value in the FADN system included the additional consideration of labour costs involved in production on agricultural land and interest on the remaining capital.

The sum of the fragmentary values of sustainability for individual inputs for a holding was used in the calculation of the value of holdings' sustainability. The sustainability of individual inputs was calculated by the specification of the share of certain inputs in the creation of the added value of a holding and comparison of the obtained value with the corresponding share of the whole group of holdings tested. As a result, the obtained value of a holding's sustainability cor-

[159] A. Czyżewski, K. Smędzik (2010), *Efektywność techniczna i środowiskowa gospodarstw rolnych w Polsce według ich typów i klas wielkości w latach 2006-2008*, „Roczniki Nauk Rolniczych", Seria G, nr 97/3, p. 3.

[160] M. Ehrmann (2008) *Comparing Sustainable Value Approach, Data Envelopment Analysis and indicator approaches – An application on German dairy farms*, 12th Congress of the European Association of Agricultural Economists, Ghent.

responds to the average values of the tested population. The obtained results facilitate the ordering of holdings according to the efficiency of management associated with the sustainability of production and the features determining their position in the ranking where value higher than one means the higher productivity of tested holding as compared to the average for the group.

The second method of measurement applied in the research of methods of measuring management efficiency is directly related to the DEA analysis. This method uses linear programming in order to record the technical efficiency of individual holdings in relation to effective holdings. The research uses the method oriented towards inputs, where minimising of inputs while maintaining a specified level of production is the objective function.

The third method used in research was based on the system of indicators of the ecological management of land prepared in Thueringer Landesanstalt fuer Landwirtschaft (TLL)[161]. The suggested indicators characterise both the positive and negative impacts of agricultural production on environmental resources, and include the economic and social aspects of agriculture. The research used a narrowed scope of indicators applied in the scope of data collected in the FADN system, e.g. economic and environmental. In the research, indicators characterising the impact of agricultural holdings on environmental resources were standardised according to the scale in which the optimal value of individual characteristics corresponded to the first place in ranking. The tolerance limit was defined for each tested characteristic, based on extreme admissible values. The values exceeding the limits of tolerance were considered as potentially harmful, and their deviation from the optimum was marked with the use of a logarithmic scale, which had a stronger impact on the worsening of an entity's position in the ranking.

The comparison of the obtained results showed significant differences in the classification of holdings depending on grouping and the applied method. In the case of the grouping of holdings according to the economic value and intensity of the production, a similar results for the Sustainable Value (SV) and economic indicators was obtained. In both methods the economic performance of holdings increased in parallel with the size of the holding. At the same time, the results obtained by the application of both methods showed reverse correlations among environmental indicators. However these regularities were not observed in the case of the application of the DEA method, where in a group of holdings characterised by average results, small holdings were included as well as medium-size ones. The grouping of holdings according to their affiliation to areas con-

[161] TLL (2002), www.tll.de/kul-old/use-02.htm and Umwelttestbetriebsnetz Thüringen 2003/04.

sidered as disadvantageous for agricultural production revealed conventional holdings as characterised by worse results as compared to holdings with ecological production. But in the case of areas not classified as disadvantageous for agricultural activity, conventional holdings achieved insignificantly better economic results. Holdings fully situated in areas of disadvantageous conditions for farming were characterised by the lowest productivity calculated according to the SV method, whereas holdings fully situated outside these areas had the highest values. The lower economic results of holdings in the majority situated in areas of conditions disadvantageous for farming were proved in the results of tests with the use of the DEA method. But holdings fully situated in these areas obtained results similar to holdings situated outside these areas. The holdings situated in areas of conditions disadvantageous to farming were characterised by better indicators that characterise the impact of agricultural holdings on environmental resources described by balance of organic matter and the utilisation of pesticides. On the other hand, indicators characterising the economic results of holdings were definitely better than those situated outside areas of disadvantageous conditions for agriculture activity.

The comparison of research conducted with the use of individual methods indicates a convergence between the SV and DEA methods. However, in the case of the assessment of the characteristics of holdings in terms of impact on the natural environment, the results obtained with the use of the holding' sustainability method were significantly different than the remaining methods. According to the authors, the selection of the research method should be subordinated to the analysed problem. In particular, the DEA method does not give an answer to the question on the possible reasons for productivity differences among farms. It facilitates only the indication of better and worse holdings in terms of productivity characterised by arbitrarily-selected features. Therefore selection of output and input factors of production, especially related to social and environmental performance of agriculture is subject to criticism. In this light the application of different methods facilitating the correct process of deduction is recommended.

Another type of complex research is the analysis of the efficiency of management using different databases, and the final assessment is then based on aggregated fragmentary results. In these results, subgroups of agricultural holdings in terms of their physical parameters and features proving sustainability in different spheres may be defined[162]. These researches facilitate in par-

[162] J.St. Zegar (2009a), *Z badań nad rolnictwem społecznie zrównoważonym [8]. Zrównoważenie polskiego rolnictwa w świetle danych statystyki publicznej*, ed. J.St. Zegar, seria „Program Wieloletni 2011-2014", nr 161, IERiGŻ-PIB, Warszawa, p. 7-11.

ticular the indication of problematic areas constituting the base for the programming of agricultural policy.

Summing provided discussion research on the productivity of the agricultural sector most often includes the results and inputs which are the subject of economic calculation. Such investigations serve as the assessment of transformations happening in agriculture in its economic sphere. In research conducted on the sector level, the averaged results do not include the diversity of agricultural holdings. The assessment of the agriculture performance is therefore of a indicative type, and refers mainly to the area of economic sustainability.

The research on agriculture performance regarding the differences in the production intensity and the structure of agricultural holdings is to be considered as obligatory. In these researches economic results are to reflect the current competitiveness of agricultural holdings shaped by market mechanisms. While market mechanisms forcing the concentration and specialty of production, we may expect significant differences in production technologies applied among different groups of farms. Therefore the application of non-parametric methods for productivity research is limited to group of farms according to their specialisation.

Monitoring of ecologic and social performance of farms with the use of specific indicators is to complete the measurement of farm productivity. In these spheres of sustainability, pro-development processes refer to the long-term efficiency partially assessed by market mechanisms. The efficiency of agriculture in the social and economic spheres may be thus associated with its potential to compete in the future periods. This requires combination of traditional measurements of technical productivity with indicators illustrating the grade of sustainability in the ecological and social spheres.

3. Productivity and sustainability of agriculture in development strategies

The productivity and sustainability issues are essential part of contemporary strategies for national and regional development. These two issues are differently addressed depending on stage of development and aggregation level of strategy. The aggregation level correspond to space or sector scope of strategy. Usually space related level of aggregation bases on geographical stratification of country. On the other hand sectoral stratification links strategy with economic activities that are of critical importance for whole economy.

The stage of development refers to overall performance of economy and social structures either of region or country level. Development challenges are defined here according to the recent and expected development limitations and social needs. Concerning the food sector the provision of food security and safe-

ty are commonly recognised as critical however the qualitative issues are of growing importance with the general development stage.

The type of strategy defines indicators to monitor problems and effects of policies supporting requested direction of development. From the applicative point of view they characterize scope of indicators as for agriculture performance measurement. Therefore analysis of the recent strategies related to agriculture development will characterise desired measures of productivity assessment in line with sustainable development.

The post-war strategies of economic development for European countries perceived development of the agricultural sector from the food production stimulation perspective as the basis for securing food availability. The importance of the restoration of the productive potential of agriculture in Western Europe was reflected in the Treaty of Rome establishing the European Economic Community, where agriculture was interpreted as the EU economy sector securing the self-sufficiency of the Community in the field of agricultural production[163]. Increase of productivity of agriculture was supported by different forms of direct support, and the policy for guaranteed prices. Simultaneously, individual states were stimulating the technical development of agricultural holdings through the support of investments and the implementation of modern technologies in agriculture. Similar economic objectives were assigned to the agriculture of Eastern and Central European countries. However in these countries, the restoration of agricultural production was based mainly on own resources of agriculture sector while part of the economic surplus generated in agriculture was supporting the development of other sectors of the national economy[164]. Consequently, in certain periods low investment in Polish agriculture resulted in decreases in agricultural production.

In Western European countries, with the achievement of agricultural production meeting food self sufficiency, the pressure on the improvement of the economics of food production was increased. Further growth in subsidised production has become unjustified, particularly in the face of more intense problems with the growing of food surpluses being non-competitive on the global market. Limitations in production support implemented in the following years were to provoke growth in the economic efficiency of European agriculture by means of the liberalisation of agricultural production and the improvement in

[163] www.polskawue.gov.pl/files/polska_w_ue/prawo/traktaty/Traktaty_rzymskie.pdf – *Traktaty Rzymskie*, Artykuł 39.
[164] M. Pohorille (1966), *Rozwiązanie problemu przeludnienia agrarnego w świetle doświadczeń Polski* [w:] *Rolnictwo a wzrost gospodarczy*, ed. A. Muller, A.Woś, PWRiL, Warszawa, p. 206-208.

agricultural structures[165]. Limitations in the development of production caused increased problems of profitability in European agriculture that, despite support, has guaranteed parity incomes only in a few countries[166]. At the same time, the new challenges facing the European economy have strengthened the need to review the perception of European agriculture.

The basis of the current economic policy of the European Union was stipulated in the Lisbon Strategy pointing to the need to increase the competitiveness of the EU economy. Ultimately, the strategy was to lead to the transformation of the EU economy to the most-competitive level and with the highest growth dynamics[167]. The improvement in the development of economic areas based on knowledge, in combination with the maintenance of sustainable economic growth, were to serve this purpose. It should be stressed that the strategy's concept was formulated in a period of relatively high unemployment and slower economic growth in Europe compared to the main competitor, also in agricultural production – the North American economy. The Lisbon Strategy differentiated three pillars for which separate, detailed objectives were specified. In the first pillar, the detailed objectives included the achievement of the competitiveness of the EU economy, the improvement in the dynamics of economic growth, the development of economic spheres based on knowledge, and the restructuring of internal markets. The second pillar of the strategy was related to the social aspects of the EU economy, where the key was the development of the quality of human resources and the prevention of social exclusion. In this sphere, social consistency was the priority objective, but activities promoting employment were mostly intended to serve the elimination of poverty and social exclusion, rather than direct action supporting the incomes of the poorest citizens of the EU. The third pillar stressed the need for the ecological balancing of the EU economy and the strengthening of the protection of natural resources. The above-mentioned detailed objectives indicate the need for differentiating the assessment of the productivity of the EU. Apart from the traditional quantitative assessment relating to the comparison of production volumes and expenditures, it became necessary to include parameters describing the quality of production process in economy performance assessment.

The universal nature of the Lisbon Strategy, assuming the need for the implementation of the three pillars of sustainability in the majority of sectors of

[165] M. Wigier (2004), *Przyczyny i charakter zmian polityki strukturalnej w rolnictwie integrującej się Europy*, seria „Studia i Monografie", nr 124, IERiGŻ-PIB, Warszawa.
[166] Z. Floriańczyk (2003), *Charakterystyka instrumentów Wspólnej Polityki Rolnej oraz ich wpływ na dochody rodzin rolniczych*, IERiGŻ, Warszawa.
[167] Lisbon Strategy evaluation document (2010), Commission staff working document, SEC(2010) 114 final, Brussels, 2.2.2010.

the national economy, met the requirements of the development of European agriculture. In particular, in terms of the first pillar, the continuation of the process of the liberalisation of agricultural production, leading to the optimising of production in terms of its structure and quantity, was justified. Similarly, the farmers and inhabitants of rural areas were among the addressees of the second pillar, due to different income levels and the worse access to the attributes of civilisation. Considering the close relationship of production and the use of environmental resources, agriculture was also perceived as one of the main sectors of the economy in terms of it potential in the field of sustainable management of ecological resources.

The assumptions of the Lisbon Strategy were reflected in the reforms of the Common Agricultural Policy that gradually eliminated connections between the level of support of agriculture and agricultural production simultaneously decreasing the scope of intervention on the market for agricultural products[168]. The structure of programmes of support for investments in agricultural holdings to larger extent promoted holdings characterised by development potential, as well as towards the adjustment of production profile to market needs. Support for agricultural activity for the benefit of the natural environment and the qualitative requirements of agricultural production was also strengthened. In the light of guidelines for the support of rural areas in Member States, the measurement of the productivity of agriculture should refer to economic results and the positive impact on the natural environment. On the other hand, productivity in terms of the realisation of the social aspects of development specified in the Lisbon Strategy was related to the improvement in the quality of lives of the inhabitants of the countryside, where the level of incomes of rural population was one of the elements. In this sense, the realisation of strategy assumptions as related to agriculture was formally broadened to include rural areas while stressing the need for the restructuring of the agricultural sector.

The performed evaluation of the Lisbon Strategy proved its inefficiency in the realisation of assumed objectives, which was reflected by the lower-than-presumed economic growth, including sectors considered as priority, and increasing the problem of unemployment. The plurality of objectives and priorities was cited among the reasons for the failure of the strategy that often collided with each other[169]. These remarks may be referred directly to agricultural policy, where instruments supporting extensification were listed aside mechanisms aimed at in-

[168] Council Regulation (EC) No. 1259/1999 of 17 May 1999 establishing common rules for direct support schemes under the common agricultural policy, p. 80.
[169] W. Kok (2003), *Enlarging the European Union. Achievements and Challenges*, European University Institute, Robert Schuman Centre for Advanced Studies.

creases in the productivity of agriculture through the intensification of production. In this sense, the policy for the development of agriculture and rural areas turned out to be ineffective as far as balancing the conflict between increased market productivity and the sustainability of agricultural production is concerned.

The revision of the Lisbon Strategy revealed the need to choose and be precise on the key priorities that would be the central element of the process of the coordinating of the economic policy of the EU. According to the assumptions of the renewed strategy, the growth in the economy and employment considered as priority was to be realised through increases in the attractiveness of the European economic space for investment and the support of widely-interpreted innovation. On the other hand, economic growth is linked with investments in education, and the development of science was to lead to an increase in the number of jobs in developmental sectors. The assessment stressed the need for the acceleration of the implementation of modern technologies in the EU economy, determining the level of competitiveness. But modern technologies are identified as the quantity and quality of applied innovations leading to an increase in the efficiency of the EU economy.

The assumptions of the modified Lisbon Strategy had an influence on the structure of the EU agricultural policy. In the reform of the Common Agricultural Policy of 2005, the objectives and scope of aid for the development of agriculture and rural areas with the definition of the three key areas: the agri-food economy, the natural environment and the widely-interpreted rural economy[170]. The programme considered as justified the concentration of efforts to improve the competitiveness of agriculture and forestry, the natural environment and rural areas, as well as the quality of life in rural areas. The process of the restructuring of agriculture by stressing its innovative nature was the basis of the competitiveness of agriculture. On the other hand, the land economy was to contribute towards an increase in the attractiveness of rural areas and the protection of environmental values. As far as the quality of life in rural areas is concerned, support for the diversification of economic activity was strengthened. Taking the above-mentioned trends in support as markers of efficiency in the management of agriculture and rural areas, the assessment of agricultural productivity in the economic sphere gained a qualitative character, referring to structural changes in agriculture, and the type of technologies applied in the process of its restructuring.

The economic crises of recent years proved the correctness of the selection of the basic objectives of the Lisbon Strategy, namely the stimulation of economic growth and increase of employment. However, it stressed the weak-

[170] Council Regulation No. 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

ness of solutions implemented for the prevention of the negative consequences of the global economic crisis. As a consequence, economic growth and the ending of the increase in employment have become the keys for the current EU development strategy: *Europe 2020 – A strategy for smart, sustainable and inclusive growth*[171]. In the new strategy, the smart, sustainable and supporting social inclusion growth was added to the three main priorities of the economic growth of Europe. The concept of smart development includes the continuation of the need for strengthening sectors of economy based on knowledge and the promoting of innovation. The sustainable-development priority has underlined the need to transform the economy towards technologies more friendly to the natural environment. An increase in the efficiency of the utilisation of resources, especially non-renewable, would lead directly to the strengthening of the competitiveness of the EU economy in the face of shrinking resources of traditional raw materials. Priorities in the area of social development would stress the need for economic development towards high employment, and securing social and territorial cohesion. The strategy underlined the need for the collaboration of Member States for combating the crisis and the implementation of reforms enabling the addressing of challenges connected with globalisation, the ageing of society and the rational utilisation of environmental resources. The strategy took on a twofold approach to the active functioning of the European economy in the management of global natural resources and combating climate changes[172]. On the one hand, the strategy guaranteed preferences for clean and low-carbon technologies. In the strategy the process of the transformation of the European economy through the implementation of energy- and material-efficient technologies works as an engine for economic growth. But improvement in efficiency resulting from the limitation of the current expenditures involved in the production process should be the effect of modernisation investments in this field. The emission of greenhouse gases, considered as the reason for climate changes, was listed among the predictable results of the modernisation of the economy. In this sense the limitation of this emission indicates concern about environmental resources and investments aimed at the improvement in the social quality of life, also in future periods. For modern agriculture, production technologies friendly to the environment determine the speed of crop growth, thus influencing the limitation of pressure to enlarge the resources of agricultural land in order to in-

[171] *EUROPE 2020. A strategy for smart, sustainable and inclusive growth* (2010), The European Commission, Communication from the Commission, COM (2010) 2020 final, Brussels.
[172] *A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy* (2011), The European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM (2011) 21 final, Brussels.

crease agricultural production[173]. Technical and biological progress was listed among the preferred trends in technological transformation, at the same time indicating a positive impact on the limitation of the emission of greenhouse gases from agriculture. The bio-based economy formula is applied in the biological progress according to which progress would be based on own biological resources and be subordinated to sustainable production rigours[174]. Such progress also requires an increase in research efforts in the field of agriculture and biotechnology and the intensification of the transfer of innovative solutions and knowledge to agriculture.

Considering the above, apart from monitoring of productivity, the assessment of the efficiency of agriculture should take into account changes in the quality of the production process proving its sustainability and innovative nature. The combination of these last two parameters of assessment comes down to the convergence of transformation processes, agriculture in this case, with the green-growth concept[175]. The distinction of incremental innovation, disruptive innovation and systemic innovation is important for this assessment[176]. Incremental innovation, e.g. not requiring changes in production technology, and relying on its modification in order to lower the pressure on the natural environment are the most common in agriculture, as significant investment expenditures are not necessary here. Similarly, disruptive innovation utilises current technology replacing certain processes with new solutions leading to desired improvements in production processes. Systemic innovations involving complete changes in production technology as referred to agriculture are based on the achievements of external sectors. This is related to the fragmentation of entities in agriculture and their limited options for the self-financing of developmental research. On the other hand, the higher mobility of small and medium-sized entities for the implementation of the new technologies makes agriculture more susceptible to the implementation of systemic innovations as compared to other sectors of economy. In this light, systemic innovations are of the nature of an investment leading to the higher quality and efficiency of the production process, as compared to incremental and disruptive innovations. However, the effects of the former are indeed significantly delayed in time, which should be taken into account in the assessment of results of their implementation.

Similarly to the Europe 2020 strategy, the development of Polish economy in the next decades is considered from the perspective of its sustainability.

[173] Ibidem, p. 21.
[174] OECD (2009), *The Bioeconomy to 2030: designing a policy agenda*, p. 15.
[175] OECD (2011), *Fostering Innovation for Green Growth*, Green Growth Studies, p. 19-20.
[176] Ibidem, p. 19-20.

In the proposal of the long-term strategy of the national development *"Poland 2030. The third wave of modernity"*, a simultaneous strive for the strengthening of the cohesion and competitiveness of the economy were considered as fundamental[177]. In these aspects, the need to strengthen territorial cohesion, generational solidarity and innovation were differentiated. Among pro-development activities, special attention was drawn to the reallocation of public expenditures on the education, health, transport and communications infrastructure, and natural environment, research and development, as well as culture.

As far as the agricultural sector is concerned, the broadening of the function of rural areas in the economy was pointed to as a determinant of trends in the modernisation of agriculture. The modernisation of agriculture is linked here with structural transformations that should lead to the concentration of agricultural production. Production concentration should facilitate the application of more efficient technologies resulting in the growth of unitary production output. At the same time, considering the development of non-agricultural jobs, concentration gives opportunities for the maintenance of the productive potential of agriculture, and keeping the level of agricultural production, guaranteeing food security. The promotion of the production and consumption of high quality food was included in elements strengthening Polish food security.

In the strategy for the national development, first place was granted to functions of agriculture in the field of food security perceived through the prism of growth, especially the high quality of production. The issue of production sustainability refers here mainly to the maintenance of the productive potential of agriculture, but economic potential for development of rural areas in non-agricultural sectors is underlined. Summing up, the sustainable development of agriculture and rural areas focuses on the economic, social, and, indirectly, the ecological spheres, with general economic guidelines indicating technical progress as the driving force behind transformations in agriculture. In such a case, the assessment of efficiency of agriculture stresses the issue of technical productivity and changes in the structure of production. At the same time, sectoral assessment should be broadened by spatial assessment of rural areas.

The long-term strategy for the national development indicating the need for the improvement of environmental conditions in general economic development refers to the ecological sphere of the sustainable development of agriculture. The integrated management of the resources with the use of low energy technologies, spatial planning, management of valuable natural land, as well as the stimulation of adaptive solutions to climate changes, and moderate intensifi-

[177] *Polska 2030. Trzecia fala nowoczesności. Długookresowa Strategia Rozwoju Kraju* (2011), Kancelaria Prezesa Rady Ministrów, Warszawa, p. 9.

cation of production activities defines the direction of transformations in agriculture and the assessment of its efficiency. The basic measurements here are indicators of intensiveness of energy, energy-saving technologies implementation and balances of interaction of agriculture inputs on natural environment.

Contrary to the dominance of the economic sphere in the National Development Strategy, the development of Polish agriculture in proposal of *Strategy for Sustainable Development of Rural Areas, Agriculture and Fishery*, prepared by the Ministry of Agriculture and Rural Development, refers directly to all areas of sustainable development[178]. The spatial nature of the Strategy points to agriculture as one of the main economic activities utilising resources of rural areas. The improvement in the quality of the lives of inhabitants of rural areas assumed as the main goal of the development of Polish agriculture indicates preferences for sustainability in the social sphere and the simultaneous strengthening of public goods linked with the rural economy.

The detailed objectives enumerated in the strategy referring to economic sustainability underline the necessity for increases in the productivity of the agri-food sector. The following are named among trends in activities aimed at increases in productivity[179]:

- modernisation and increases in innovation in the agri-food sector;
- the creation and transfer of knowledge or technology aimed at the sustainable development of the agri-food sector;
- the adjustment of structures of the agri-food sector to changing challenges in Poland, the EU and on the global scale;
- the promotion and enlargement of sales markets for agri-food products.

The modernisation of the agri-food sector is perceived mainly through the prism of improvements in production infrastructure, the implementation of innovative solutions, the betterment of work conditions and higher involvement by manufacturers in the trends of developmental research. Apart from the impact on the economic and social sphere through privileged technical solutions friendly to the environment, the modernisation of the agricultural sector refers to challenges in the ecological sphere. Typically, modernisation activities underline the diversification of the structure of agricultural holdings and entities in the food industry. The adjustment of activities aimed at the improvement of productivity to the potential and the possibilities of development of respective groups of agricultural holdings points to the need for keeping the diversity of entities as an element of sustainability in the social and economic spheres. In this light,

[178] *Strategia Zrównoważonego Rozwoju Wsi, Rolnictwa i Rybactwa* (2011), wersja z 15.06.2011 r., MRiRW, Warszawa, p. 20.
[179] Ibidem, p. 23.

structural transformations in the agri-food sector named in the strategy are of a complex nature and include the transformation of agricultural structures, as well as the organisation of manufacturers. The betterment of the production base structure of agricultural holdings, e.g. through the integration of land, preferences for young farmers and support for different forms of agricultural manufacturers' organisation are assumed as priorities in this respect. On the other hand, creation and transfer of knowledge to the agri-food sector have an indirect impact on all spheres of sustainable development, with the dominant role of agricultural counselling in the transfer of scientific achievements to agriculture. Improvements in productivity, especially in agriculture, are linked to the implementation of biological progress and modern biotechnologies. The preferred forms of activities in this area include the promotion of clusters, parks and technological platforms that could play an active role in the creation and transfer of knowledge to the agri-food sector. Support for the promotion of agri-food products contributes to the development of the economic sphere forming demand.

In the ecological sphere, the strategy underlines the importance of the protection of resources, soil and water through the rational economy in fertilisers and pesticides, soil protection against erosion, acidification, falls in the content of organic matter and contamination with heavy metals. The simplification and popularising of good agricultural culture, and stimulating desired activities through direct payments, as well as the implementation of solutions in the area of changes in technology and the structure of production corresponding to challenges linked with global climate warming, are to contribute towards the preservation of quality and the production potential of soil. In agriculture, the popularising of crops more resistant to drought and flooding, the implementation of effective mechanisms of risk management in agricultural production, as well as changes in agri-techniques as a response to shifts in the vegetation period, are particularly desirable in this field. In this light, the assessment of efficiency of developmental processes in the ecological sphere is of a qualitative nature. The qualitative aspect refers here to compliance with boundary conditions defining the scope of applicable production technologies, and observing production regimes and structure. The strategy points to the need for higher utilisation of agricultural resources for the production of renewable energy sources. The necessity of keeping the productivity of soil and neutrality towards food security are conditions limiting the development of this type of production. In this area, activities enabling the simultaneous utilisation of biomass energy and the remaining organic substance for the fertilisation of soil in order to preserve its production capacity will be particularly supported. The assessment of the efficiency of agriculture refers here to its function in support of the power security of the

economy. The utilisation of resources, especially agricultural land for biomass production, cannot influence their limitation in food production.

Presented strategies have direct impact on the direction of development and productivity of Polish agriculture. They combine productivity and sustainability issues, however differently emphasising economic, social and ecologic functions of agriculture and rural areas. The issue of productivity of agriculture production that traditionally was linked with food security gained importance as a base of competitiveness of agriculture production. Economic sustainability of European agriculture is therefore linked with ability to compete on world food market and following maintain level of production that secure provision of food. Policies supporting competitiveness of the European agriculture on world food market stresses the necessity of implementation of modern energy and input saving technologies. Similarly productivity growth is connected with bio-technologies that together would result in reduction of negative impact of agriculture production on environment. Together with promotion of environmentally friendly practices they are to support ecologic sphere of agricultural sustainability. The improvement of rural population quality of live correspond with social sphere of sustainability. However development of non – agricultural economic activities are recognised here as a motor of rural population incomes improvement.

The national strategies recognise the sustainable development of Polish agriculture through modernisation and moderate intensification of production that would directly effect on improvement of agricultural incomes. Transformation of Polish agriculture toward industrial type is justified with lower productivity of resources used in agriculture. However this process should not be harmful for farm diversification that is consider as an element of sustainability. Similarly preferential support for young farmers is to preserve sustainability of farms from their existence perspective. Sustainability in ecologic sphere together with environmentally friendly practices are to be meet with the support of boundaries on the level of input use and natural productivity of land conservation.

4. Indicators of productivity and sustainability for Polish agriculture

The issues of productivity and sustainability of agriculture sector while of complex nature are subject of strategic policies. The market competiveness regulate the issue of productivity improvement in economic sphere, however discarding external effects that are critical component of sustainability. Therefore the development policies are to insure sustainability in ecologic and social spheres and supporting market orientated productivity improvement. The differences between the level of agriculture development between Western European and Polish agriculture are of historical background and respectively linked with

attributes of market and central economy. However the globalisation process creates equal environment that prefers market orientated economies despite their level of development. The implementation of modern technologies in agriculture are recognised as a basis for productivity improvement on EU and Polish agriculture level. Efficiency of these technologies are justified through lower demand for inputs and energy accompanied with production growth thanks to biotechnologies. EU level preferences for less intensive agriculture techniques are questionable in case of Polish agriculture that challenging adjustments of farm structures. Here moderate concentration of production is necessary for modern technologies application designed for larger scale operations. Consequently the improvement of incomes of farming population is expected due to higher productivity and scale of production. Modern technologies that are of positive impact of natural resources conservation are preferable that support sustainability in ecologic sphere.

Promising methods to measure agriculture productivity on sector level bases on general indicators related to critical from the sustainability point of view factors of production. Namely indices of partial productivity of input like energy and fertilisers are useful for assessment of competitiveness of agriculture production between countries. These however are of economic importance and long term ability to maintain technical advantages. Similarly average productivity of agricultural land is to provide information of the economic performance of agriculture and ability to create value of market production. Methods related to total factor productivity assessment and input intensification are to provide indicative values of sector performance and dependence on scare resources.

The assessment of farms productivity in case of Polish agriculture should be conducted with combined methods to indicate best performing units in different categories of farms with respect to their sustainability level. Namely combination of indicators describing level of farm sustainability with DEA method are most promising in assessment of farms productivity and sustainability. Following national strategies recommendations the investigation of farm productivity should take into account diversification of Polish farms and their scale of operation that is optimal form the modern technologies application and possible structural changes monitoring. Farm productivity investigation is to be accompanied with assessment of their ability to maintain land natural productivity and impact on environment. This allows for monitoring their performance from ecologic sphere perspective. On the other hand assessment of human capital level and structure of incomes are to support measurement of performance form social and economic sphere perspectives. Diversification of incomes are critical from the sustainability of small farms perspective and farms of high human capital should generate adequate incomes to be competitive with other sectors of economy.

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