Problems and opportunities of environmental cost accounting at agricultural enterprises

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Abstract. During the reporting period, information on costs, including environmental costs, is recorded on various synthetic accounts, sub-accounts, cost items, including complex cost items, as well as on analytical accounts. Meanwhile, one of the accounting tasks is to systematize disparate information and to calculate on its basis the cost price of a unit of output. In financial accounting, the task of forming a calculation with a full list of environmental costs is not feasible due to the heterogeneity of costs and regulatory restrictions. It is only possible to maximize the allocation of the nomenclature of items related to the environmental component in the composition of current costs. To solve this problem, it is necessary to abandon the "boilerplate" analytics, which contradicts the accounting of environmental costs, which, on the contrary, requires deep detailing. The article critically examines approaches to the organization of environmental cost accounting and develops recommendations for solving the problematic aspects of accounting in the application of by-process and by-order methods by enterprises specializing in crop production.

1 Introduction

In modern conditions, the issues related to achieving the minimum impact of agricultural production on the environment become especially relevant [1-3].

When conducting financial and economic activities, it is important to take into account the impact of production processes on the environment, leveling their negative impact [4, 5]. In this regard, there is a need to develop mechanisms to reduce the environmental impact of air pollutant emissions [6, 7].

Intensive agricultural practices can lead to soil degradation and erosion, jeopardizing long-term fertility and productivity. Accounting for the costs of soil erosion includes estimating the costs associated with soil conservation measures, cover cropping, and sustainable land management practices [8-10].

Agricultural activities can contribute to water pollution through the release of pesticides, fertilizers and sediments into water bodies. Accounting for environmental costs in this context involves evaluating investments in precision irrigation, water recycling systems and

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technologies aimed at reducing the use of water-intensive resources [11-14].

Monoculture and chemical use can negatively affect biodiversity on and around farms. Accounting for biodiversity loss involves recognizing the costs associated with implementing agroecological practices, conserving natural habitats and adopting biodiversity-friendly farming practices [15-18].

Agriculture contributes significantly to greenhouse gas emissions, primarily through livestock production and the use of synthetic fertilizers. Accounting for these emissions involves quantifying the carbon footprint of agricultural operations and exploring investments in renewable energy, methane capture technologies, and carbon sequestration techniques [19-21].

Agricultural operations generate waste, including crop residues and packaging materials. Proper waste management involves considering the costs associated with recycling, composting or converting agricultural waste into valuable resources, thereby minimizing environmental impacts [22-24].

Benefits of environmental cost accounting in agriculture:

1. Increased efficiency of resource utilization. Integrating environmental costs into agricultural accounting encourages farmers to adopt resource-saving practices. This can lead to cost reductions, increased yields, and overall improved resource efficiency [25-27];
2. Risk reduction. Through environmental cost accounting, farmers can identify and mitigate risks associated with climate change, changes in legislation and market preferences. Sustainable practices not only contribute to environmental protection but also increase the sustainability of agricultural operations [28, 29];
3. Increased market access and reputation. Consumers are increasingly demanding environmentally responsible products. Farmers who consider environmental costs and follow sustainable practices can gain a competitive advantage by gaining access to markets where organic products are prioritized and by building a positive reputation [30, 31].
4. Long-term viability. Accounting for environmental costs is integral to ensuring the long-term viability of agricultural operations. By adopting sustainable practices, farmers contribute to the conservation of natural resources and ecosystems, ensuring that the land remains productive for future generations.

As the global community faces the challenges of climate change and environmental degradation, accounting for environmental costs in agriculture is becoming a vital tool for promoting sustainable and responsible agricultural practices. Farmers, policy makers and stakeholders must collaborate to develop robust accounting systems that reflect the true environmental costs of agricultural activities [32, 33].

2 Materials and Methods

The research methodology is based on the dialectical approach, observation, synthesis of disparate information, analysis of the obtained results; as well as elements of accounting methods, such as calculation, accounts, etc. The research is based on the dialectical approach, observation, synthesis of disparate information, analysis of the obtained results. Scientific works of Russian and foreign scientists devoted to the problems of environmental cost accounting formed the information base of the study.

The method of accounting for production costs is understood as such a «set of methods and techniques of construction » of production accounting, which provides "the formation of information about actual costs for the management of the production process and subsequent reasonable costing of production costs". The most widespread in crop production is the by-process method.

The essence of the by-process method is reduced to the fact that the technological stage of growing products is divided into a number of processes, each of which collects its own costs of production. In crop production, such processes (stages) include:- обработка пашни до посева;

- sowing and cultivation of plants;
- cleaning, harvesting, preparing expressed products for storage and transporting them from the field.

The process-by-process method generates information on costs for each production process, which makes it possible to track cost dynamics and determine the impact of each individual process on the overall crop production cycle. At the end of the year, all costs are summarized together by crop and further distributed between the main, associated (if any) and by-products (the latter usually includes straw, haulm, etc.). Thus, accounting and costing objects in crop production often do not coincide.

Agro-Industrial Complex enterprises in their accounting practice can also use the order-by-order method, which allows them to account for costs, including environmental costs, by accumulating a separate order for growing one or more crops under a contract within the account 20 «Fixed production ». Thus, the costs of fulfillment of such an order will be systematically separated from all other costs of preparation, sowing and harvesting, which, as before, will be accounted for under the process method. However, regardless of the accounting method, environmental costs are still fragmented by synthetic accounts, sub-accounts, items of complex costs, etc., and are not accounted for by the process method.

3 Results

Within the framework of financial accounting, some environmental costs are accounted for on account 26 «General business expenses», which means that they are closed by reducing the financial result in accordance with the legislation; some environmental costs can be reflected in other expenses of the enterprise on account 91 "Other income and expenses". Also, some environmental costs are of a capital nature, which means that they are closed indirectly - through the mechanism of amortization. Thus, the task of creating a calculation with a full list of environmental costs is not feasible or a priority in financial accounting. Instead, it should be about the maximum possible allocation of the nomenclature of items related to the environmental component of crop production in the current costs included in the cost of production.

In order to solve this problem, enterprises need to abandon the methods of aggregated cost accounting, as any aggregated accounting, in fact, is a type of «boiler» accounting, within the framework of which distribution processes are inevitably carried out, without which the costs, depersonalized in nomenclature groups («boilers»), cannot be directly brought to the types of products. At the same time, distribution processes, as opposed to direct allocation of costs to specific crops and plant varieties, are conditional, since the results obtained with their help characterize, rather, the proportions of planned indicators used in the allocation methodology than the actual consumption of resources by specific crops. Accordingly, the environmental costs recorded in the cost accounts within a particular «boiler» will be distributed among the products that make up the nomenclature group («boiler»), even if individual products do not consume such costs. Also within a «pot», the resulting deviations due to distribution processes can be either only positive or only negative, even though there may actually be savings for some crops in the group and overruns for others. In other words, variance management within the framework of 'boilerplate' analytics becomes impossible.

Developing the subject of analytical consolidation, let us analyze the options for the organization of analytical accounting of environmental costs in the conditions of the process method (Table 1).

Table 1. Variants of organization of analytical accounting of environmental costs at crop production enterprises in the framework of the by-process method.

Cost accounting method	Variant	Analytical granularity			Opportunities for accounting for environmental costs
		By division	**By crop area structure**	**By object of accounting**	
By-process	1	Departments, brigades, etc.	Fields and plots	Cultures, plant varieties	Maximum
	2	Departments, brigades, etc.	Fields and plots	Nomenclature groups («cauldrons»)	Limited
	3	Departments, brigades, etc.	X	Cultures, plant varieties	Standard for small businesses. For others, limited
	4	Departments, brigades, etc.	X	Nomenclature groups («cauldrons»)	Limited
	5	X	Fields and plots	Crops, plant varieties	Standard for small businesses. For others, limited
	6	X	X	Cultures, plant varieties	
	7	X	X	Nomenclature groups («cauldrons»)	Minimal

In total, the table shows 7 variants - starting from the maximum analytical detailing on production accounts and ending with the minimum analytical detailing - with the corresponding information capabilities of environmental cost accounting. Accounting for the processes themselves can be carried out both on sub-accounts to the account 20 «Main production» and allocated as independent objects of cost accounting, which are then written off to crops and plant varieties, in this case the analytics of the posting: debit 20 credit 20 - changes accordingly.

The maximum possibilities of accounting for environmental costs, due to the detailed analytical detailing, arise in the case when at the crop production enterprise accounting is carried out (see option 1 in the table):

- for each subdivision (departments, brigades);
- by crop area structure (fields and plots);
- by crops and plant varieties.

Keeping records of costs for specific crops and varieties makes it possible to track environmental costs up to the formation of the cost of a unit of grown products. Here, however, it is necessary to take into account the factor of geographical location of the land plot where the crop was harvested. The fact is that the same crop or plant variety can be sown on different fields (plots), and the ecological component brought into the process of cultivation may (by way of experimentation, increasing diversity, marketing purposes, etc.) not take place on all fields and plots. In this case, the absence of «cropping pattern» in the analytics leads to the fact that the cost of production by crop and variety is averaged, because environmental costs are correlated with the entire output of a particular product, and not only with that part of it for which such costs were actually incurred.

As for the «subdivision» analytics, it allows correlating the results obtained with the actions of responsible persons. In other words, this analytics is designed to control the efficiency of achieving the planned indicators for agricultural work performed by the enterprise's subdivisions. Failure to record costs by subdivisions (which can be expressed in the use of a single item «Main subdivision») will not distort the cost of production indicators, but in case of their deviation from the planned values, the accounting system will not be able to provide information on whose fault these deviations were made (see options 5, 6, 7 in the table). This, in turn, will mean that the accounting system will not generate information on which units incurred environmental costs in the reporting year.

Some variants given in the table (specifically, variants 3, 4) are detailed by subdivisions, but not detailed by fields and plots, which reduces the effectiveness of control of responsible persons even with formal involvement of the «Subdivisions» analytics. This is due to the fact that fields may have different yields; therefore, the refusal of analytical accounting by sown areas averages the cost of crops and varieties, which means that departments and brigades will be set the same unit planning values, which reduces the effectiveness of the planning system at the enterprise. And since the cost of crop production usually increases when environmental costs are incurred, the averaging factor will be affected to a greater extent than usual, because the increase in the cost of production will actually be distributed among all units growing such a crop, even if the environmental component of the crop was absent at other sites.

Obviously, the refusal of analytical accounting «by subdivision » can be justified in the case when the scale of the AIC enterprise is limited to one department or brigade (see option 5 in the table), i.e. when it is a small business. For such enterprises, the refusal to record costs by division will not be critical, because the only division should take responsibility for the results of activity. For this reason, the table for option 5 indicates that the possibilities of accounting for environmental costs under this analytical structure are "standard" for small enterprises, while for other organizations there are limitations.

Also for small crop production enterprises it is acceptable in some cases to keep analytical accounting only for crops and plant varieties, while the analytics «Divisions » and "Sown area structure" may be absent due to the presence of a single division and several fields and plots where individual crops and varieties are grown that do not coincide with crops and varieties of other plots. In this case (see option 6 in the table), the environmental cost accounting options are "standard" as in the previous option, while for the other organizations these options have limitations.

The options with the use of nomenclature groups in the analytics instead of specific crops and plant varieties require separate consideration (see options 2, 4 and 7 in the table). The table notes that the formation of nomenclature groups essentially leads to the appearance of "pots" in the analytics with their inherent conditional methods of distribution, which distort the values of costs of production, as well as the cost of a unit. But in this case we should be careful, as there is a fundamental difference between the forced distribution method, for example, with the complex use of raw materials or the emergence of conjugate products; and the deliberate «depersonalization» of costs, which by nature are direct and they can be linked to specific types of products, without further resorting to distribution processes. In this regard, not every nomenclature group in analytics should be recognized as a «boiler», but only those that were deliberately created to simplify accounting, and that can be "abolished" by directly relating costs to crops and plant varieties.

nomenclature groups, formed unreasonably, are indicated «limited» possibilities of environmental cost accounting (see in the table options 2 and 4) and "minimal" (see in the table option 7). The authors of the article proceed from the fact that the formation of «boilers » in the form of nomenclature groups inevitably distorts the cost of production, as well as reduces the ability to control the safety of the crop at the enterprise. The analytics, formed directly by types of crops and plant varieties, allows (even with poor quality planned cost values) to form correct actual values of costs of production for individual objects of accounting. The "boilerplate" analytics, on the contrary, not only creates dependence of actual output costs on the planned values, on the basis of which the distribution is carried out, but also strengthens possible distortions, because after some time the cost indicators obtained within the framework of «boilerplate» analytics, themselves become the basis for the formation of planned values.

Thus, the «boilerplate» approach increases the likelihood of distortion of output and unit cost indicators due to the impact of actual and planned values on each other, and thus can affect the reliability of profit and return on sales values. As for environmental costs, it is obvious that the cost of sales distorted as a result of «boilerplate» analytics distribution cannot objectively reflect the environmental component in the calculation, since environmental costs together with other items undergo the same distribution procedure using planned values. Moreover, in the «boiler» organization of analytics, environmental costs, even related to a particular crop or plant variety, will be equally attributed to all items of the «boiler», which will be reflected in the calculation for each crop or plant variety, even if they did not consume resources related to the environmental component in the activities of the enterprise. Therefore, the implementation of environmental costs cannot be combined with "boilerplate" accounting, because the former requires increased detail to reflect environmental costs in the calculation for a particular crop or variety, while "boilerplate" accounting directly contradicts this.

In this regard, the combination of «boiler» analytics with other analytical positions is not able to fully eliminate the negative aspects of the use of impersonal costs in accounting, because additional detailing, for example, on the structure of crop areas narrows the boundaries of the «boiler" to the field or plot, but within them the "boiler» still remains. The combination of the "boiler" analytics with the detailing «by subdivisions» also raises questions: it was noted above that in the conditions of aggregated accounting the management «by deviations» becomes ineffective, in connection with which it is not clear how and for what departments and brigades will be responsible. Undoubtedly, in some cases it is possible to come up with additional management and accounting «supports» that will reduce the negative impact of aggregated analytics on the decisions made, but from the position of a systematic approach this problem has only one solution - the gradual elimination of «pots» from the accounting analytics.

Based on the above, the authors believe it is necessary to add to the «Methodological Recommendations on accounting of costs and output in crop production» approved by the Department of Finance and Accounting of the Ministry of Agriculture of Russia on October 22, 2008, information on «boiler» analytics with a detailed disclosure of the disadvantages of such an approach in the context of the application of cost and process methods. Also, these recommendations should add information that environmental cost accounting cannot be based on the application of «boilerplate» analytics, as, on the contrary, it requires deepening rather than consolidation of analytics.

4 Discussion

As the agricultural sector faces pressing environmental sustainability challenges, the need for robust internal controls to manage and reduce environmental costs is becoming increasingly evident [34, 35]. Internal controls play a key role in accurately identifying and categorizing environmental costs within agricultural operations. This includes identifying and quantifying costs associated with soil conservation, water management, biodiversity conservation, emission reduction and other aspects critical to environmental sustainability.

Implementing internal controls allows agricultural enterprises to conduct a comprehensive risk assessment of environmental costs. By identifying potential risks such as soil degradation, water pollution or regulatory non-compliance, farmers can develop strategies to reduce these risks and improve the sustainability of their operations.

Agriculture is subject to changing environmental regulations. Internal controls ensure that farming practices comply with these regulations, reducing the risk of penalties for non-compliance and legal consequences. Regular audits and inspections help maintain compliance with environmental standards.

Internal controls facilitate the monitoring of resource efficiency within agricultural operations [36, 37]. This includes tracking the use of water, fertilizer and other inputs to identify areas where resource consumption can be optimized while minimizing environmental impact and operating costs.

Agricultural enterprises can use a system of internal controls to ensure compliance and monitor the implementation of sustainable practices. This can include integrating precision farming, agroecological practices and technologies that reduce greenhouse gas emissions, promoting environmentally responsible farming.

Internal controls ensure accurate accounting of environmental costs, allowing transparent reporting to stakeholders, regulators and the public [38, 39]. Well-documented reports demonstrate a commitment to sustainability, enhancing the reputation of agricultural enterprises in the eyes of consumers and investors.

Agriculture can benefit from internal controls aimed at identifying and evaluating technologies that reduce environmental costs. This can include investments in precision farming tools, renewable energy and innovative farming practices that contribute to long-term environmental sustainability.

5 Conclusions

Thus, the application of the by-process and by-order methods for accounting of environmental costs should be based on the refusal from enlargement of items in the analytics, forming «cauldrons» of depersonalized costs that require distribution - to bring them to individual crops and plant varieties. In this case, the «pots» distort the calculation calculations, which makes the allocation of items of environmental costs meaningless, as it is not accompanied by obtaining reliable indicators. At the same time, the combination of «boilers» with other types of analytics, even if detailed, does not eliminate the problems associated with distortion of the cost of production, but only limits them. The use of the order-by-order method, with the help of which the orders of contractors interested in environmentally friendly crop products can be separated from other orders, does not solve the problem of "boiler" analytics, because within the framework of one order several crops and plant varieties can be grown and shipped at once, for which reason the opening of such an order without additional detailing of the order by crops and plant varieties becomes similar to the opening of the same nomenclature group. The maximum possibilities of accounting for environmental costs are conditioned by the presence of detailed analytics, and arise in the case when at the plant growing enterprise accounting is carried out for each subdivision (departments, brigades), the structure of sown areas (fields and plots), as well as crops and plant varieties.

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