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INDICATORS OF SUSTAINABLE DEVELOPMENT FOR AGRICULTURE

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ИНДИКАТОРЫ УСТОЙЧИВОГО РАЗВИТИЯ СЕЛЬСКОГО ХОЗЯЙСТВА

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ІНДИКАТОРИ СТАЛОГО РОЗВИТКУ СІЛЬСЬКОГО ГОСПОДАРСТВА

Abstract. Sustainability in agriculture is a complex concept and there are a lot of methods and scholars for its measuring. Advantages and disadvantages of different estimation system were considered and some of indicators were analyzed. "Feed-back" approach was offered to improve the methods of sustainability estimation.

The main difficulty in measuring and monitoring of agricultural sustainability is that it is a rather dynamic than a static concept with long-term correlation. There are different systems of and approaches for monitoring starting from high level international organizations (The World Bank, UN, OECD etc.), regional and state systems, and variety of researches by the topic.

But the main critical issues of them are that indicators of sustainability are not considered in pair resource-result. The "feedback" approach was proposed by reviewing principles of sustainable development estimation in agriculture. A key idea of the "feedback" approach is to define a correlation between recourses and effects. The system of indicators helps estimating the correlation in the boxes Financial and Material Resources, Human Resources, Environmental Resources and appropriate effects.

Some indicators were estimated and monitored using official database, but there is a lack of information in environmental and social part of estimation system. Therefore, to give politicians and researches a background for decision-making on agrarian policy the system of state statistic can be improved by adding some sustainable development indicators in agriculture.

Keywords: agricultural sustainability, measuring system, sustainability indicators, resources and effects

Introduction

Ukraine confirmed the importance of global Sustainable Development Paradigm and the official willingness to observe its principles in 1992 on Rio Earth Summit. During more than 20 years, Ukrainian policy has been drifted and it is time to measure its achievements towards the sustainability, especially in the context of EU integration process. Sustainable development has been defined in many ways, but the most frequently quoted definition is from Our Common Future, also known as the Brundtland Report: «Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs» [1, p. 43]. The principles of sustainability should be integrated vertically (state government – local government – business and households) and on horizontally level (by fields of economy). The core point for reach the sustainability is to resolve the conflict of interests between economic, social and environments goals. Agriculture is

the sector of economy, which plays the special rule in making and solving such conflict.

Researches in Sustainable Agriculture, Sustainable Rural Development, and Sustainable Land Management try to answer the question: «How combine the interest of farmers, local communities and food corporations to improve the quality of life, to save the rural style of life and to solve the global food problem?» For any study of sustainability in agriculture, the start point is how to estimate its level and tendency combining economic, social and environmental criteria. There is no standard estimation system because the local specific of agriculture, particularities of statistical services in different countries and different viewpoints about the system of indictors.

The main objective of this article was to define the tendency of Ukrainian agriculture according the Sustainable Development Principles, reviewing the criteria of agricultural sustainability accepted by international organizations and proposed by researches. It should be declared that the research did not take into account the methods for micro level estimation, which could be use in farm management.

Methods

The main functions of any indicators are simplifying, clarifying and making arranged information for decision-making. There is the list of indicators' sets for sustainable development estimation (Adelle, Pallemaerts 2009). [2] Not all of them can be used in agriculture. Some of the sets include only environmental or resource productivity aspects in this sphere.

On the international level, the most common and widely used are indicators developed by UN Commission on Sustainable Development, which includes 14 themes, 50 core indicators and 96 sub-indicators (UNCSD 2009). Sustainability in agriculture measures by the core-indicator «Arable and permanent cropland area» and sub-indicators: efficiency of fertilizer using, using of pesticide and area under organic farming (theme «Land», sub-theme «Agriculture»).

OESD has been implementing the system approach for evaluation sustainability. Environmental indicators include more than 50 core position; sectoral environmental indicators (transport, energy, household consumption, tourism, agriculture); indicators derived from environmental accounting; decoupling environmental indicators. 34 countries are included in monitoring system by the agri-environmental indicators: index of agricultural production, index of crop production, index of animal production, arable land, and land used for crop production, grassland, percentage of arable land in total area of the country, using of fertilizers, soil degradation, and soil balance by elements.

OESD is also the founder of Global Project in Measuring the Progress of Societies (Istanbul Declaration 2007) and Work on Material Flows and Resource Productivity (OECD, 2008). The first project aimed to monitor the progress of societies in democracy and citizens' wellbeing. The second one implements the 3R policy (Reduce, Reuse and Recycle) in resources management.

Eurostat's SDIs have been specially designed by the European Commission to monitor the progress on sustainable development. There are more than 100 indicators divided into 10 groups. However, agriculture is not the topic of investigation. To

compensate this gap the Indicator Reporting on the Integration of Environmental Concerns into Agricultural Policy (IRENA) was founded in 2002. IRENA consists of over 35 indicators about areas involved in agriculture, consumption of pesticides, emission of methane and nitrous oxide, population trend of farmland birds, agricultural share of water use.

Taking into account the willingness of Ukraine to move towards European Union, it is very important to implement EU's and international vision of sustainable development estimation. Mentioned above indicators are needed to be supported by appropriate and reliable statistical information.

Various parameters for measuring agricultural sustainability have been proposed by scholars. All of them in different way include three components – social, economic and environmental. The database of the State Statistic Service of Ukraine were examined and compared with the parameters of sustainable development mentioned in the different scholars' classification (Hayati et al. 2010).

The World Bank accumulates the information about countries' development indicators and among them, there is the topic «Agriculture and Rural Development», which include more than 20 indicators (Table 1).

Among positive tendencies for Ukraine are the increasing:

- the productivity of Agriculture in economic sense (per worker);
- the cereal yields (but it can be much more higher, taking into account the quality of soil and climate conditions);
- assess to the improved water source for rural people.

The negative tendency are the next ones:

- small level of crop and especially livestock production indexes;
- decreasing of rural population more than 3 billion for 20 years;
- decreasing the part of Agriculture in total GDP.

The World Bank database gives researchers and politicians the information for comparing countries in dynamics and by groups, but it is difficult to define the causal connections in sustainable development tendency. So the methods of estimation can be improved.

Results

The «feedback» approach was proposed by reviewing the principles of sustainable development estimation (Fig. 1).

The list of parameters was defined to estimate the indicators by categories of resources and effects (Table 2). To clarify the system's connections the indicators were situated in pairs «resources – parameters». All mentioned indicators can be monitored and the tendency by each criterion should be defined.

The main idea of «feedback» approach is to define the correlation between recourses and effects. Nevertheless, using the official statistic, we could estimate only some of indicators in pairs [3]. Therefore, it was fond the correlation indexes between amounts of investment in agriculture (economic resources), GDP and profitability of agriculture (economic effect), number of employees (social resources), job productivity and salary dynamics (economic and social effect).

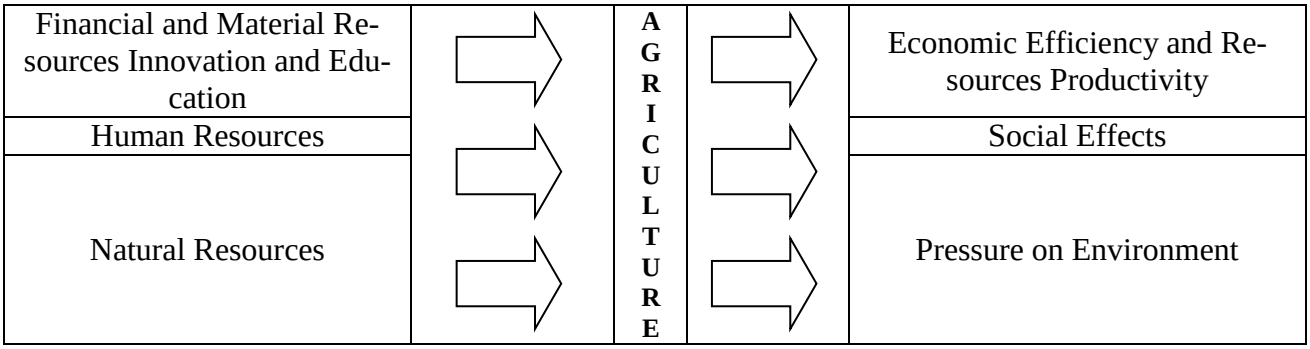

Fig. 1 – Criteria of sustainable development – «feedback» approach (developed by the author)

Table 1 – Some indicators of «Agriculture and Rural Development» of the World Bank Database for Ukraine (designed by the author) [2]

Indicators	1992	2002	2012	Maximum/minimum of indicators, 2012
Natural resources involved in Agriculture				
Land area, sq. km	579320			Maximum: Russian Federation 16376870
Agricultural land, % of land area	72.4	71.5	71.3	Minimum: Singapore 1, maximum: Uruguay 87.2
Arable land, % of land area	57.6	56.2	56.1	Maximum: Bangladesh 59.0
Arable land (hectares per person)	0.64	0.68	0.71	Maximum: Australia 2.07
Agricultural irrigated land, % of land	…	…	5.2	Maximum: Japan 34.7
Material resources				
Agricultural machinery, tractors per 100 sq. km of arable land	153	124	…	…
Fertilizer consumption (kilograms per hectare of arable land)	…	15.9	41.3	Maximum: Qatar 12088
Productivity of Agriculture				
Cereal yield (kg per hectare)	2834	2750	3185	Maximum: United Arabic Emirates 73107
Crop production index (2004-2006 = 100)	99.4	88.5	136.2	Maximum: Mongolia 291.5
Livestock production index (2004-2006 = 100)	171	103	100	Maximum: Bahrain 242.8
Social indicators				
Rural population, billions	17.3	15.8	14.1	Maximum: India 845,510
Rural population (% of total population)	33	33	31	Maximum: Trinidad and Tobago 91
Employment in agriculture (% of total employment)	21	21	17	Minimum: Argentina 1, Maximum: Bhutan 62
Improved water source (% of rural population with access)	…	93	98	Minimum: Congo 29
Economic results				
Agriculture, value added (% of GDP)	20.4	14.6	9.3	Minimum: Qatar 0.1, Maximum: Sierra Leone 56.7
Agriculture value added per worker (constant 2005 US$)	1760	2354	4375	Minimum: Burundi 129, Maximum: Slovenia 133663

Table 2 – Indicators of sustainable development in agriculture (developed by the author)

Criteria of resources involved (input)	Indicators	Criteria of effects (output)	Parameters
Financial and Material Resources	Total value of assets involved in Agriculture	Economic Efficiency and Resources Productivity	GDP in agriculture, in plant-growing and animal production
	Investments in Agriculture (per 1 ha)		Profitability in Agriculture
	Costs' structure by kinds of material resources (fuel, electricity, chemicals) – per 1 ha or per unit of product		Production of Agricultural products by kinds (per capita, per 1ha)
Human Resources	Amount of person, involved in agriculture	Social Effects	GDP per person, involved in Agriculture
Human Resources	Labour hours in agriculture	Social Effects	Productivity of labour hours
	Salary's share in costs of agricultural products		Average salary (income) in Agriculture and correlation between productivity and salary
Natural Resources	Total cultivated area by types of using (crop production, grassland, gardens)	Pressure on Environment	Percentage of cultivated area with erosion; Balance of phosphorus and nitrogen on cultivated areas; Amount of humus in soil
	Amount of irrigation water used per unit of land		Efficiency of irrigation; Water balance and quality of ground and underground water
	Using of environmentally friendly technologies		Area of organic farming and its efficiency; Alternative energy in agriculture; Waste in agriculture and its recycling

The high level of correlation (0,855) was determined in pair investment and GDP in Agriculture. Science 2008 investment in Agriculture increases on 2.7 billion of UAH and GDP on 14 billion of UAH (according with the equitation – Fig. 2).

At the same time, correlation between investment, profitability and GDP in Agriculture is not evident. So, the financial result of agricultural activity is influenced by other factors.

Also there is the strong correlation between productivity in Agriculture and salary – index of correlation 0.981. The positive tendency is the increasing the level of salary in Agriculture (Fig. 3).

According with Table 2 and taking into account the ability of official statistic database, we cannot estimate all proposed indicators of environmental box. Only some figures about fertilizer using are available (Fig. 4).

One of the base principle of sustainable development in agriculture is land protection and soil quality saving. And one of the indicators of this process is responsible using of fertilizers. And there is very dangerous tendency in Ukraine – reduction of fertilized land, especially by organic fertilizers. In 1990 the level of agricultural land fertilization was 63.8% by mineral fertilizers and 13.3% by organic ones. In the 1996

the level was 20 and 5 % accordingly. There is no strong correlation between level of fertilization and crop yield, nevertheless such reduction in using of fertilizers, especially organic ones has destroyed impact in long-term perspective.

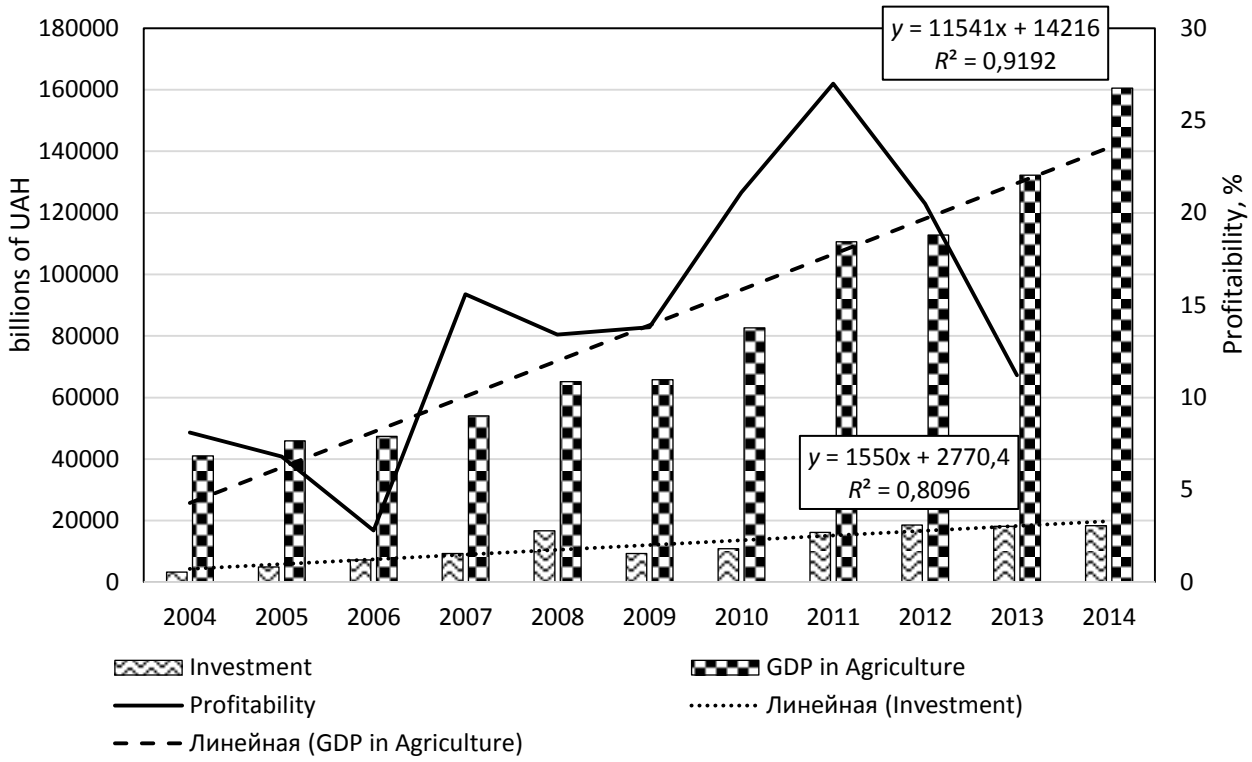

Fig. 2 – Dynamic of economic indicators of sustainable development (designed by author by the official statistic [3])

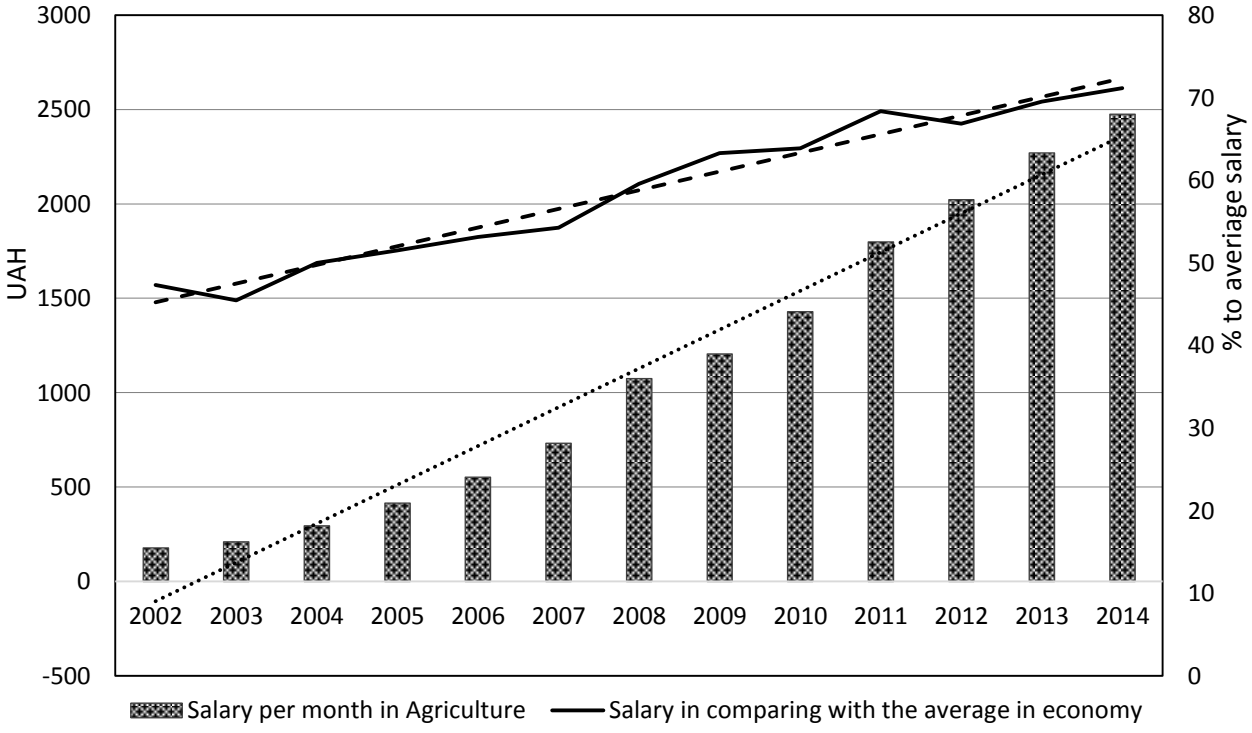

Fig. 3 – Dynamic of social indicators of sustainable development (designed by author by the official statistic [3])

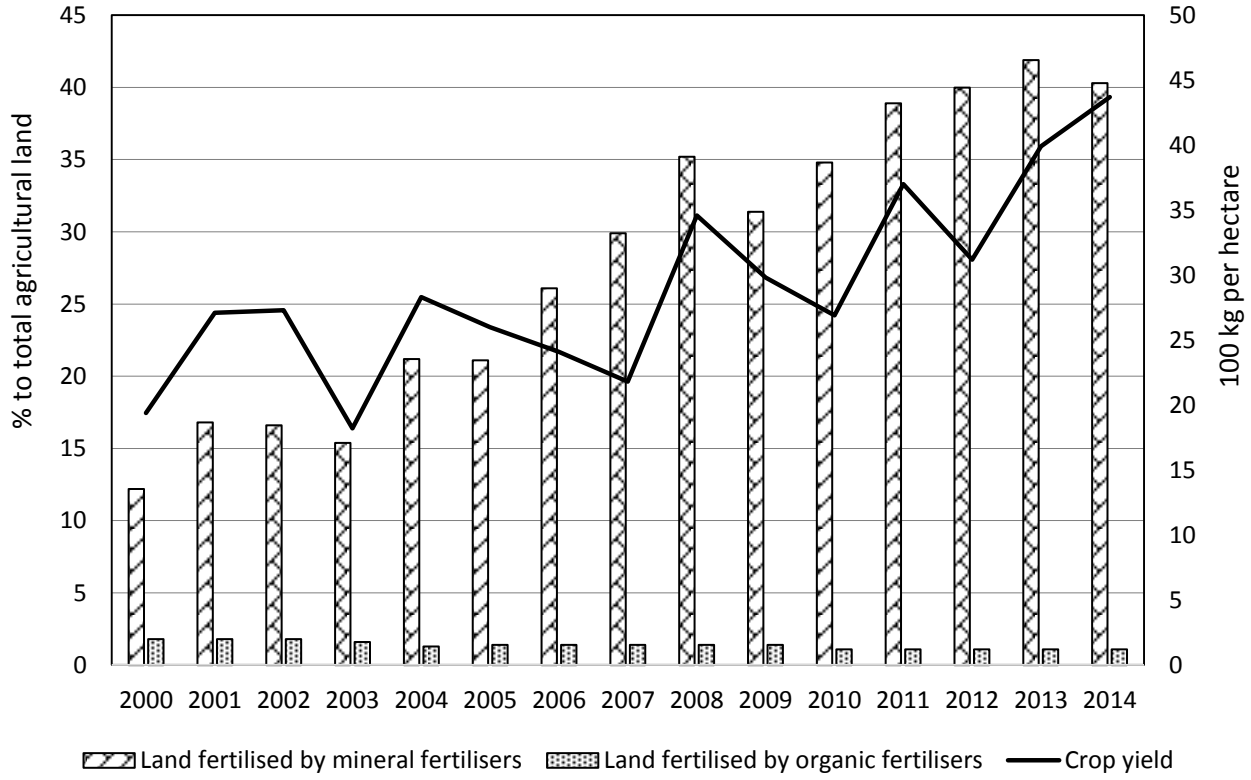

Fig. 4 – Dynamic of natural resources indicators of sustainable development (designed by author by the official statistic [3])

Conclusions

The main difficulty in measuring and monitoring of agricultural sustainability is that it is dynamic rather than static concept with long-term correlation. There are different system and approaches to monitoring starting from high level international organizations (The World Bank, UN, OECD etc.), regional and state systems, and variety of researches by the topic.

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Some indicators were estimated and monitored using official database, but there is lack of information in environmental and social part of estimation system. Therefore, to give politicians and researches background for decision-making in agrarian policy the system of state statistic can be improved by added the part of sustainable development indicators in agriculture.

СПИСОК ЛИТЕРАТУРЫ

1. World Commission on Environment and Development (WCED). Our common future. Oxford: Oxford University Press [Электронный ресурс]. – Режим доступа: http://www.un-documents.net/our-common-future.pdf. – Загл. с экрана.

2. Agriculture, value added (% of GDP) [Электронный ресурс]. – Режим доступа:

http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS. – Загл. с экрана.

3. Державна служба статистики України [Электронный ресурс]. – Режим доступа: : www.ukrstat.gov.ua. – Загл. с экрана.

4. Dariush, H., Zahra, R., Ezatollah, K. Measuring Agricultural Sustainability [Электронный ресурс]. – Режим доступа: http://www.springer.com/cda/content/document/cda_downloaddocument/9789048195121-c2.pdf. – Загл. с экрана.

5. Sustainable Development Indicators. An Overview of relevant Framework Programme funded research and identification of further needs in view of EU and international activities. European Communities [Электронный ресурс]. – Режим доступа: http://www.ieep.eu/assets/443/sdi_review.pdf. – Загл. с экрана.

6. Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition. United Nations [Электронный ресурс]. – Режим доступа: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=107&menu=1515. – Загл. с экрана.

REFERENCES

1. Our common future (1987), “World Commission on Environment and Development (WCED)”, available at: http://www.un-documents.net/our-common-future.pdf (Accessed 7 January 2015).

2. The World Bank, “Agriculture, value added (% of GDP)”, available at: http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS (Accessed 15 January 2015).

3. The State Statistics Service of Ukraine – the official website, available at: www.ukrstat.gov.ua. (Accessed 25 January 2015).

4. Hayati, D., Ranjbar, Z. and Karami, E. (2010), “Measuring Agricultural Sustainability”, available at: http://www.springer.com/cda/content/document/cda_downloaddocument/9789048195121-c2.pdf.

5. European Communities (2009), “Sustainable Development Indicators. An Overview of relevant Framework Programme funded research and identification of further needs in view of EU and international activities”, available at: http://www.ieep.eu/assets/443/sdi_review.pdf (Accessed 15 January 2015).

6. United Nations (2007), “Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition”, available at: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=107&menu=1515 (Accessed 14 January 2015).

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Аннотация. Устойчивость в сельском хозяйстве является комплексной категорией, существует множество методов и научных подходов для ее оценки. В статье рассмотрены преимущества и недостатки различных оценочных систем, проанализированы отдельные индикаторы. Для усовершенствования методики оценки был предложен подход «обратной связи» показателей.

Главная трудность в измерении и контроле сельскохозяйственной устойчивости состоит в том, что это – больше динамическое, чем статическое понятие с долгосрочной корреляцией. Есть различные системы и подходы для контроля начиная с международных организаций высокого уровня (Всемирный банк, ООН, ОЭСР и т.д.), региональных и государственных систем и разнообразных исследований по теме.

Но главные критические проблемы их то, что индикаторы устойчивости не рассматриваются в паре ресурс-результат. Подход с «обратной связи» был предложен после рассмотрения принципов стабильной оценки развития сельского хозяйства. Ключевая идея подхода «обратной связи» состоит в том, чтобы определить корреляцию между ресурсами и эффектами. Система индикаторов помогает оценке корреляции финансовых и материальных ресурсов, человеческих ресурсов, природных ресурсов и соответствующих эффектов.

Некоторые индикаторы были оценены и контролировали использующую официальную базу данных, но есть недостаток информации в экологической и социальной части системы оценки. Поэтому для того чтобы дать политикам и исследователям основания для принятия решения в аграрной политике, система государственной статистики может быть улучшена добавлением некоторых индикаторов устойчивого развития в сельском хозяйстве.

Ключевые слова: устойчивость в сельском хозяйстве, системы оценки, индикаторы устойчивости, ресурсы и эффекты

Анотація. Стійкість у сільському господарстві є комплексною категорією, існує безліч методів та наукових підходів для її оцінки. У статті розглянуті переваги та недоліки різних оціночних систем, проаналізовано окремі індикатори. Для удосконалення методики оцінки був запропонований підхід «зворотного зв'язку» показників.

Головні труднощі у вимірі й контролі сільськогосподарської стійкості полягає в тому, що це – більше динамічне, чим статичне поняття з довгостроковою кореляцією. Є різні системи й підходи для контролю починаючи з міжнародних організацій високого рівня (Всесвітній банк, ООН, ОЭСР і т.д.), регіональних і державних систем і різноманітних досліджень по темі.

Але головні критичні проблеми їх те, що індикатори стійкості не розглядаються в парі ресурс-результат. Підхід з «зворотним зв'язком» був запропонований після розгляду принципів стабільної оцінки розвитку сільського господарства. Ключова ідея підходу з «зворотнім зв'язком» полягає в тому, щоб визначити кореляцію між ресурсами й ефектами. Система індикаторів допомагає оцінці кореляції фінансових і матеріальних ресурсів, людських ресурсів, природних ресурсів і відповідних ефектів.

Деякі індикатори були оцінені й контролювались використовуючи офіційну базу даних, але є недолік інформації в екологічній і соціальній частині системи оцінки. Тому для того щоб дати політикам і дослідникам підстави для ухвалення рішення в аграрній політиці, система державної статистики може бути поліпшена додаванням деяких індикаторів сталого розвитку в сільському господарстві.

Ключові слова: стійкість у сільському господарстві, системи оцінки, індикатори стійкості, ресурси і ефекти

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НЕКОТОРЫЕ ПРОБЛЕМЫ ЭНЕРГОСБЕРЕЖЕНИЯ ПРИ РАЗРУШЕНИИ МИНЕРАЛЬНОГО СЫРЬЯ В УДАРНО-ЦЕНТРОБЕЖНЫХ ДРОБИЛКАХ

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ДЕЯКІ ПРОБЛЕМИ ЕНЕРГОЗБЕРЕЖЕННЯ ПІД ЧАС РУЙНУВАННЯ МІНЕРАЛЬНОЇ СИРОВИНИ В УДАРНО-ВІДЦЕНТРОВИХ ДРОБАРКАХ

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SOME PROBLEMS OF ENERGY SAVING AT BREAKING MINERAL RAW MATERIALS IN THE SHOCK-CENTRIFUGAL CRUSHER

Аннотация. В статье рассматриваются некоторые проблемы измельчения минерального сырья в ударно-центробежных дробилках с вертикальным валом рабочего органа. Рассматриваются гипотезы, связывающие подведенную к дробилке работу с показателем, характеризующим результаты процесса измельчения (гипотезы Кирпичева, Бонда, Ребиндера и др.); предпочтение отдается гипотезе Риттингера, согласно которой вновь образованная поверхность при измельчении руды пропорциональна произведенной работе. Излагается математическая модель разрушения минерального сырья в ударно-центробежных дробилках; в основу модели положена концепция квазихрупкого разрушения Черепанова Г.П.: «… величина необратимой работы, затраченной на образование единицы площади свободной поверхности тела при развитии трещины, является постоянной материала, не зависящей от нагрузок, формы и размеров тела». Для расчета энергоемкости разрушения минерального сырья при деформациях сжатия и сдвига используется теория Кулона – Навье с функцией поврежденности материала. Показано, что наиболее энергосберегающим механизмом разрушения материалов в ударно-центробежных дробилках являются способы и средства, в которых реализуются преимущественно сдвиговые напряжения.

Ключевые слова: ударно-центробежные дробилки, теория Кулона-Навье, функция поврежденности минерального сырья, энергосберегающие механизмы

Постановка задачи

Анализ особенностей рабочего процесса разрушения минерального сырья в ударно-центробежных дробилках с вертикальным валом рабочего органа изложен в [1]. Рассматриваемая проблема в целом сводится к установлению