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ORIGINAL ARTICLE

The accounting improvement of ecological activity and agroecosystems conservation

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The growth of environmental threats, deterioration of agroecosystems, and the increase of environmental loading on natural resources are a consequence of unsystematic ecological management and lack of scientifically sound rational models of accounting for ecological activity as the only source of meeting information requests of stakeholders. The role of accounting in ensuring the environmental safety of agrarian business is significantly underestimated; as a result, the existing methodological approaches and a set of financial reporting indicators cannot fully satisfy the information requests of the key stakeholders. The article is devoted to substantiating theoretical and methodological bases of ecological activity accounting and development of directions of its improvement to preserve agroecosystems. The conceptual vision of the accounting model of ecological activity as a factor of agroecosystem preservation is grounded in the article. The authors' definition of ecological expenses in the accounting system is given. The article provides the adaptive model of accounting and analytical provision of ecological management, which is based on the improvement of understanding and accounting of ecological expenses. The elements and structure of environmental protection expenditures by types of economic activity in Ukraine during 2017-2019 are analyzed. The necessity of improving the synthetic ecological expenses accounting by introducing separate analytical accounts to the subaccounts of class 8 "Expenses by elements" with the corresponding list of analytical accounts of the first and second-order, is proved. The practical value of the proposals lies in achieving a qualitatively new understanding of the Institute of Accounting in terms of preserving ecosystems and providing users of financial statements with appropriate, relevant, and accurate information about the possible impact of agricultural production on the environment that will ultimately increase ecological and social responsibility of the agrarian business.
Keywords: accounting, ecological activity, agroecosystem, ecological expenses, environment, accounting and analytical provision.

Introduction

Annually the anthropogenic loading on the environment increases; more often, it results in polluting territories, reducing the quality of the atmo-, lytho-, hydro- and biosphere. Along with the low level of environmental awareness of citizens, today, the acute problem is the low level of business entities' ecological responsibility, especially in the agrarian sector of Ukraine's economy.

Today, environmental safety is an integral attribute of modern state development. It requires a radical change in the imperatives and values of modern civilization, the countries' ecological perspective, their understanding that it is a rational use, preservation, restoration, and augmentation of natural capital that can form an environment (Krukov et al., 2020). In the agriculture of Ukraine, there are several environmental problems, which include loss of natural fertility, soil degradation, depletion, wind and water erosion expansion, environmental pollution by chemicals, radionuclides, heavy metals, livestock waste. The quality of agricultural land is gradually deteriorating (Stepanenko et al., 2020). The high level of agricultural land development, imperfect methods of its cultivation, uncontrolled use of mineral fertilizers and plant protection chemicals, increase in soil-depleting crops sowings as well as the lack of crop rotations led to land degradation, reduced soil fertility, and productivity of agricultural lands (Nagirna & Savchuk, 2014).

The connections between materials, energy, plants, and animals have not been incorporated into the accounting framework, and "service" or information flows (such as flower pollination by bees) are usually ignored (Hannon et al., 1991). The global environmental policy should be aimed at the practical implementation of approaches for effective environmental management. This implies integration of environmental policy into all spheres of the economy, the introduction of programs for purification of atmospheric air and water, waste and resource management, protection of ecosystems, the formation of an eco-network, limitation of industrial pollution of territories, protection of territories from anthropogenic threats and threats of transboundary

nature, prevention of technogenic hazards, implementation of measures to suspend global warming and invasive processes (Vyshnevska et al., 2020).

Accounting as the only source of relevant, reliable, and safe information of business entities should become an integral part of ensuring the sustainable development of rural areas, which is impossible without implementing ecological management's rational principles. The place of environmental management as well as accounting and analytical provision of ecological activity of economic entities, particularly in the agrarian sector, is the object of scientific research of many economists, including R. de Jong, B. Edens, N. van Leeuwen, S. Schenau, R. Remme, L. Hein, I. Zamula, D. Grytsyshen, L. Maksymiv, N. Pravdjuk, V. Naghirna, I. Savchuk, L. Sakhno, O. Vyshnevska, G. Solovida, H. Latan, B. Hannon, R. Costanza, R. Ulanowicz, I. Sadovsjka, O. Prokopyshyn, L. Ghnatyshyn, O. Savchenko. These scientists developed a robust theoretical and practical basis for forming ecological accounting systems at micro- and macro-levels. However, today the role of information support of ecological management in agroecosystem conservation remains very insignificant.

The underdevelopment of research in ecological accounting problems causes the role of accounting to be ignored while ensuring the implementation of the provisions of sustainable economic development (Zamula, 2010). In other words, today, there is no strong scientific basis for accounting development of ecological activity because of imperfections in government regulation and the low level of environmental awareness and environmental responsibility of top management of Ukrainian agrarian business. As a result, it leads to an increase in ecological expenses and losses, rising on a national scale.

According to the published document under the auspices of the UN "System of Environmental-Economic Accounting 2012 - Experimental Ecosystem Accounting" ecosystem accounting is a coherent and integrated approach to the assessment of the environment through the measurement of ecosystems and measurement of flows of services from ecosystems into economic and other human activity. The scale on which the accounting may be conducted varies: the ecosystems measured may range from specific land cover type areas, such as forests, to larger integrated areas, such as river basins, and may include areas considered to be relatively natural and those that are more severely affected by human activity, such as agricultural areas (UN et al., 2014).

The modern approaches to developing economic and ecological aspects of accounting development are quite diverse and contradictory. In turn, it forces the science of accounting to develop in an unstructured direction, which does not allow the formation of new scientific knowledge and solve urgent practical issues (Gritsishen, 2015). According to the research results, G. Solovida and H. Latan (2017) proved the connection between ecological strategy, ecological management accounting, and ecological indicators, emphasizing that ecological strategy can directly affect the ecological indicators through ecological management accounting. It directly impacts social consequences and requires increasing pressure, particularly from public authorities (Solovida & Latan, 2017). Ecosystem accounting aims to identify changes in the condition and extent of ecosystem units and the resulting changes in the quantity and - where possible - the supplied ecosystem services' monetary value. Consequently, Ecosystem Accounting provides a powerful tool to monitor the economic impacts of pressures and protection measures on ecosystems and subsequent changes in ecosystem services (de Jong et al., 2016).

Simultaneously, the theoretical and methodological principles of ecological accounting in changing the demands of the institutional environment of Ukrainian agrarian business, achieving sustainable development goals, and changing approaches to information disclosure in integrated reporting are not sufficiently granted, which determined the topic of this scientific research.

The study aims to substantiate the theoretical and methodological accounting foundations of ecological activity and develop areas for improvement to preserve agroecosystems.

Materials and methods

The information base of the study is normative legal acts of accounting; official materials of the State Statistics Service of Ukraine; scientific works of home and foreign economists on the problems of accounting and management of ecological activity; reference and methodical materials; materials of the Federation of Auditors, Accountants and Financiers of the AIC of Ukraine, authors' observations.

Results and discussion

In 1999, the Government of Ukraine ratified the Convention on the Access to Information, Public Participation in Decision-Making and Access to Justice concerning the Environmental Matters (Aarhus Convention), according to paragraph 3 "Environmental Information" means any information in written, audiovisual, electronic or any other material form of factors such as substances, energy, noise, and radiation, as well as activities or measures, including administrative measures, environmental agreements, policies, legislation, plans and programs that affect or may affect the components of the environment, expenses and results analysis and other economic analysis and assumptions used in decision-making concerning environmental issues (the Verkhovna Rada of Ukraine, 1998).

Directive 2003/4 / EC of the European Parliament and of the Council dated January 28, 2003, on freedom of access to information concerning the state of the environment, which replaces the Council Directive 90/313/EEC, foresees that "environmental information" shall mean any information in written, visual, aural, electronic or any other material form on:

(a) the state of the elements of the environment, such as air and atmosphere, water, soil, land, landscape, and natural sites including wetlands, coastal and marine areas, biological diversity and its components, including genetically modified organisms, and the interaction among these elements;

(b) factors, such as substances, energy, noise, radiation or waste, including radioactive waste, emissions, discharges, and other releases into the environment, affecting or likely to affect the elements of the environment referred to in (a);

(c) measures (including administrative measures), such as policies, legislation, plans, programs, environmental agreements, and activities affecting or likely to affect the elements and factors referred to in (a) and (b) as well as measures or activities designed to protect those elements;
(d) reports on the implementation of environmental legislation;
(e) cost-benefit and other economic analyzes and assumptions used within the framework of measures and activities referred to in (c); and
(f) the state of human health and safety, including the contamination of the food chain, where relevant, conditions of human life, cultural sites, and built structures since they are or may be affected by the state of the elements of the environment referred to in (a) or, through those elements, by any of the matters referred to in (b) and (c). (European Parliament, 2003).

Simultaneously, according to Article 360 of the Association Agreement between Ukraine and the EU, the Parties develop and strengthen cooperation on environmental protection and thus contribute to the long-term goals of sustainable development and green economy (Association Agreement, 2014). Thus, the problem of ecologization of a national economy is an integral part of European integration processes; it should contribute to the construction of a useful model of ecological accounting.

Accounting for environmental facilities and the impact of business activities on the environment is especially important for agricultural enterprises. The specificity of the agricultural sector carries out their business activities in close connection with nature. One of the environmental management problems in this area is developing and improving trends and principles of ecological accounting and control, including financial and management accounting, reporting by environmental indicators, and environmental audit.

The 'reinvestment' in natural capital may take several different forms other than the costs of management measurements, including protection, restoration, or forgoing the use of natural capital assets to ensure that natural resource systems retain their capacity to renew themselves. The lack of information about the level of natural capital required to maintain ecosystem services' capacity at acceptable levels is a significant impediment to developing valid accounts (UK, Houses of Parliament, 2011).

In modern scientific research, the idea of establishing the spheres of anthropogenic factors' influence on ecosystems and their corresponding reflection in the system of accounting remains quite debatable. Ecological accounting is particularly limited by accounting and reporting models of the reflection of industrial wastes, depletion of natural resources, and payment of environmental taxes. At the same time, agricultural production as a factor of anthropogenic impact on agroecosystems necessitates the inclusion of the ecological accounting of the essential information about the negative effects on the environment and ecological expenses.

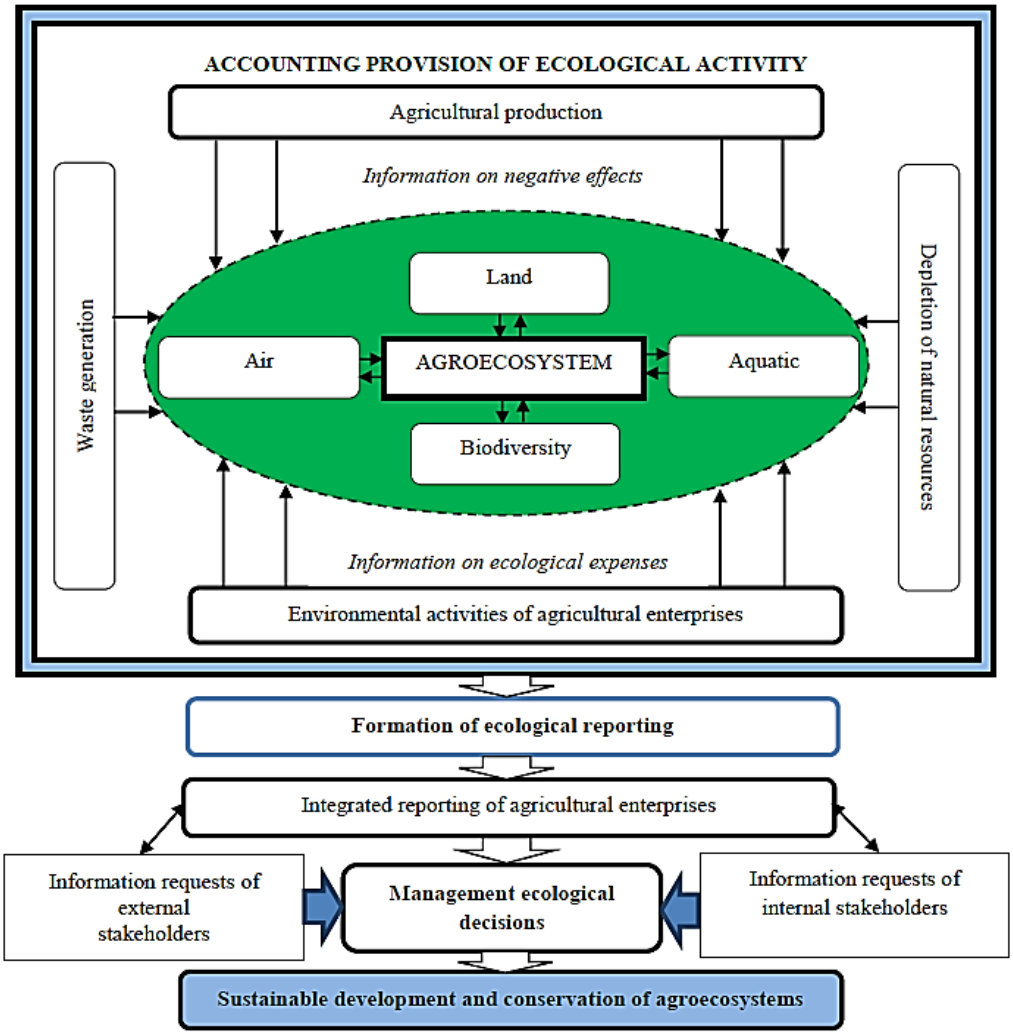

Fig. 1. A conceptual vision of the accounting model of ecological activity as a factor of the agroecosystems conservation (developed by the authors).

The authors' conceptual vision of the accounting model of agricultural enterprises' ecological activities is to identify information flows on possible negative impacts of agricultural production on ecosystems and the ecological expenses for restoring ecosystems, significantly eliminating waste. It is achieved through the practical construction of eco-oriented accounting policies, which will allow the formation of an environmental block of integrated reporting. As a result, it will help meet external and internal stakeholders' information requests concerning the ecological activities (Fig. 1).

Achieving the stated goal of sustainable development of agroecosystems based on qualitative, reliable, and relevant information involves constructing a rational model of accounting and analytical provision of ecological activity. This approach is grounded on the development of regulatory and driver models based on financial and non-financial information flows, using the unified ecological analysis structure, which will monitor agrarian business's relevant ecological risks in real-time. The approach's main methodological direction is the synergy of goals, principles, objectives, and methodological support to obtain the expected results for the agroecosystems conservation (Fig. 2).

The basis of the accounting model of ecological activity in terms of ecosystem conservation due to the negative effects of agricultural production is the methodology of ecological expenses as a specific scale indicator of the nature conservation activity of enterprises, industries, or the national economy.

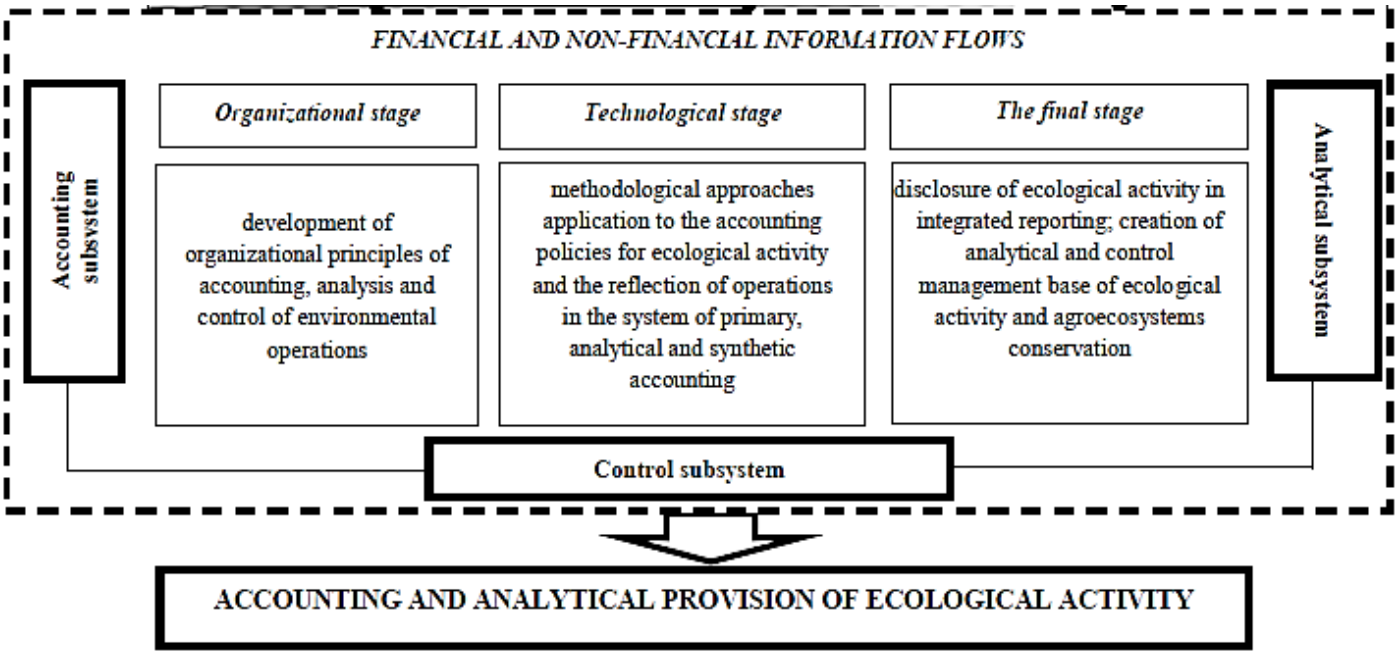

Fig. 2. Adaptive model of accounting and analytical management provision of ecological activity
Source: developed by the authors

According to the State Statistics Service of Ukraine, the share of agricultural, forestry, and fishery enterprises in 2019 accounted for only 1.0% of total environmental expenditures (Table 1), a meager figure for the agrarian country. Moreover, this share has tended to decrease (by 0.4%) in the recent three years.

Table 1. Elements and structure of expenditures on environmental protection according to the types of economic activity in Ukraine within 2017-2019 (with actual prices)*

Type of economic activity	2017		2018		2019	
	mln hrn	%	mln hrn	%	mln hrn	%
Agriculture, forestry and fishery	428.9	1.4	418.1	1.2	440.7	1.0
Mining and quarrying	5968.1	19.0	7780.2	22.6	9371.1	21.4
Processing industry	8004.7	25.4	10323.8	30.0	11677.7	26.7
Supply of electricity, gas, steam, and air conditioning	6148.8	19.5	4423.9	12.9	9458.2	21.6
Water supply; sewerage, waste utilization	6523.3	20.7	8212.5	23.9	9697.6	22.2
Transport, warehousing, postal and courier activity	576.4	1.8	742.3	2.2	819.0	1.9
Public administration and defense; compulsory social insurance	1382.4	4.4	995.0	2.9	517.4	1.2
Other types of economic activity	2459.4	7.8	1496.5	4.4	1754.1	4.0
Total	31492.0	100.0	34392.3	100.0	43735.9	100.0

* compiled by the author based on State Statistics Service of Ukraine (2020)

In our opinion, the reasons for the identified trends are, on the one hand, the lack of a proper system of state regulation of the natural environment restoration, except for the environmental tax, and on the other hand, the lack of a coherent identification model, classification, accounting of ecological expenses and their representation in the integrated reporting. Such a model can provide external and internal stakeholders, especially government regulators, with relevant information and influence nature conservation decisions.

The essence of accounting management of ecological expenses lies in choosing the means of influencing payments to improve product quality, preserve the environment, improve the efficiency of natural resources to achieve strategic goals with the most significant environmental impact at the hierarchy levels (Pravdyuk, 2020).

We should state that modern literature sources (Pravdyuk, 2020, Prokopyshyn & Hnatyshyn, 2016, Savchenko et al., 2015, Zamula, 2010, Sakhno & Levchenko, 2007, Maksymov, 2005) contain different definitions of ecological expenses, most of which reflect the fact of the economic benefits reduction connected with nature protection activity of the enterprises (tab. 2). In the methodology of statistical accounting of our country, the current expenses of environmental protection are regarded as all the enterprise expenses on environmental protection and environmental management, which are carried out at the expense of own or borrowed funds of the enterprise or the state budget.

Table 2. Definition of ecological expenses in the works of scientists

Author	Year of publication	Definition of ecological expenses
L. Maksymiv	2005	internalized expenses arising from voluntary or mandatory measures to prevent, eliminate, reduce pressure on the environment, as well as the expenses from productivity losses and irreversible losses of energy, raw materials, and supplies (Maksimov, 2005)
L. Sakhno, O. Levchenko	2007	ecological expenses are represented in money equivalent as a set of all types of resources required for nature conservation activity (Sakhno & Levchenko, 2007)
I. Zamula	2010	The given notion of "ecology" involves both the use and protection of the environment; the notion of "ecological expenses" is broader than "environmental expenditures". All expenses associated with implementing ecological activity are ecological expenses of the enterprise (Zamula, 2010)
O. Savchenko, O. Datsij, A. Bajda, H. Zyma	2015	expenses associated with implementing ecological activity; they differ from other expenses of the enterprise and depend on the scope of its activity and the degree of impact on the environment (Savchenko et al., 2015)
O. Prokopyshyn, L. Hnatyshyn	2016	all expenses of the enterprise on environmental protection and rational use of nature, which are carried out from its own or borrowed funds of the enterprise (Prokopyshyn & Hnatyshyn, 2016)
N. Pravdyuk	2020	the system of elements and means of optimal construction of the accounting process to obtain and provide reliable, operational, analytical, and qualitative information for environmental management and control of resources used in the field of environmental protection (Pravdyuk, 2020)

Heads of Ukrainian agro-industrial enterprises, who seek to increase funding from Western markets' capital, understand that the lack of information on the ecological situation in the new Ukrainian balance sheets will reduce investor confidence in financial statements. Ecological information should be an integral part of compiling precise and reliable reports. However, in Ukraine, there are no normative acts regulating accounting activity in the field of ecology, which would provide a detailed reflection in the financial statements liabilities and expenses associated with the ecological activity. Therefore, developing the foundations to develop ecological accounting and auditing is socio-economically necessary for crisis prevention (Zhuk, 2012).

In modern literature, there are many approaches to the Classification of ecological expenses, which are distributed according to the criteria of activities, the nature of the impact on the environment, frequency, the possibility of assessment, type, purpose, funding sources. I. Sadovska (2014) stressed that it is necessary to divide ecological expenses into those related to specific types of crop or livestock production and general production of ecological expenses at agricultural enterprises. Also, for more effective management of ecological expenses, it is advisable to group them by centers of responsibility. It will increase control over the expenses incurred, their compliance with the planned volumes and immediately identify the causes of deviations from the norms (Sadovska, 2014).

In our opinion, the main criterion of classification of ecological expenses in accounting should be their functional purpose and the ability to relate to a specific element of expenses, which will simplify the preparation of integrated reporting. Based on the practical experience of chief accountants-members of the Federation of Auditors, Accountants and Financiers of AIC of Ukraine, analyzed Reports on the management of leading agricultural holdings, as well as authors' observations, in order to implement the accounting model of ecological activity as a factor of sustainable development of agroecosystems at the technological stage we propose to divide the ecological expenses into five groups (Fig. 3).

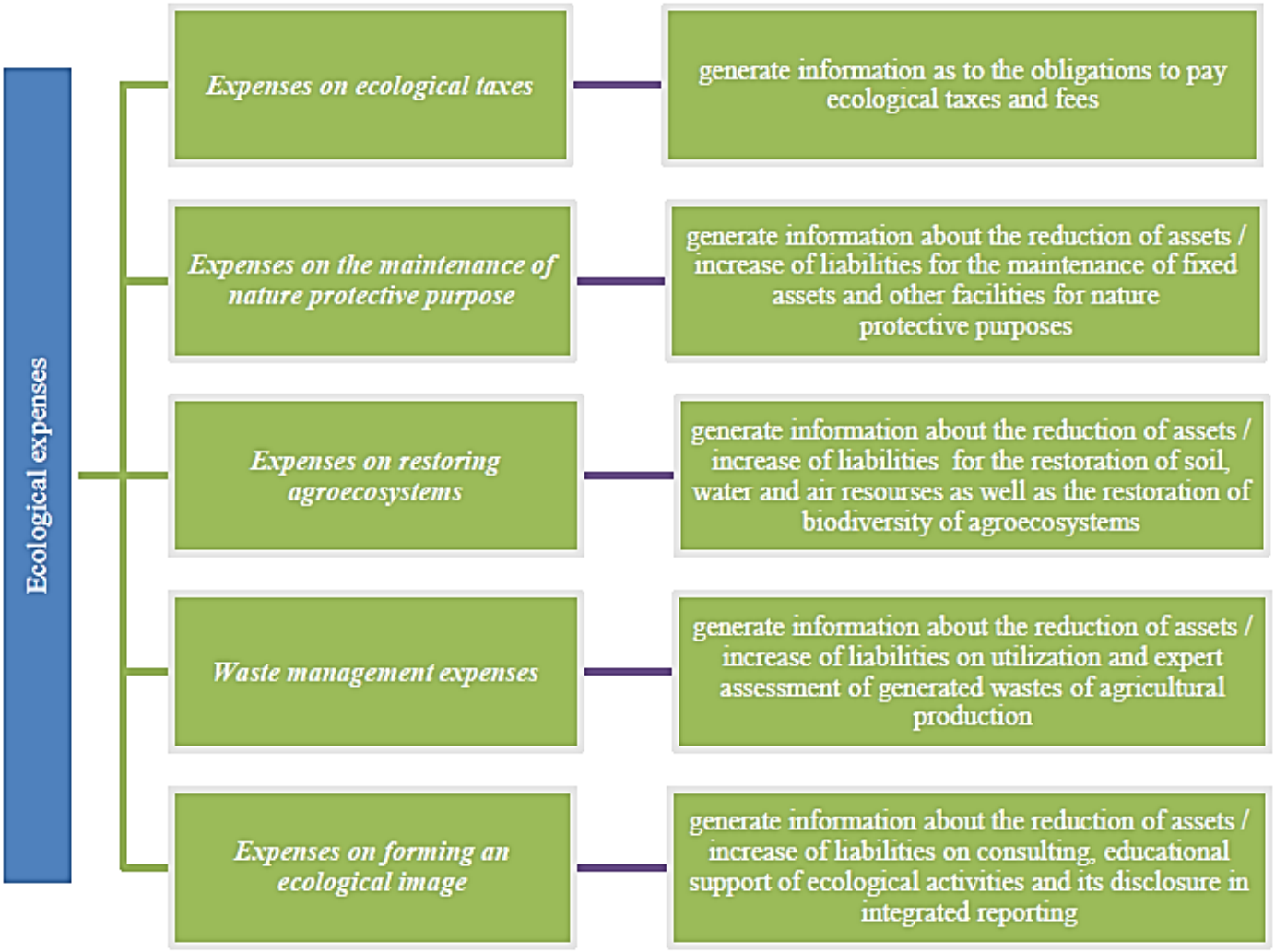

Fig. 3. Classification of ecological expenses in the accounting system (developed by the authors).

At present, there is no consensus about the representation of ecological expenses in the accounts due to the lack of regulatory and legal support for their accounting at the level of a separate Regulation (standard) of accounting and fragmentary application of guidelines developed by accounting practice. Thus, most agricultural enterprises partially include ecological expenses into direct production expenses, general production, and administrative or others.

In our opinion, microenterprises and enterprises with insignificant impact on the environment should conduct separate records of ecological expenses at the level of their inclusion to general production expenses with their further distribution proportionally to the share of impact on agroecosystems of individual industries in crop or livestock production.

However, for agricultural enterprises that significantly impact agroecosystems (more than 5-10% of the total aggregate expenses of which are ecological ones), it is advisable to introduce separate analytical accounts. These are the subaccounts of class 8 "Expenses by elements" (the Verkhovna Rada of Ukraine, 1999) according proposed by as on Fig. 3 classification of ecological expenses with the corresponding list of analytical accounts of the first and second-order (Table 3).

The main idea of the proposed analytical sections of ecological expenses is to differentiate the expenses by elements arising from maintaining the ecological entities incurred by the agricultural enterprise, ecological expenses arising from involving third parties, and the amount of paid ecological taxes.

At the end of the reporting period, the amounts accumulated at the subaccounts of the class 8 "Expenses by elements" are transferred to the corresponding expense accounts depending on the character of their appearing and connecting with the object of expenses accounting (Fig. 4).

Table 3. Proposals as for the accounts structure for the accounting of ecological expenditures within the class 8 " Expenses by elements."

Account code / Account name	
80	Material expenses
801	Expenses on materials and supplies
801.X*	Expenses on raw materials and materials of ecological purpose
802	Expenses on purchasing semi-finished products and component
802.X	Expenses on purchasing semi-finished products and component of ecological purpose
803	Expenses on fuel and energy
803.X	Expenses on fuel and energy for the ecological purpose
804	Expenses on containers and packaging materials
804.X	Expenses on containers and packaging materials for the ecological purpose
805	Expenses on building materials
805.X	Expenses on building materials for the ecological purpose
806	Expenses on spare parts
806.X	Expenses on spare parts for the ecological purpose
807	Expenses on agricultural materials
807.X	Expenses on agricultural materials for the ecological purpose
808	Expenses on goods
808.X	Expenses on ecological goods
809	Other material expenses
809.X	Other materials expenses of ecological purpose
81	Salary expenses
811	Expenses on salary and tariff payments
811.X	Expenses on salaries and tariffs to maintain the entities of ecological purpose
812	Expenses on awards and incentives
812.X	Expenses on awards and incentives to maintain the entities of ecological purpose
813	Expenses on compensation payments
813.X	Expenses on compensation payments to maintain the entities of ecological purpose
814	Expenses on vacation payment
814.X	Expenses on vacation payment of employees engaged in maintaining the ecological entities
815	Expenses on other unworked time
815.X	Expenses on other unworked time of employees engaged in maintaining the ecological entities
816	Other labor expenses
816.X	Other labor expenses on employees engaged in maintaining the ecological entities
82	Expenditures on social events
821	Expenditures on compulsory state social insurance
821.X	Expenses on obligatory state social insurance of the workers engaged in maintaining the entities of ecological purpose
83	Amortization
831	Amortization of fixed assets
831.X	Amortization of fixed assets for the ecological purpose
832	Amortization of other non-current tangible assets
832.X	Amortization of other non-current tangible assets for the ecological purpose
833	Amortization of intangible assets
833.X	Amortization of intangible assets for the ecological purpose
84	Other operating expenses
841	Other ecological expenses
841.1	Expenditures on ecological taxes
841.11	Expenditures from the environmental tax for pollutants emissions into the atmosphere by stationary sources of pollution
841.12	Expenses from the environmental tax for pollutants discharges directly into water bodies
841.13	Expenditures from the environmental tax for forming radioactive waste
841.14	Expenses from other environmental taxes and fees
841.2	Expenditures on other services for agroecosystems conservation
841.21	Expenses on land recultivation
841.22	Expenses on cleaning and water bodies restoring
841.23	Expenses on restoring forest belts and landscaping
841.24	Expenses on expert ecological and laboratory research of the ecosystem
841.3	Expenses on other waste management services
841.31	Waste removal/disposal expenses
841.32	Expenses on expert ecological and laboratory research of industrial waste
841.4	Expenses on other services for forming the ecological image
841.41	Expenses on consulting support of ecological activity
841.42	Expenses on preparing ecological reports
841.43	Expenses on ecological training of staff

* from now on - the analytical account code according to the Work Plan of the company's accounts.

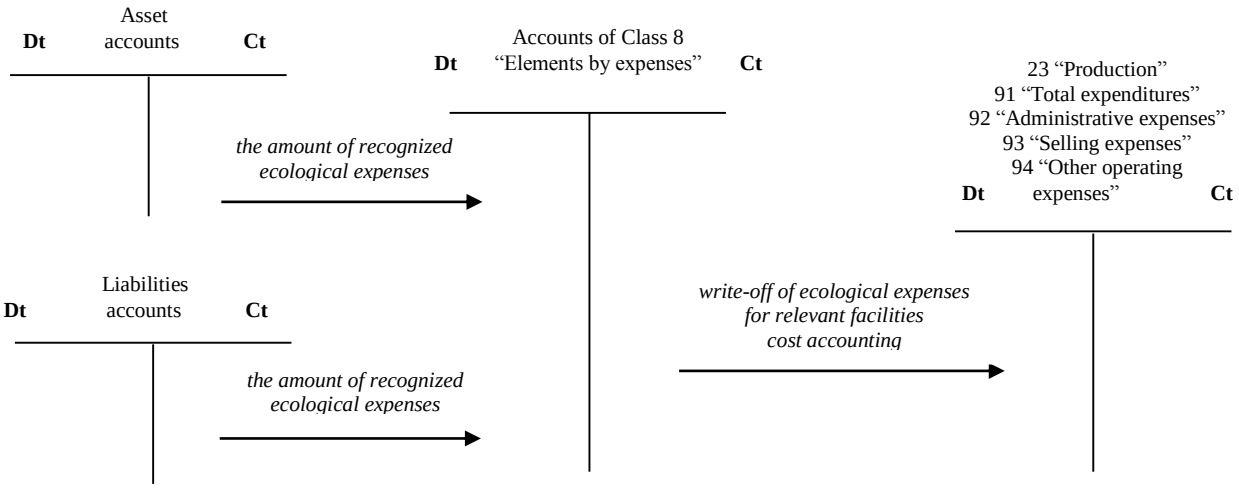

Fig. 4. General scheme of reflection of ecological expenses on accounts of accounting (developed by the authors)

We suppose that applying the proposed approach allows achieving maximum detailing of ecological expenses at different levels of analytics in both management and financial accounting and generates the information that can reflect the effects of agribusiness on agroecosystems and increase ecological responsibility of entities.

We consider that these proposals will contribute to a more accurate representation of ecological expenses in the system of integrated reporting, particularly while preparing the Report about management and forms of State Statistical Surveillance No 1 - ecological expenses (annual) "The Report about the expenditures on environment protection" (the Verkhovna Rada of Ukraine, 2019). Also, the proposed approach does not contradict the general methodology of the Statement of financial results (Section III "Elements of operating expenses") according to the requirements of the National Regulation (Standard) of Accounting 1 "General requirements for financial reporting" (the Verkhovna Rada of Ukraine, 2013). The proposed approach will be of particular practical value for the system of ecological operational analysis and control, which are crucial subsystems for the management of agricultural enterprises' ecological activity.

Conclusions

Achieving sustainable development and agroecosystems conservation goals is impossible without implementing the key postulates of ecological controlling. The role of accounting in ensuring the ecological safety of agribusiness remains significantly underestimated; as a result, the existing methodological approaches and a set of financial reporting indicators cannot fully satisfy the information requests of the key stakeholders.

Thus, we suggested treating the ecological expenses as a decrease in economic benefits as reduction of assets or increase of liabilities in connection with paying ecological taxes, maintenance of entities of nature protection purpose, ecosystem renewal, waste management, and the formation of ecological image, which can be reliably estimated and referred to the corresponding reporting period.

Information on the possible influence on agricultural production on agroecosystems and the volumes of ecological expenses generated by the accounting system should be a decisive factor of ecological responsibility of agricultural business with its mandatory disclosure in integrated reporting. We consider that our proposals as to the formation of accounting and reporting model of ecological activity based on improving methodological approaches to identification, analytical and synthetic accounting of ecological expenses will help preserve agroecosystems and maximize the impact of accounting on understanding manageability in society.

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