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Social and environmental costs: the impact of accounting and analytical support on enterprises' sustainable development in Germany and Ukraine

Abstract. The authors investigate the theoretical and methodological ability of the accounting institute to solve the problem of information support for the implementation of the national (global) sustainable development policy. This ability is demonstrated by using methods of accounting and analytical support and mathematical analysis of the quadratic correlation and regression dependence of the added value of enterprises from the value of social and environmental costs. All studies were conducted separately for micro, small, medium and large enterprises in Ukraine and Germany (2011-2019).

The results are designed using the U-shaped curve which demonstrates a direct relationship between environmental costs and the added value of the company for Ukrainian enterprises and indirect one for micro and large enterprises in Germany. Social expenses show a significant inverse U-shaped relationship with the value of the company in Ukraine, but large German enterprises fall out of this list and patterns.

The ability of integrated reporting to mitigate the imbalance between the added value of the enterprise (enterprise value) and social/environmental costs has been proven. It is determined that the formation and presentation of integrated reporting should be the prerogative of not only large enterprises, but also medium and small ones, and it will ultimately lead to the sustainable development of the region, industry, and country.

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Соціальні й екологічні витрати: вплив обліково-аналітичного забезпечення на сталий розвиток підприємств у Німеччині та Україні

Анотація. Авторами було підтверджено науково-практичну гіпотезу про теоретичну та методичну спроможність інституту бухгалтерського обліку вирішувати проблему інформаційного забезпечення реалізації національної (глобальної) політики сталого розвитку.
Ця мета була досягнута шляхом використання методів обліково-аналітичного забезпечення та математичного аналізу квадратичної кореляційної і регресійній залежності доданої вартості підприємств від величини соціальних й екологічних витрат.
Всі дослідження були проведені окремо для мікро-, малих, середніх і великих підприємств України та Німеччини (2011–2019 рр.). Результати спроектовані за допомогою U-подібної кривої, яка демонструє прямий взаємозв'язок між екологічними витратами й доданою вартістю фірми для українських підприємств і навпаки – зворотним зв'язком для мікро- і великих підприємств Німеччини. Соціальні витрати показують значний зворотний U-подібний зв'язок із вартістю фірми в Україні, але великі німецькі підприємства випадають із цього списку й закономірності.
Доведено спроможність інтегрованої звітності пом'якшувати дисбаланс між доданою вартістю (цінністю) підприємства та соціальними/екологічними витратами. Визначено, що формування та подання інтегрованої звітності повинно бути прерогативою не тільки великих підприємств, а й середніх і малих, і це в результаті приведе до сталого розвитку регіону, промисловості, країни тощо цілому.
Ключові слова: інтегрована звітність; соціальні/екологічні витрати; додана вартість підприємства; квадратичний кореляційний і регресійний аналіз; сталий розвиток; Німеччина; Україна.

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Социальные и экологические издержки: влияние учетно-аналитического обеспечения на устойчивое развитие предприятий в Германии и Украине

Аннотация. Авторами была подтверждена научно-практическая гипотеза о теоретической и методической способности института бухгалтерского учета решать проблему информационного обеспечения реализации национальной (глобальной) политики устойчивого развития.
Эта цель была достигнута путем использования методов учетно-аналитического обеспечения и математического анализа квадратичной корреляционной и регрессионной зависимости добавленной стоимости предприятий от величины социальных и экологических издержек.
Все исследования были проведены отдельно для микро-, малых, средних и крупных предприятий Украины и Германии (2011–2019 гг.). Результаты спроектированы с помощью U-образной кривой, которая демонстрирует прямую взаимосвязь между экологическими затратами и добавленной стоимостью фирмы для украинских предприятий и наоборот – обратной связью для микро- и больших предприятий Германии. Социальные расходы показывают значительную обратную U-образную связь со стоимостью фирмы в Украине, но крупные немецкие предприятия выпадают из этого списка и закономерности.
Доказана способность интегрированной отчетности смягчать дисбаланс между добавленной стоимостью (ценностью) предприятия и социальными/экологическими издержками. Определено, что формирование и представление интегрированной отчетности должны быть прерогативой не только крупных предприятий, но и средних и малых, и это в конечном итоге приведет к устойчивому развитию региона, промышленности, страны.
Ключевые слова: интегрированная отчетность; социальные/экологические издержки; добавленная стоимость предприятия; квадратичный корреляционный и регрессионный анализ; устойчивое развитие; Германия; Украина.

1. Introduction

The discussion on sustainable development has reached an unprecedented extent. Albeit not without disagreement, the vast majority of researchers agree that the insufficient attention to resource consumption deprives future generations of an intact social and natural environment (Toth & Szigeti, 2016). Companies, in turn, have acknowledged their share in contributing to such a development both as polluters and as civil society actors (Prior et al., 2012). Furthermore, a business case in doing so has been created by many companies (Burritt et al., 2011).

Despite this acknowledgment, companies have been making only slow progress (Crutzen et al., 2017), so that pressure to account for their progress has been exerted. Therefore sustainability reporting has established as an effective form of pushing companies away from unsustainable practices (Schaltegger et al., 2015).

Current trends in changing of financial and non-financial reporting lead to greater interconnection and intersection of accounting methods and means, which activate the analytical component. This ultimately leads to the organization of accounting and analytical support system for sustainable development, as an ordered, independent, fully or partially decentralized system of monitoring, collection, identification, registration, generalization, processing, control and analysis of economic, social and environmental information. That is consistent with management objectives based on the advantages of modern needs for the development, justification and managerial decisions of sustainable development of enterprises (Sokil, 2017).

According to the analysis of the preparation of non-financial reports by enterprises in the world and Ukraine, their greatest concentration in Europe and South America was revealed. In Ukraine, the preparation of non-financial reports is still the prerogative of large national companies and representative offices of transnational corporations. However, the European integration processes accelerate and expand the introduction in Ukraine of integrated reporting or sustainable development reporting (Global Reporting Initiative, 2020).

The main goal of the article is to test the hypothesis on the need to introduce and improve the accounting method - reporting on sustainable development enterprises of all sizes. This is done in Ukrainian context. This goal will be achieved by mathematical analysis of the quadratic correlation and regression dependence of the added value of enterprises on the size of social and environmental costs.

2. Brief Literature Review

Current research in the field of monitoring, reporting and accounting for sustainable development is reflected in various sectors of the economy and interests (Schaltegger & Burritt, 2010; Bennett et al., 2013; Burritt et al., 2002, Figge et al., 2002), Liu, 2020). These studies cover the relationship of capital types in integrated reporting (Grassmann et al., 2019), analysis of the inverse and direct dependencies of financial stability and sustainable development (Trumpp &

Guenther, 2017). Today, an analytics of accounting reporting is moving to another stage, which produces the emergence of a new method: the forecasting. It can also be explained by budgeting and expansion of accounting functions in prospective studies and predicting the future management of the enterprise (Schaltegger & Beständig, 2012). And accordingly, research leads to the emergence of new conclusions and further incentives to study and expand issues of the modern accounting method - reporting.

In modern conditions and amendments to the Law of Ukraine «On Accounting and Financial Reporting in Ukraine» (The Verkhovna Rada of Ukraine, 2017), Management Reporting is the prototype of integrated reporting or reporting on sustainable development, containing not only a statement of facts, but also prospects and risks that the enterprise may face under the present conditions. The International Integrated Reporting Council (IIRC) defines integrated reporting as follows: a process founded on integrated thinking that results in a periodic integrated report by an organization about value creation over time and related communications regarding aspects of value creation (IIRC, 2020).

The prospect of changing accounting methods, and sometimes after the fact confirmation of already transformed methods, leads to a revision of the methodology of modern accounting (Zhuk & Bezdushna, 2017). Keeping track of sustainability activities as well as evaluating and communicating them requires that sustainability metrics are deployed. Therefore, sustainability indicators have enjoyed an increasing attention for at least two decades now (Searcy, 2012).

The new wave of environmental accounting studying and sustainability accounting has gained special popularity and recognition. Entire scientific schools emerged, led by a few scholars, mainly across Europe (Schaltegger et al., 2013).

The Ukrainian scientific school of sustainability accounting is only beginning to develop in the fields of Institutional Accounting Theory, namely: development and measure of integrated reporting in Ukraine (Zhuk & Bezdushna, 2017), options for the accounting methodology improving (Legenchuk & Usatenko, 2016), benefits of integrated reporting and prospects for its implementation in Ukraine (Krutova & Nesterenko, 2016), changes in accounting under the influence of sustainable development (Shigun, 2019).

Among the main impulses for the development of environmental and social accounting in Ukraine was the adoption of the Law of Ukraine «On Environmental Audit» (The Verkhovna Rada of Ukraine, 2004). It prompted accountants to rethink their understanding of accounting, its goals and methods. The latter, accounting methods, have been documented to determine the further improvement of all sustainable development accounting (Zvezdov & Schaltegger, 2015).

This article will also consider the main accounting method element - reporting. As the numerous studies show, this method has been continuously updating and improving. Reporting provides information for analysis and future forecasting or planning, but the latter is becoming increasingly relevant in modern accounting conditions in Ukraine (Zhuk & Bezdushna, 2017). This applies to large and medium-sized enterprises, who are legally required to publish management reports (integrated reporting) [16]. On the other hand, it is mainly environmental and social expenses that ensure sustainable development and provide the basis for reporting on sustainable development, integrated reporting etc. (Zhuk & Bezdushna, 2017).

The relationship between *corporate social responsibility (CSR)* and *corporate financial performance (CFP)* has been empirically investigated for decades (Orlitzky et al., 2003; Endrikat et al., 2014). First empirical studies prove a quadratic relationship between CSR activities and CFP (Trumpp & Guenther, 2017 ; Nuber et al., 2019; Wang et al., 2008; Fujii et al., 2013). To date, this positive effect remains on an aggregated level, as research does not answer the question, for which CSR activities, IR is able to moderate the value relevance. Thus, it is called to disentangle non-financial indicators that are decisive to shareholders. In addition, following the calls from Mervelskemper and Streit (2016), Nuber et al. (2019) and Wang et al. (2008) to apply alternative CSR measures studying the relationship between CSR and CFP, our study aims at answering, whether CSR expenditures represent information, which help investors to more accurately estimate a firm's value or value added at factor costs of enterprises.

Modern literature discerns between two scientific approaches to evaluating enterprises' value:

- value-creation;
- cost-concern.

The *cost-concern school* proposes a negative relationship between CSR and firm value, as CSR activities represent only cash outflows (Endrikat et al., 2014). Thus, an engagement in CSR is not in

the best interest of shareholders and puts companies at an economic disadvantage (Mervelskemper & Streit, 2016). Even though, CSR expenditures are a costly signal to investors, as they have a direct negative financial impact, they may signal the trustworthiness of firm's social responsibility. The *value-creation school* proposes a positive relationship between CSR expenditures and firm value, as CSR activities may create competitive advantages (Hassel et al., 2005). These competitive advantages, such as improved relationships with stakeholders, improved brand reputation or employee productivity, may promote the creation of shareholder value (Malik, 2015).

Literature, therefore, started to investigate a curvilinear, specifically quadratic, relationship for both, the environmental dimension and the social dimension of CSR and CFP (Nuber et al., 2019; Wang et al., 2008); Chen & Lin, 2015). Thereby, the relationship can either be U-shaped (i.e., *too-little-of-a-good-thing effect*) or inverted U-shaped (i.e., *too-much-of-a-good-thing effect*) (Trumpp & Guenther, 2017; Fujii et al., 2013). These two theoretical frameworks encompass both a positive and negative relationship between CSR and CFP. Whereas a U-shaped relationship assumes that a minimum level of CSR activities has to be exceeded to increase CFP, an inverted U-shaped relationship assumes that when a certain peak of CSR activities is exceeded, the positive contribution towards CFP decreases (Trumpp & Guenther, 2017; Wang at al., 2008). Furthermore, this paper finds a positive firm value effect for all firms publishing an integrated report independent of their amount of CSR expenditure.

This paper contributes to the literature by combining the two research streams focusing on the association between CSR and value added at factor costs of enterprises and the capital market effects of IR. First, the paper investigates whether environmental and social expenditures are regarded as value relevant by investors. Instead of a linear relationship, a quadratic relationship is proposed. Second, the paper expands the literature by using CSR expenditures that capture the CSR efforts of companies instead of their CSR outputs. In this context, especially CSR ratings are increasingly criticized for lacking comparability. Third, the paper contributes to the question whether IR can fulfill its information-enhancing purpose to investors. Thereby, the paper adds to current IR literature by disentangling the CSR expenditures that are moderated by IR beyond proving solely an aggregated positive capital market effect of IR. Fourth, in comparison with prior IR value relevance studies, the paper examines a longer time-period from 2011 to 2019 and uses a global sample for Ukraine and Germany, as called for by prior researches.

3. The purpose

The main purpose of the paper is to confirm the scientific and practical hypothesis about the need to introduce and improve the accounting method - reporting on sustainable development for Ukrainian enterprises of all sizes. This goal will be achieved by mathematical analysis of the quadratic correlation and regression dependence of the added value of enterprises on the size of social and environmental costs.

4. Methodology

This paper adopts an empirical research approach. To achieve the aforementioned objectives, we adopt a comprehensive research methodology, which comprises the following steps (Figure 1):

1. Analysis and data collection of social, environmental costs and value added. Official statistic data and specially prepared data after official appeals and inquiries to State Statistic Service of Ukraine (2020) and Germany (Destatis, 2020) were used. Social expenses include not only compulsory salary payments and accruals on it, but also bonuses, incentive payments, advanced training expenses, the creation of appropriate working conditions and rest etc. Environmental costs include: capital investments and operating expenses to create new and modernize existing fixed assets which are used in providing of environmental safety.
2. Application of accounting and analytical procedures for generalization and primary data processing. Formation of the research hypothesis: does a theoretical and methodological ability of the accounting institute to solve the problem of information support for the implementation of the global (and national) sustainable development policy?
3. Conducting analytical statistics tests, namely, correlation and regression analysis with the subsequent formation of a quadratic trend line.
4. Analysis of the correlation dependence results: the direct and inverted U-shaped trend lines. Preparation of conclusions about the ratio between social and environmental costs, on the one hand and the enterprises value added on the other hand.

5. Using an element of the accounting method - reporting. This stage is the most important, because the formation of integrated reporting. A derivative element of the accounting method is formed - forecasting future activities in the vector of sustainable development.
6. The final conclusion formation. Theory evaluation:
   1) direct and inverse dependence of the enterprises added value on the differentiated size of social and environmental costs;
   2) confirmation of existence a new accounting method - forecasting;
   3) the need to form and issue of sustainable development reporting (integrated reporting) by small enterprises;
   4) the ability of the Accounting Institute to become a means of achieving sustainable development by using the new methods: forecasting and integrated reporting.

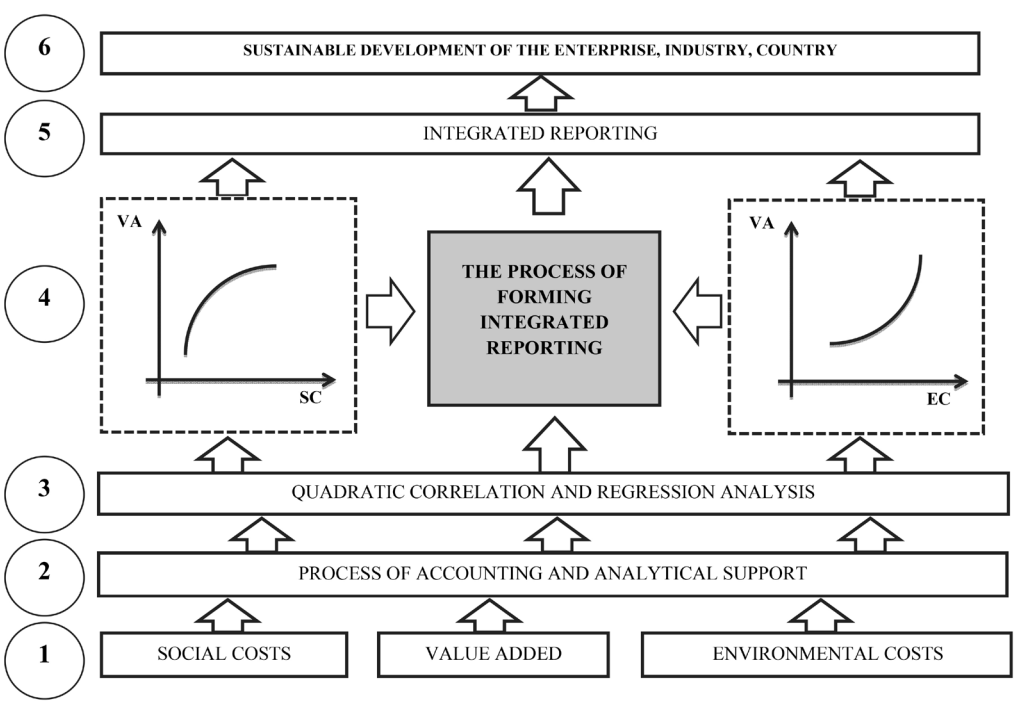
After a thorough analysis of studies of the direct and inverse quadratic dependence of social/environmental costs and value added, we analyze the dependence of these costs in the value added of enterprises in Ukraine and Germany. These enterprises are divided into 4 groups: micro, small, medium and large enterprises in accordance with Ukrainian law (The Verkhovna Rada of Ukraine, 2017) and German standards (Destatis, 2020). Categorization is determined by compliance with at least two of the criteria presented in Table 1.

The research methodology (Figure 1) includes the process of accounting and analysis of information for the formation of integrated reporting, which contribute to the creation of a positive

Table 1:
Categorization of Ukrainian and German companies based on assessed book value, net income and number of employees

Enterprise category	Annual balance sheet total (million EUR)		Annual turnover (million EUR)		Annual work unit (AWU)	
	Ukraine	Germany	**Ukraine**	Germany	**Ukraine**	Germany
Micro	≤ 0.35	≤ 2	≤ 0.7	≤ 2	< 10	< 10
Small	≤ 4	≤ 10	≤ 8	≤ 10	< 50	< 50
Medium	≤ 20	≤ 43	≤ 40	≤ 50	< 250	< 250
Large	> 20	> 43	> 40	> 50	> 250	> 250

Source: Compiled by the authors based on data by State Statistic Service of Ukraine (2020), The Verkhovna Rada of Ukraine (2017) and Destatis (2020)



Note: VA - value added, SC - social expenses, EC - environmental costs

Figure 1:
Research methodology
Source: Compiled by the authors

image and sustainable development of the enterprise. With the help of a quadratic analysis of social and environmental costs in relation to the added value of the enterprise, it becomes possible to further analyze and create integrated reporting. The reporting process encourages the company to move to a new stage of its activity - sustainable development.

5. Results

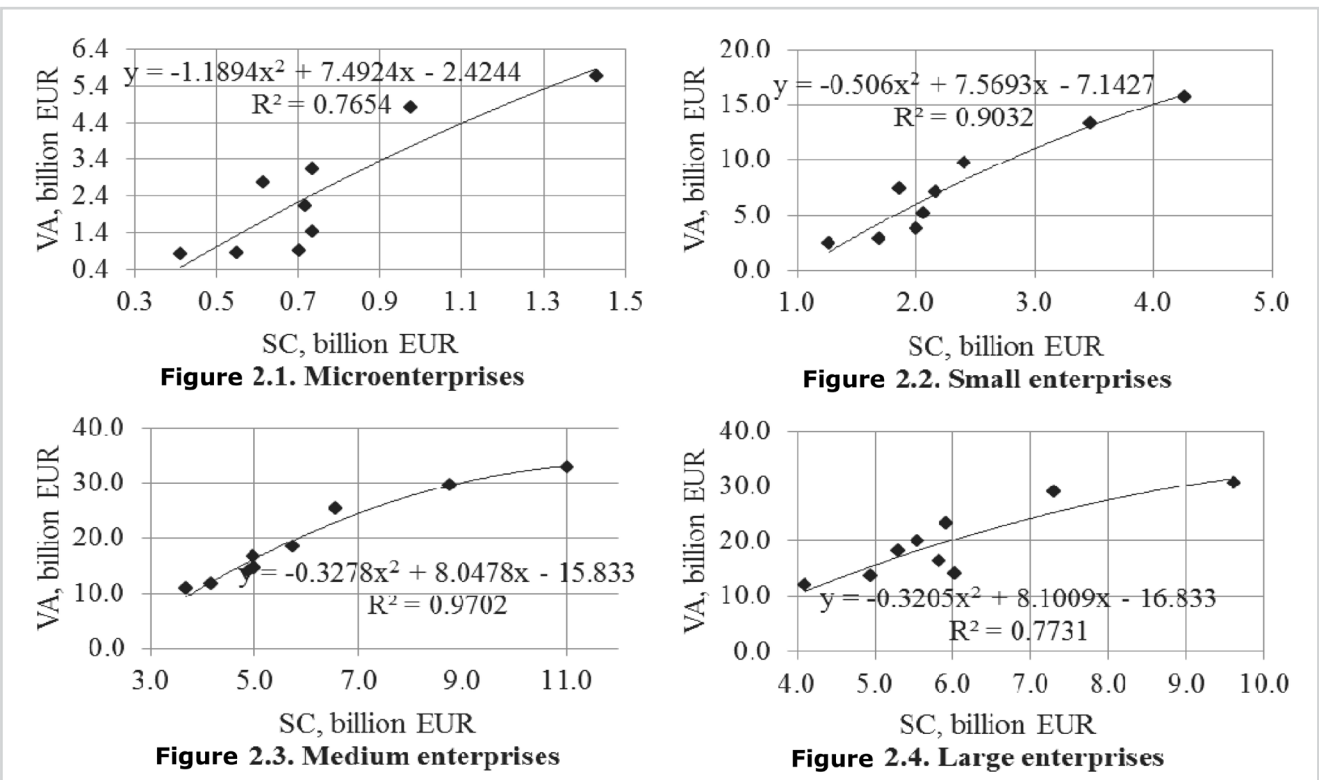
The current legal framework requires only large enterprises to generate integrated reporting, while medium-sized enterprises are allowed to generate this reporting without non-financial indicators (The Verkhovna Rada of Ukraine, 2017). By analyzing reporting data, we investigate the need for the adoption of integrated reporting in full for medium and small enterprises as well.

5.1. Regression analysis of social expenditures and value added of Ukrainian and German enterprises

An analysis of the social costs of enterprise value added is presented in the Figures 2 and 3.

For the analysis, we used the data of social expenditures and value added of Ukrainian enterprises with various sizes for 2011-2019. It is worth noting that the strongest correlation dependence of the two indicators for medium and small-sized enterprises was described with correlation coefficients of 0.9702 and 0.9032, respectively. These coefficients demonstrate a dependence of the formation of the enterprise added value due to social expenses.

Results of Figure 2 indicate a reverse U-shaped curve, which can be interpreted as follows. First, insignificant increase social expenditures at the beginning lead to a rapid increase in the added value of enterprises (the marginal growth rate of added value is larger than that of social expenditures). Second, the point is reached where the accumulated social expenditures begin to slow down the growth rate of value added of enterprises. The rate of value added is thus decreasing to fall below the starting level at the beginning of the formation and implementation of social spending.



Note: SC - social costs, VA - value added

Figure 2:
The inverse U-shaped quadratic dependence of value added on the social costs of Ukrainian enterprises in 2011-2019
Source: Calculated by the authors based on data by State Statistic Service of Ukraine (2020)

Almost the same situation exists for German enterprises, in particular for micro and small enterprises (Figure 3). The trend line for medium and large enterprises is U-shaped, which slightly violates the regularity of Ukrainian enterprises.

Preliminary finding 1: social costs must be controlled and enterprises should find such a trait and size that the maximum value added of the enterprise.

5.2. Regression analysis of environmental expenditures and value added of Ukrainian and German enterprises

An analysis of the environmental costs of Ukrainian enterprise value added is presented in Figure 4.

Analysis of Figure 4 demonstrates a U-shaped quadratic dependence of value added on environmental costs of Ukrainian enterprises. Analyzing the data of the correlation coefficient of micro and small enterprises (0.9893 and 0.9781, respectively), we observe that value added is significantly dependent on environmental costs. Less pronounced, but still high dependence can be observed in medium and large enterprises (0.8946 and 0.8734, respectively). The U-shaped trend line suggests that at the initial stages of environmental costs, the smallest increase in value added occurs. However, with the accumulation of relevant costs and the creation of appropriate conditions and means of eco-protection, there is an increase in the rate of added value, and accordingly, the position of sustainable development is strengthened.

An analysis of the environmental costs of German enterprise value added is presented in Figure 5.

Almost the same situation exists for German enterprises and environmental cost, in particular for micro and small enterprises (Figure 5). The trend line has a downward direction. This may mean that the more environmental safety costs arise, the lower the added value for German enterprises. Moreover, this trend line decreases absolutely and there is no decrease in growth rates as for Ukrainian enterprises (Figure 4).

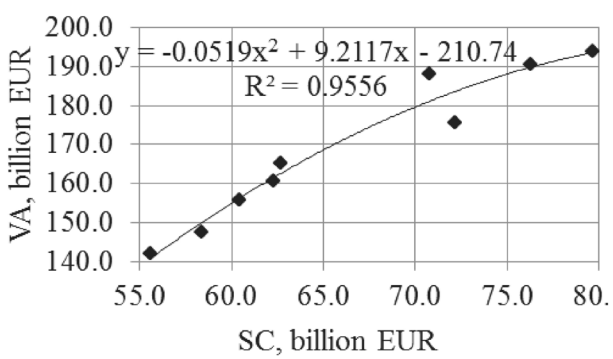


Figure 3.1. Microenterprises

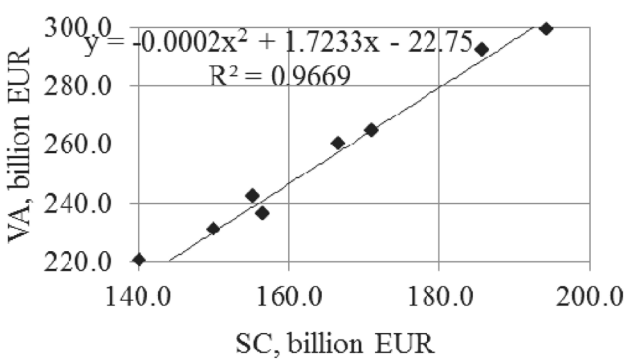


Figure 3.2. Small enterprises

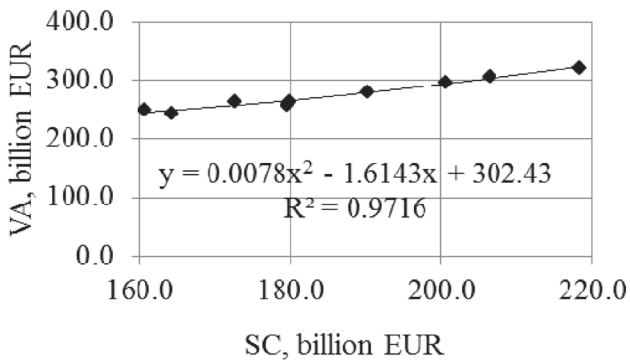


Figure 3.3. Medium enterprises

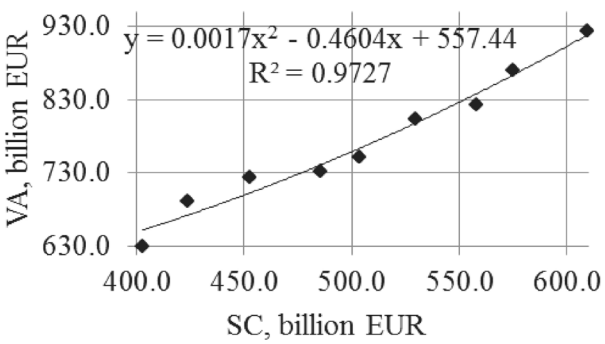
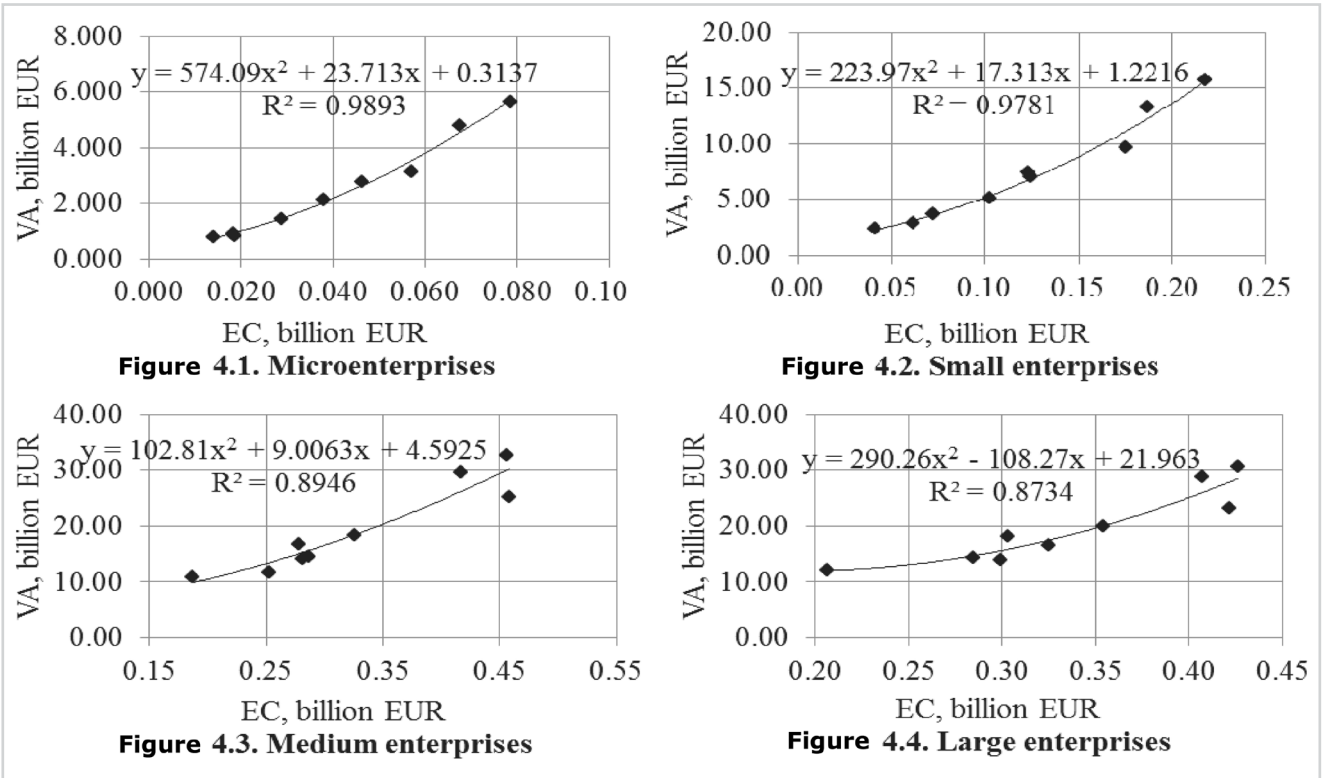


Figure 3.4. Large enterprises

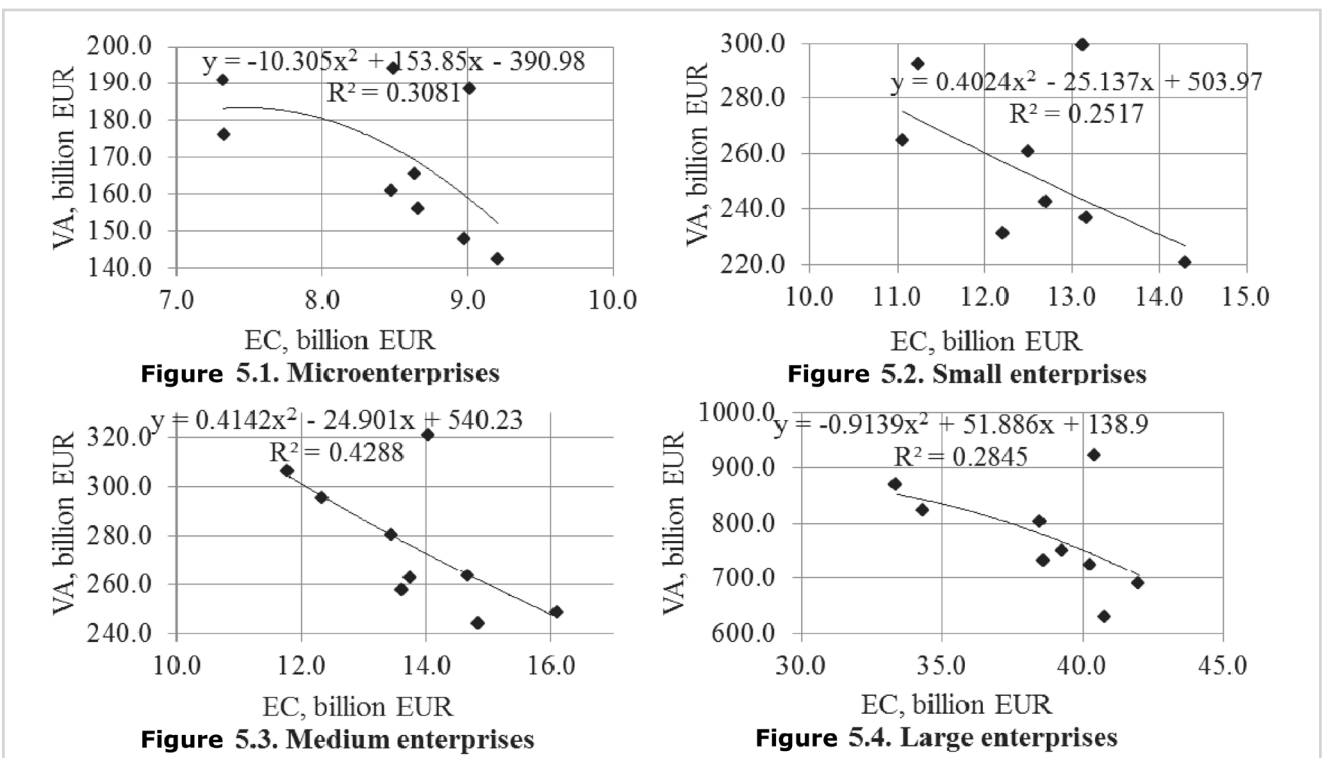
Note: SC - social costs, VA - value added

Figure 3:
The inverse and U-shaped quadratic dependence of value added on the social costs of German enterprises in 2011-2019
Source: Calculated by the authors based on data by Destatis (2020)



Note: EC - environmental costs, VA - value added

Figure 4:
U-shaped quadratic dependence of value added on the environmental costs of Ukrainian enterprises in 2011-2019
Source: Calculated by the authors based on data by State Statistic Service of Ukraine (2020)



Note: EC - environmental costs, VA - value added

Figure 5:
The inverse and U-shaped quadratic dependence of value added on the environmental costs of German enterprises in 2011-2019
Source: Calculated by the authors based on data by Destatis (2020)

Preliminary finding 2: a powerful impulse for sustainable development is possible with the accumulation of an appropriate base of eco-fixed assets. There is a direct dependence of value added on eco-expenditures, especially at the first stages of capital investment and current eco-expenditures.

5.3. The moderating role of IR

The publication of an integrated report facilitates investors' appraisal of the financial value contribution of social and environmental expenditures. With regard to the effect of IR itself, the paper finds a significant positive association between firms publishing an integrated report and firm value consistently over all company sizes.

This paper finds a significant association with firm value added for the interaction term of the squared aggregated environmental expenditures. Error rate is $p<0.05$ (for Ukrainian and German enterprises) and it confirms *the disclosure of an integrated report positively moderates the quadratic association between environmental expenditures and firm value added.*

Nevertheless, the contribution of in integrated report to the company value is positive only for those companies with low environmental protection costs or for those who pursue an active environmental strategy with a large volume of environmental protection costs (vertical form areas) (the rule of U-shaped curves). In these cases, the IR needs to justify to investors why the firm invests a little or a large amount of resources in social and environmental activities. By investing little or nothing in environmental activities, IR could harm a firm's reputation. Companies with an active environmental strategy can use IR to explain how high environmental costs benefit the company. Firms who dedicate a moderate amount of resources to environmental social and activities have a lower contribution to the firm value added when publishing an integrated report than firms that do not publish a report at all. Thus, the cost of publishing an integrated report seems to outweigh the benefits of explaining the need for environmental costs (horizontal area) (Figure 6).

The analysis of the squared social expenditures shows that the aggregated social expenditures (error rate is $0.009<p<0.10$) are moderated by IR. Thus, *the disclosure of an integrated report positively moderates the quadratic association between social expenditures and firm value.* Figure 7 plots the association between the aggregated social expenditures and firm value with and without the moderation of IR. There is a significant moderation effect through IR and solely a significant positive firm value contribution for all firms publishing an integrated report, the inverse U-shaped curve is shifted upwards parallelly.

Overall, IR seems to soften the link between environmental costs and firm value added, but not for social costs and firm value added. Technical knowledge may be required to understand the economic impact of environmental costs. Thus, without further explanation, the financial contribution of environmental expenditures is uncertain. In contrast, additional explanations are not required for social expenditures, as investors may expect certain social expenditures from the company to obtain an activity license. Social costs can be seen as a legitimate aspect of CSR, which investors can be interpreted well without publishing an integrated report.

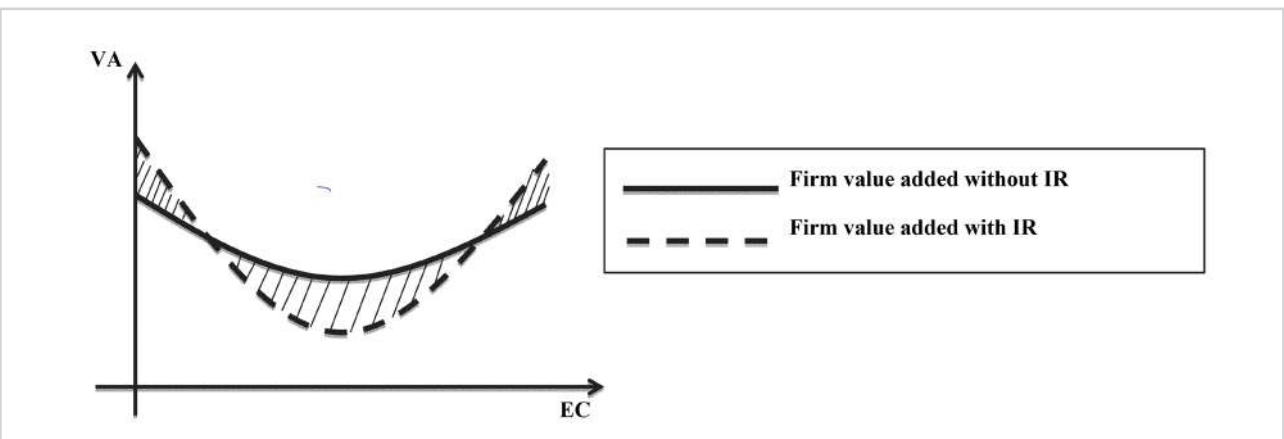


Figure 6:
The model of U-shaped relationship («too little of a good thing») between environmental expenditures (EC) and firm value added (VA), with and without moderation by IR
Source: Compiled by the authors

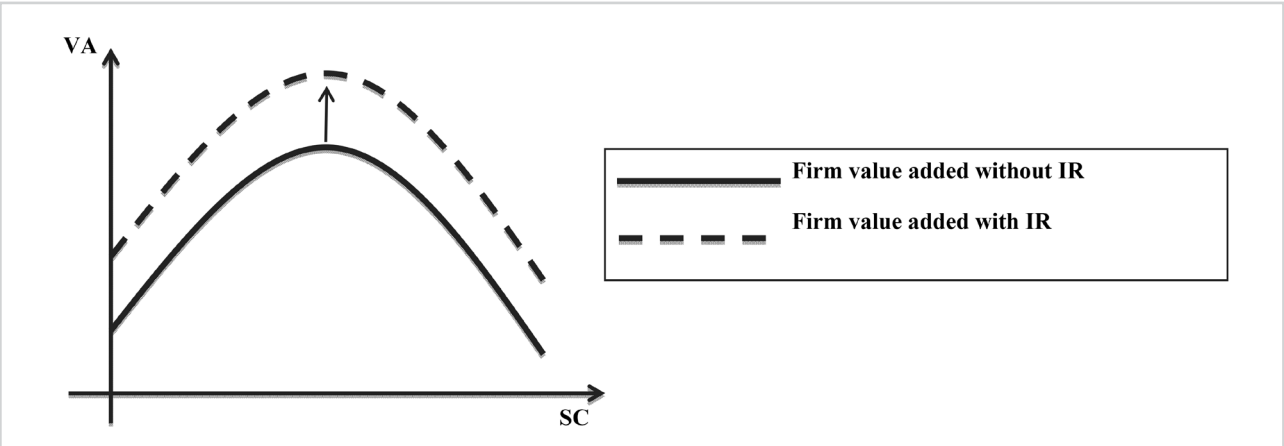


Figure 7:
The model of inverted U-shaped relationship («too much of a good thing») between social expenditures (SC) and firm value added (VA), with and without moderation by IR
Source: Compiled by the authors

6. Conclusions

This paper seeks to shed light on the effects of introducing and improving the practice of reporting on sustainable development. This was carried out by a mathematical analysis of the quadratic correlation and regression dependence of the added value of enterprises on the size of social and environmental costs. For this, we develop hypotheses and test them on Ukrainian and German companies of various all sizes.

The results can be projected upon a significant U-shaped curve, which demonstrates the relationship between environmental costs and firm value added for Ukrainian and vice versa for German enterprises (micro and large enterprises). Social spending shows a significant inverted U-shaped relationship with firm value in Ukraine but large German enterprises drop out of this list. These results accord with the previously discussed views that a cost-related school and a value-creating school coexist. And the main focus should be aimed on quadratic models. Regarding the deterrent effect of IR, the results show that IR moderates the U-shaped relationship between environmental spending and firm value added, but not social spending and firm value added.

This paper's contribution to research on integrated reporting and sustainable development is relevant for scholars and practitioners - managers and investors in particular. Managers should be aware that there is a minimum level of environmental protection costs necessary to create a positive value-added effect for the company. In this sense, companies who purse an active environmental strategy can benefit from integrated reporting. Managers should also be aware that there is a maximum of social costs after which the marginal added value decreases. The publication of an integrated report entails a positive impact on the value of the company, regardless of social costs. Investors may be interested in looking not only at the output of CSR variables (for example, ratings, CO_2 emissions and so on), but also at the input variables of CSR, such as the costs of CSR, to improve their investment situation.

The above models of the dependence of the added value of the enterprise on social / environmental costs and, accordingly, the level of sustainable development need to be interpreted carefully. The implication that managers should invest in an active environmental strategy thereby incurring environmental costs. In the context of social costs, there is mainly a direct correlation of expenses and sustainable development.

Based on the above conclusions, Ukraine and Germany could consider expanding mandatory integrated reporting beyond large and medium-sized enterprises. Small enterprises could also benefit from integrated reporting (according to some statements of EU countries, this should be mandatory). And this is the near future.

So, the general hypothesis of the ability of the Accounting Institute to ensure the sustainable development of entrepreneurship is confirmed. Moreover, accounting methods are reinforced with transformed integrated reporting. The objective of this reporting is not only a statement of facts but also forecasting. Now accounting is expanding its authority not only by stating the facts of socio-economic events, but also fulfils the function of forecasting and ensuring sustainable development.

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Economic development of fishery and accounting support of cost management for biological conversion in fish farming of Ukraine comparing to the other CEE countries

Abstract. Over the last decade, the fishing industry in Ukraine has a negative trend, while in the other CEE countries (Belarus, Poland, and The Czech Republic) there is an increase in production. The study highlights the strengths and weaknesses of the industry in Ukraine and its international trade capacity in comparison with some other CEE countries. It is stated that the economic efficiency of growing domestic fishery products is determined by the level of its costs and market price impacted by producers to a much higher extent than in any other type of agricultural product.

We determine that the main problem with regard to accounting and analytical support of biological transformations in fisheries is the lack of theoretical substantiation and the imperfection of the methodology of accounting management of the costs of biological transformations in the field. It is emphasized that the basic condition for effective management of costs for the production of fishery products and providing accounting information about them is the existence of sound accounting methodology for managing the costs of biological transformation.

Controlled (relevant) segments in the fisheries sector are identified to solve the problem with their simultaneous division into separate production processes (repartitions). The application of the proposed classification of production redistribution will improve the system of synthetic and analytical accounting of biological assets and biological transformations and will provide information needed for managers.

The influence of organizational and technological peculiarities of the aquaculture production process on the developing of the accounting system of fishery enterprises has been investigated which gives the opportunity to develop and implement an adequate accounting system of cost management at the enterprises of the branch. It is stated that the main prerequisite for effective cost management is the objective display of cost information in space and time.

We propose to appoint the cost of production of fishery products at the end of each production redistribution. At the end of the calendar year, the costs of each redistribution the cycle of which has not been completed should be considered as an unfinished production of the fisheries industry. The expediency of accepting the total volume of production in natural meters as the basis for the distribution of indirect fisheries costs is substantiated. The examples of calculations and accounting approaches are given to support the authors' statements and conclusions.

Keywords: Biological Assets; Agricultural Products; Production Costs; Fish Farming; Fishery Enterprise; Aquaculture; Biodiversity; Polyculture Growing; Expenditure Accounting; Accounting Of Production Process; Method Of Accounting For Biological Assets; Information Management
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Економічний розвиток рибогосподарського комплексу й облікове забезпечення управління витратами на біологічні перетворення в рибницьких господарствах України порівняно з іншими країнами ЦСЄ

Анотація. За останнє десятиріччя рибницька галузь в Україні має негативну тенденцію, тоді як в інших країнах ЦСЄ (Білорусі, Польщі, Чехії) спостерігається нарощення обсягів виробництва. У дослідженні виділено сильні та слабкі сторони розвитку галузі в Україні та її експортно-імпортний потенціал порівняно з іншими країнами ЦСЄ. Вказано, що економічна ефективність вирощування продукції вітчизняного рибництва визначається рівнем її собівартості та ринковою ціною, вплив на яку товаровиробник має значно вищий порівняно з іншими видами аграрної продукції. Це обумовлено тим, що на ринок продукція надходить безпосередньо від виробника до споживача, без участі численних посередників. Означений вид агробізнесу є конкурентоспроможним й економічно привабливим з точки зору залучення інвестицій.

У статті визначено, що основною проблемою щодо обліково-аналітичного забезпечення біологічних перетворень у рибництві є недостатність теоретичного обґрунтування й недосконалість методики облікового забезпечення управління витратами на біологічні перетворення в даній галузі. Наголошено, що основною умовою ефективного управління витратами на виробництво продукції рибництва та забезпечення обліковою інформацією про них є наявність обґрунтованої методики облікового забезпечення управління витратами на біологічні перетворення.

Для вирішення проблеми визначено контрольовані (релевантні) сегменти у рибницькій галузі з одночасним їх поділом на окремі виробничі процеси (переділи). Застосування запропонованої класифікації переділів виробництва поліпшить систему ведення синтетичного й аналітичного обліку біологічних активів і біологічних перетворень, а також забезпечить інформаційні потреби менеджерів.

Авторами досліджено вплив організаційно-технологічних особливостей процесу виробництва продукції аквакультури на побудову системи бухгалтерського обліку рибогосподарських підприємств, що дає можливість розробити та впровадити адекватну систему облікового забезпечення управління витратами на підприємствах галузі. Зазначено, що основною передумовою ефективного управління витратами є об'єктивне відображення інформації про витрати в просторі та часі. Запропоновано розподіл загальновиробничих витрат і калькулювання собівартості продукції рибництва здійснювати після завершення кожного виробничого переділу. Із завершенням календарного року витрати кожного переділу, цикл якого не завершений, слід вважати незавершеним виробництвом галузі рибництва. Обґрунтовано доцільність прийняття за базу розподілу непрямих витрат рибництва загальний обсяг виготовленої продукції в натуральних одиницях виміру. На підтвердження заявлених підходів і висновків авторів наводяться приклади розрахунків й алгоритми ведення обліку.

Ключові слова: біологічні активи; сільськогосподарська продукція; виробничі витрати; рибництво; рибне підприємство; аквакультура; біорізноманіття; вирощування полікультури; облік витрат; облік виробничого процесу; метод обліку біологічних активів; управління інформацією.

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Экономическое развитие рыбохозяйственного комплекса и учетное обеспечение управления расходами на биологические преобразования в рыбоводных хозяйствах Украины по сравнению с другими странами ЦВЕ

Аннотация. За последнее десятилетие рыбная отрасль в Украине имеет негативную тенденцию, тогда как в других странах ЦВЕ (Беларуси, Польше, Чехии) наблюдается наращивание объемов производства. В исследовании выделены сильные и слабые стороны развития отрасли в Украине и ее экспортно-импортный потенциал по сравнению с другими странами ЦВЕ. Указано, что экономическая эффективность выращивания продукции отечественного рыбоводства определяется уровнем ее себестоимости и рыночной ценой, влияние на которую товаропроизводитель имеет значительно выше по сравнению с другими видами аграрной продукции. Это обусловлено тем, что на рынок продукция поступает непосредственно от производителя к потребителю, без участия многочисленных посредников. Указанный вид агробизнеса является конкурентоспособным и экономически привлекательным с точки зрения инвестиций.

Определено, что основной проблемой учетно-аналитического обеспечения биологических преобразований в рыбоводстве является недостаточность теоретического обоснования и несовершенство методики учетного обеспечения управления затратами на биологические преобразования в данной области. Отмечено, что основным условием эффективного управления затратами на производство продукции рыбоводства и обеспечение учетной информацией о них является наличие обоснованной методики учетного обеспечения управления затратами на биологические преобразования.

Для решения проблемы определены контролируемые (релевантные) сегменты в рыбоводческой отрасли с одновременным их разделением на отдельные производственные процессы (переделы). Применение предложенной классификации переделов производства улучшит систему ведения синтетического и аналитического учета биологических активов и биологических преобразований, а также обеспечит информационные потребности менеджеров.

Авторами исследовано влияние организационно-технологических особенностей процесса производства продукции аквакультуры на построение системы бухгалтерского учета рыбохозяйственных предприятий, что дает возможность разработать и внедрить адекватную систему учетного обеспечения управления затратами на предприятиях отрасли. Указано, что основной предпосылкой эффективного управления затратами является объективное отражение информации о расходах в пространстве и времени. Предложено распределение общепроизводственных затрат и калькулирование себестоимости продукции рыбоводства осуществлять после завершения каждого производственного передела. По завершении календарного года расходы каждого передела, цикл которого не завершен, следует считать незавершенным производством отрасли рыбоводства. Обоснована целесообразность принятия за основу распределения косвенных расходов рыбоводства общего объема произведенной продукции в натуральных измерителях. В подтверждение заявленных подходов и выводов авторов приводятся примеры расчетов и алгоритмы ведения учета.

Ключевые слова: биологические активы; сельскохозяйственная продукция; производственные затраты; рыбоводство; рыбное предприятие; аквакультура; биоразнообразие; выращивание поликультуры; учет затрат; учет производственного процесса; метод учета биологических активов; управление информацией.

1. Introduction

In the modern economic conditions, there is a problem of finding new methods of cost management in fisheries in order to reduce the cost of production and ensure its competitiveness. However, the situation is compounded by the fact that fisheries were in the nascent stages of economic reform and have not yet acquired adequate logistical and financial support, and the issue of accounting and analytical support for cost management was not given a separate role. Today the situation has changed dramatically. Management decisions are made based on data of accounting and analytical information system.

In our study, we pay a particular attention to the economic and accounting category of general production costs (overhead costs) as they are called in the Ukrainian national instructions to the accounting based on IAS 2 - «Inventories». Overhead costs have different referring and explanations in economic literature. In regard to our subject, which is fishery and production, they are also called indirect manufacturing costs and factory overhead. They include direct factory-related costs that are incurred when producing a product. Overhead is also used to characterize three general kinds of costs, namely: those for indirect materials, indirect labour, and all other miscellaneous production expenses (for example, taxes, insurance, depreciation, supplies, utilities, and repairs) upon the specific national regulation and practice in place.

The information base of the research includes the latest data of CEE national statistics services as of the beginning of 2020. Therefore, the period under analysis and investigation is

2011-2018. As far as the process of increasing the volume of fishery products production is time- and resource-consuming, the tendencies and situation shown in our research stay relevant for the years ahead.

2. Brief Literature Review

The systematic research of accounting support of cost management of the enterprise through the prism of management needs have recently been opened up in the works of leading domestic scientists conducting research in the field of cost accounting methodology, as well as the foreign ones: M. Milling (2019), F.-A. Guinea (2016), C. Cretu and V. Gheonea (2011), J. D'Souza et al. (2000), H. Saygili (2009).

In Ukrainian practice there is experience in determining the methodology for accounting for the costs of production of biological assets. In particular, O. Smolskaya (2015) examined the state of accounting for production costs in crop production, T. Vovchuk (2009) - in forestry. Many methodological recommendations for accounting in fisheries are provided by N. Vdovenko et al. (2007, 2017). The main components of agricultural accounting policies have been investigated by I. Tomashuk (2019), N. Zdyrko (2012), N. Pravdiuk (2005) and others. However, the issue of accounting for the management of expenditures on biological assets of fisheries has not been adequately addressed and needs more analysis.

3. The purpose of the paper consists in the theoretical and methodological substantiation and development of practical recommendations for the improvement of accounting management of the costs of biological transformations in fisheries, in particular the accounting and distribution of general production costs (overhead costs).

4. Results

The fisheries sector of Ukraine plays a significant role in providing the population with food and the sectors of national economy - with raw materials. This branch of agribusiness contributes to the reproduction of natural resources and increases the employment of the population.

The dynamics of aquatic bioresources production in Ukraine over the last decade has been negative. The fish catch in 2018 decreased by 17 thousand tonnes (or 21%) compared to 2017 and according to State Fiscal Service of Ukraine data amounted to 64.7 thousand tonnes (Table 1).

The occupation of Crimea has become one of the most negative consequences for the development of domestic fisheries. As a result, fishing ports and fisheries enterprises were lost to fisheries research institutions (Pravdiuk, 2017). State Fiscal Service of Ukraine since 2014 provides data on the volume of extraction of other aquatic living resources, without taking into account the temporarily occupied territory of the Autonomous Republic of Crimea and Sevastopol. Therefore, we consider it advisable to carry out the survey for 2009-2018 without taking into account the indicators of the mentioned territories (Figure 1).

According to the results of the study, it is concluded that the volume of extraction of living aquatic bioresources, and therefore of fish directly, in Ukraine during this period tends to decrease.

Considering the statistics of the fishing industry in foreign countries (Belarus, The Czech Republic, Poland), it is concluded that the decline of the industry is observed in Ukraine (Figure 2).

Table 1:
Extraction of aquatic bioresources*

No.	Year / Units of measurement	Aquatic bioresources	Growth rate	Including fish	Growth rate
		tonnes	in % to the previous period	tonnes	in % to the previous period
3	2011	80848		80273	
4	2012	77057	-4.69	76048	-5.26
5	2013	83485	8.34	82353	8.29
6	2014	91252	9.30	80958	-1.69
7	2015	88552	-2.96	73963	-8.64
8	2016	88443	-0.12	78490	6.12
9	2017	92645	4.75	81875	4.31
10	2018	86222.5	-6.93	64737.9	-20.93

Note: * - excluding the temporarily occupied territory of the Autonomous Republic of Crimea and Sevastopol.

Source: State Fiscal Service of Ukraine, 2020b

The analysis of the available actual statistics of the main economic indicators of the activities of fishery enterprises showed that despite the loss of fish production, this type of agribusiness is quite competitive and economically attractive from the point of view of investments.

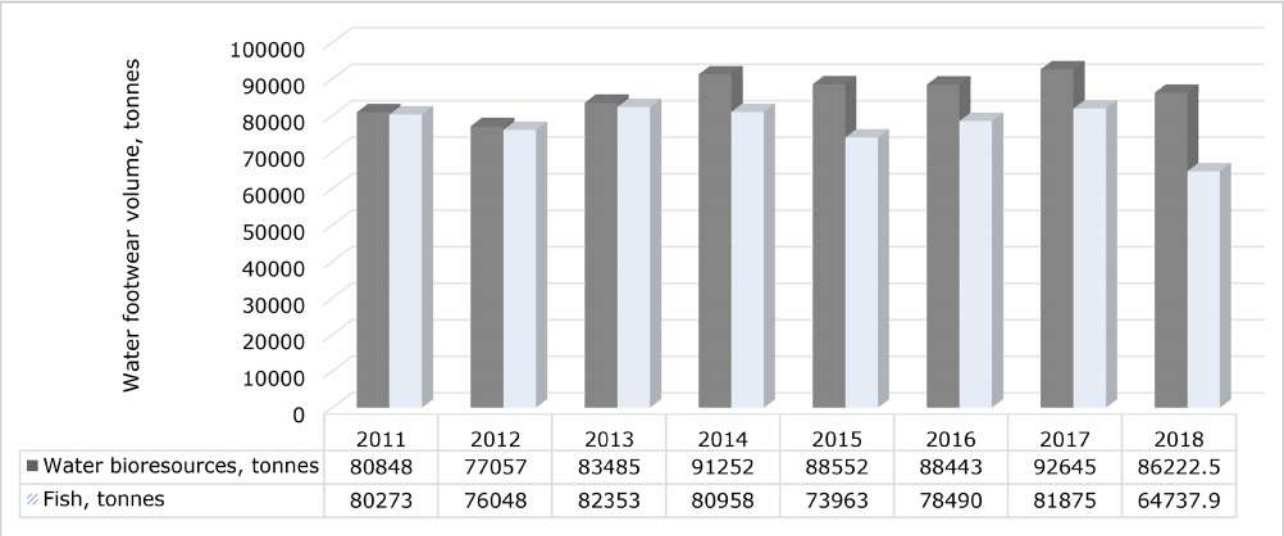

Figure 1:
Catching of fish and extraction of other aquatic living resources in 2011-2018*, tonnes
Note: * - excluding the temporarily occupied territory of the Autonomous Republic of Crimea and Sevastopol.
Source: State Fiscal Service of Ukraine, 2020b

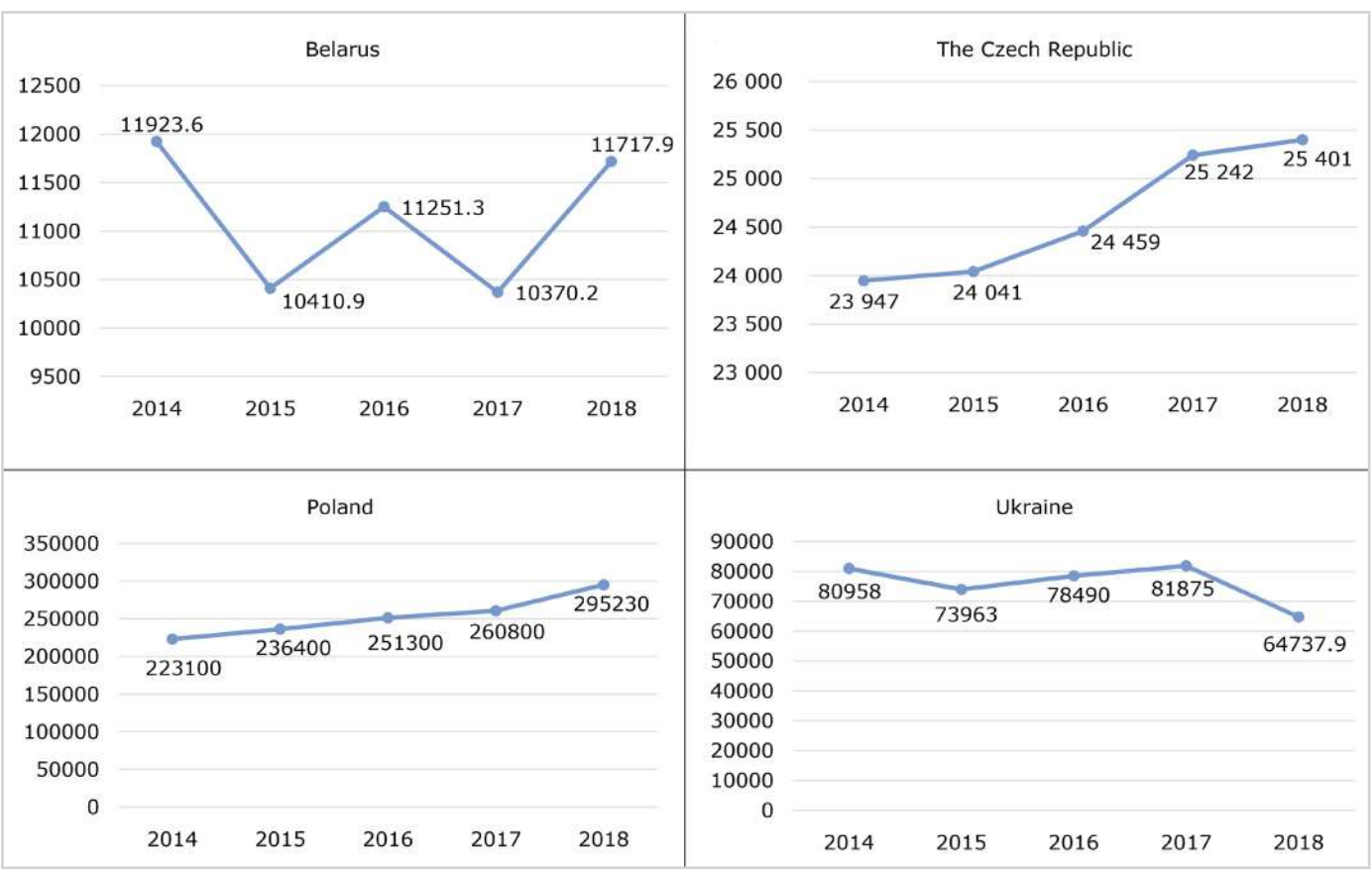

Figure 2:
Catching of fish and extraction of other aquatic living resources in 2011-2018*, tonnes
Note: * - excluding the temporarily occupied territory of the Autonomous Republic of Crimea and Sevastopol.
Source: State Fiscal Service of Ukraine, 2020b

Fisheries allow for high income in a small area and require a minimum of technical means compared to other agrarian sectors of the economy and stable solvent demand for products.

According to the calculated statistics, in 2018 in Ukraine the consumption of fish and fishery products is 11.8 kg per person a year, which is 9.2% more than the consumption of the similar product in 2017. For reference: the rational rate of consumption of fish and fishery products by Ukrainians, according to the recommendations of the Ministry of Health, was set at the level of 20 kg per person a year, which was not achieved during the years of Ukraine's independence. The results of the analysis of the consumption of staple food by one person are grouped in Figure 3.

A large proportion of the supply of fishery products in the domestic market is provided by imports, which according to balance sheet calculations account for 75% of domestic consumption. According to operational customs data, in 2018, imports of fish and fishery products increased by 10% to 344 thousand tonnes. Three quarters of imports of fishery products are frozen fish, the main suppliers of which are Iceland, Norway and the USA.

We will analyze the volume of foreign trade turnover of fishery and fishery products of Ukraine for 2011-2018 by the sum of codes 301-308 of the Ukrainian Classifier of Goods of Foreign Economic Activity.

These are products such as: 301 «Live fish», 302 «Fresh or chilled fish», 303 «Frozen fish», 304 «Fish fillets and other fish meat», 305 «Dried, salted, smoked fish», 306 «Crustacea», 307 «Shellfish», 308 «Water invertebrates» (Table 2).

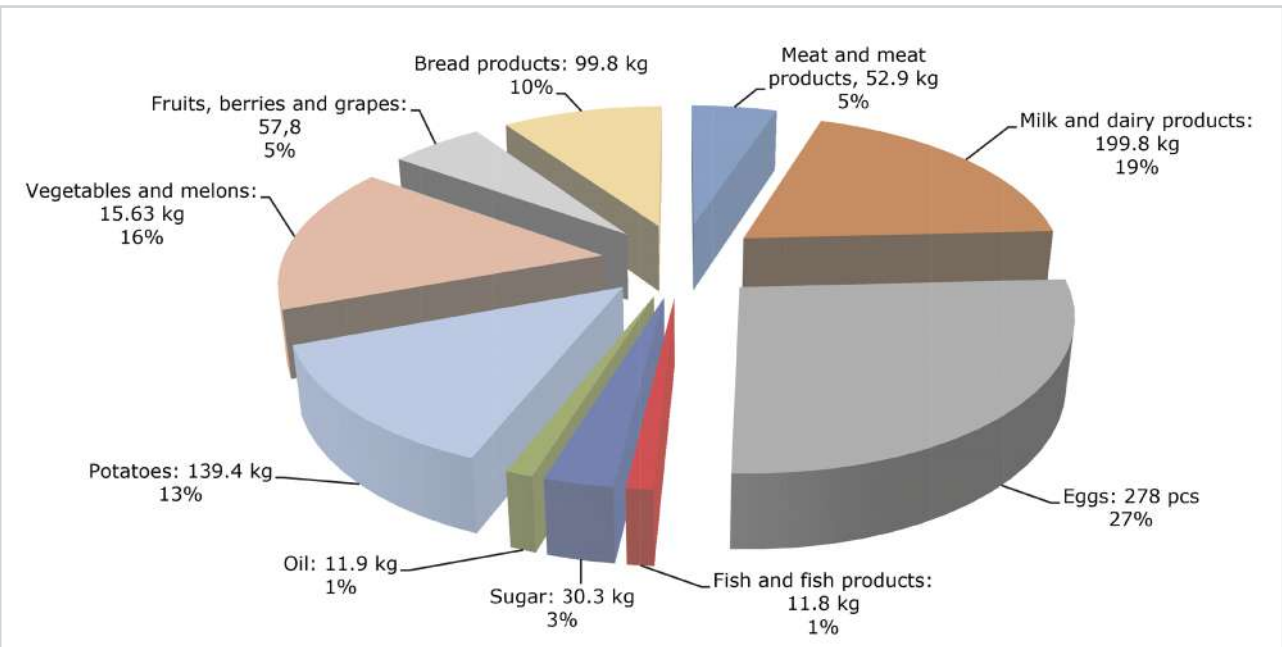

Figure 3:
Consumption of staple food by one person for 2018 in absolute and relative terms
Source: State Fiscal Service of Ukraine, 2020a

Table 2:
Total imports and exports of fish and fishery products 2011-2018, USD thousand

Year	Import Value, USD thousand	Imports, net weight, tonnes	Growth rate, %	Exports Value, USD thousand	Exports net weight, tonnes	Growth rate, %	Balance, USD thousand
2011	505472	346810		4327	883		-501145
2012	687663	382775	10.37	5802	2917	34.09	-681861
2013	863372	415310	8.50	9291	2884	60.13	-854081
2014	595504	308677	-25.68	10228	1699	10.09	-585276
2015	292237	210415	-31.83	10952	2973	7.08	-281285
2016	409982	272709	29.61	17007	5172	55.29	-392975
2017	455527	296391	8.68	26376	5311	55.09	-429151
2018	549529	344424	16.21	24982	4887	-5.29	-524547
	4359286	2577511		108965	26726		-4250321

Source: State Statistics Service of Ukraine, 2020

Therefore, the volume of imports and exports of aquaculture products is increasing every year. In addition, the growth rate of exports of these products exceeds the growth rate of imports. However, one should not be comforted by the ghostly gains on increasing exports from Ukraine. Ukraine specializes in supplying low-processed products.

Exports are focused on raw fishery products and without a radical restructuring of the industry Ukraine will not be able to take full advantage of export expansion opportunities. It is worth noting that the supply of fishery products in the domestic market is mainly provided through imports.

The structure of import and export deliveries of products according to the above codes is shown in Figure 4.

According to the calculations made on the basis of State Statistics Service of Ukraine and State Fiscal Service of Ukraine data, the share of imported fish and fishery products is about 70% of total consumption in Ukraine (Figure 5).

It is not worth expecting a decrease in imports in 2019-2020. As the process of increasing the volume of production of Ukrainian fishery products is long and requires considerable investment.

According to the results of the analysis of fish and aquatic bioresources by species, it was determined that the following aquatic bioresources were recovered in Ukraine in 2018: marine goby (18.2%) carp (14.2%), silver carp (15.4%), crucian carp freshwater (12.5%). The catch of other fish is not significant. The results of the study are reflected in Figure 6.

The economic efficiency of growing domestic fishery products is determined not only by the level of its cost, but also by the market price, on which the producer influences more in comparison with other kinds of agricultural products. This is due to the fact that in the market the products come directly from the producer to the consumer, directly, without the participation of numerous intermediaries.

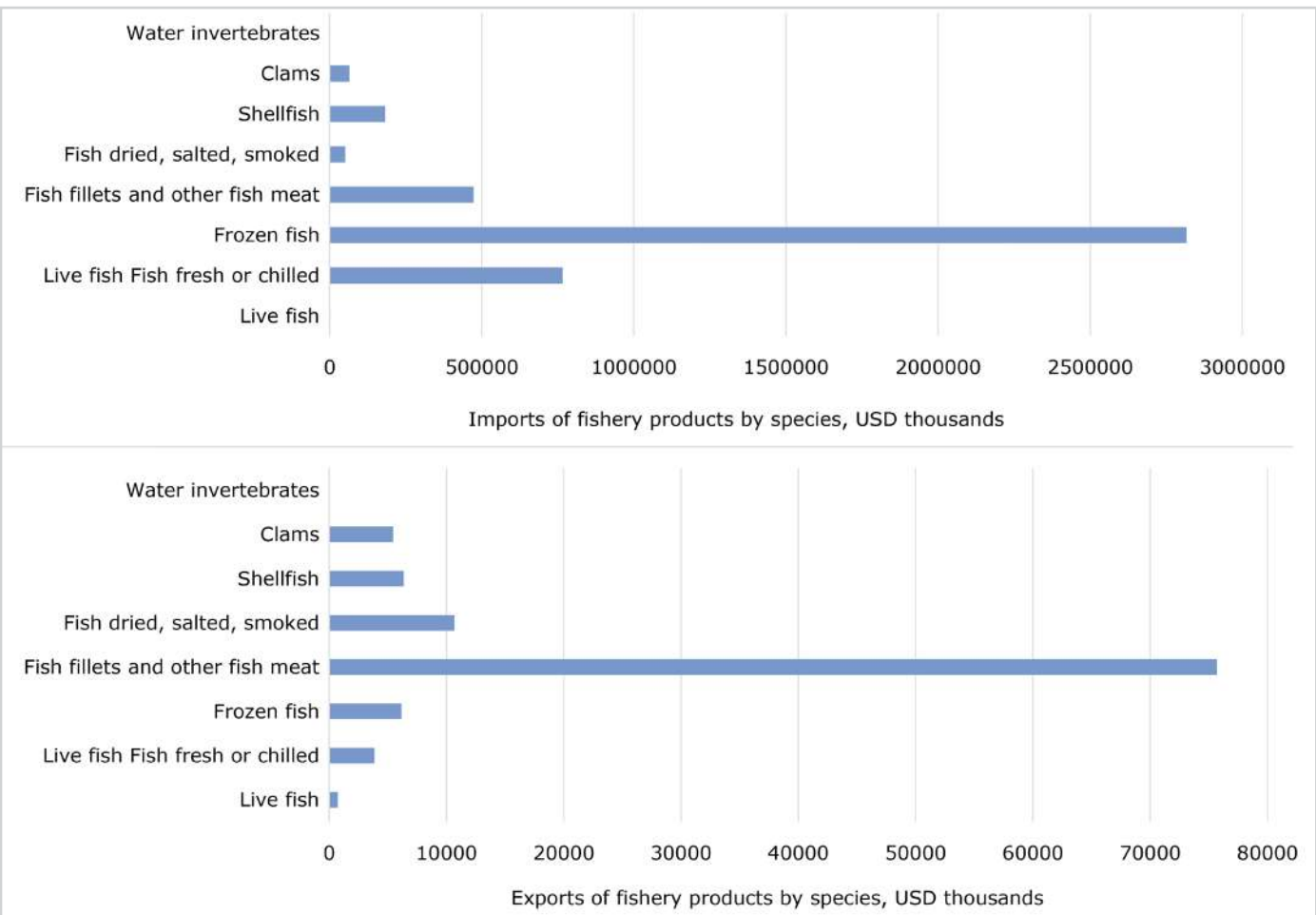

Figure 4:
Structure of import and export deliveries for 2011-2018
Source: State Statistics Service of Ukraine, 2020

The main factors hampering the development of fisheries in Ukraine are:

- not rational use of reservoirs: most of them are neglected;
- disproportionately high rents for water resources set by local government officials;
- high price of feed, which in turn raises the price of fish products. For example, in order for the carp to gain 1 kg of weight, it is needed 3 kg of feed. In case of refusing to feed the fish with expensive feed, the fish productivity is significantly reduced;
- a narrow range of farmed fish (fish farms mainly grow carp, silver carp and white carp, and all other fish species in small numbers).

Equally important factor in slowing down fishery development is the emigration of highly skilled fish farmers outside Ukraine in search of a decent income. Non-regulation of legal norms adversely affects the activities of both state and private fisheries enterprises.

Strong revolutionary decisions are needed to raise fisheries. Use of state-level reservoirs for their rational use should be streamlined. In addition, as Ya. Ishchenko points out, «modern market economic relations determine the need for changes in the fishery strategy, according to which priority should be given to increasing gross production and expanding the range of products with the use of modern intensive industrial technologies» (Ya. Ishchenko, 2016a).

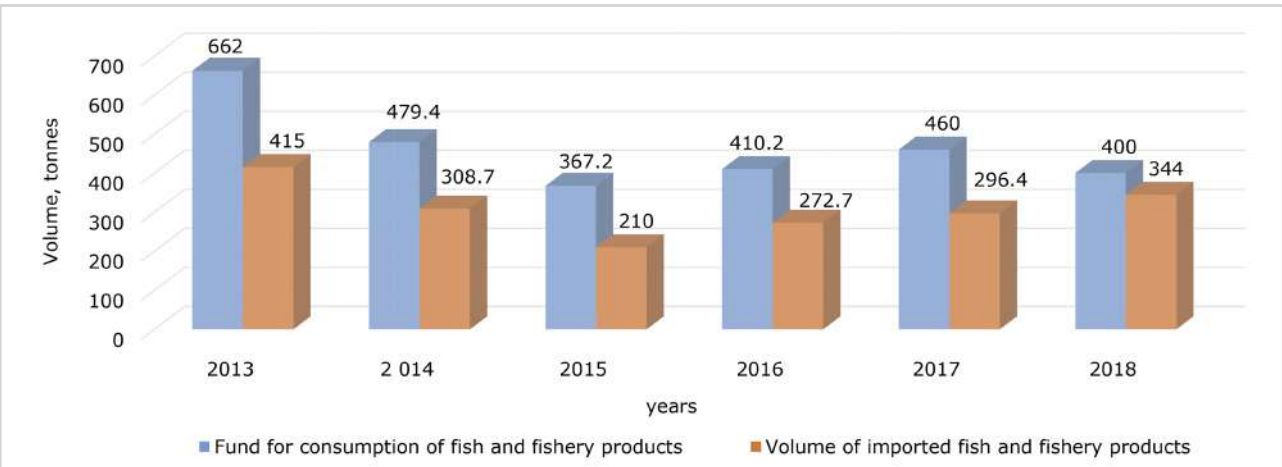

Figure 5:
The share of imports in the total consumption of fish and fish products by Ukrainians
Source: Compiled by the authors using data of State Statistics Service of Ukraine (2020), State Fiscal Service of Ukraine (2020a)

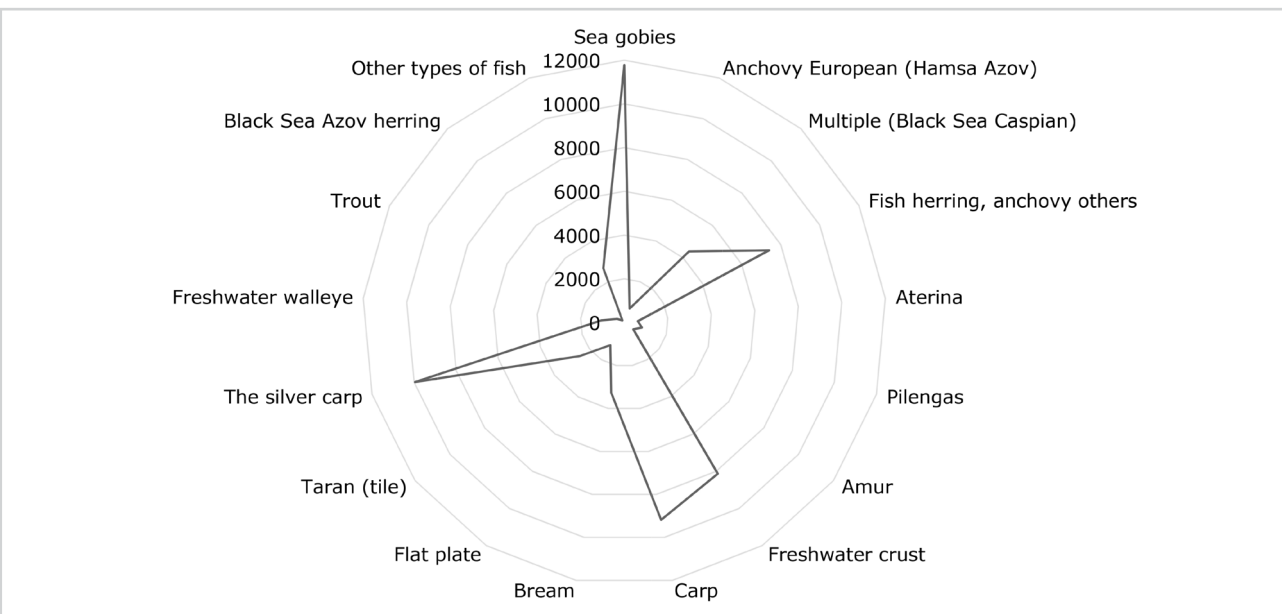

Figure 6:
Fish catch in Ukraine by species in 2018, tonnes
Source: Compiled by the authors using data of State Fiscal Service of Ukraine (2020b)

In order to properly implement the latter proposal, again, the government intervention is required to financially support these measures. To solve the problem at the micro level, you need to create a cost management system that includes information and accounting segments. M. Pravdiuk (2017) concluded that the implementation of the accounting function in the management system is possible through the improvement of the management production mechanism of aquaculture products - the development of theoretical, organizational and methodological provisions of accounting support for production and display of accounting information in the enterprises' reporting.

The goal of biological transformation management is to optimize the use of enterprises' resources in the process of their activity.

Therefore, to manage the costs of biological conversion in fisheries, the following issues need to be addressed:

1) to identify segments of production that are constantly influenced by the managers of the enterprise;
2) to formulate an overall strategic goal of reducing costs in the production of fisheries products;
3) to provide an objective distribution of costs in space and time.

To solve the first problem, we have identified controlled (relevant) segments in the fisheries sector, with the simultaneous division of them into separate production processes (redistribution). Such segments are the stages of biological transformation in fisheries. Taking into account the specificity of the fishery products production, we propose to apply a preliminary method of cost accounting and calculation, the main purpose of which is to calculate the cost of a particular product at the completion of each stage of biological transformation (Table 3).

In the management of costs, there are two areas: the first one is management of production of a specific product, and the second one is management of homogeneous technological operations. Each redistribution is a separate essential production process in the production of fishery products.

Production structure for the product involves the creation of independent production units, focused on the production and marketing of specific products. In fisheries, the example of such production units may be the unit for the cultivation of fish material, the unit for the production of commercial fish etc. The production structure, organized by homogeneous technological operations, involves the creation of production units focused on the execution of special technological

Table 3:
Stages of biological transformation and determination of the objects of calculation in the fisheries' cost accounting method

The redistribution number	Stage of biological transformation	Type of product (biological asset)	Unit of calculation	Calculation period
1	2	3	5	6
1 redistribution of production	0 stage of biological transformation	primordial, larva, fries	1 thousands of pieces, 1 kg, 1 h.	the period of catching or changing the location of the biological asset or finished product
2 redistribution of production	I stage of biological transformation	this year or 1 summer old (fish age: 0+)	1 thousands of pieces, 1 kg, 1 h.	
3 redistribution of production	II stage of biological transformation	1 year old (fish age: 1)	1 thousands of pieces, 1 kg, 1 h.	
4 redistribution of production	III stage of biological transformation	2 summer old (fish age: 1+)	1 thousands of pieces, 1 kg, 1 h.	
5 redistribution of production	IV stage of biological transformation	2 years old (fish age: 2)	1 thousands of pieces, 1 kg, 1 h.	
6 redistribution of production	V stage of biological transformation	3 summer old (fish age: 2+) commodity fish over a two-year production cycle	1 thousands of pieces, 1 kg, 1 h.	
7 redistribution of production	VI stage of biological transformation	3 years old (fish age: 3), commodity fish over a two-year production cycle	1 pieces, 1 thousands of pieces, 1 kg, 1 h.	
8 redistribution of production	VII stage of biological transformation	4 summer old (fish age: 3+), commodity fish over a three-year production cycle, repair young	1 pieces, 1 kg, 1 h.	
9 redistribution of production	VIII stage of biological transformation	uterine stock (fetuses) maintenance costs increase the cost of the offspring	1 pieces, 1 kg, 1 h.	

Source: Compiled by the authors

operations on the same type of equipment, for example, units formed by types of production and specialized rates. Thus, most agricultural enterprises in the fisheries sector are enterprises with complex organizational and production structures. This leads to the construction of a complex structure of biological conversion cost management facilities. After all, the basic condition for effective management of costs for the production of fisheries products and provision of accounting information about them is the relationship between the objects of cost management and the objects of cost accounting. We agree with Ya. Ishchenko's statement that «to obtain information about a management entity, it is necessary to create a system of accounting that has elements identical to management entities» (Ya. Ishchenko, 2016b).

In order to accomplish the second task, it must be born in mind that cost management should not entail an absolute reduction in costs but should prevent the occurrence of potentially inefficient costs. That is, the costs incurred must be justified by the economic benefits received.

The costs of biological conversion in fisheries should be managed throughout the enterprise hierarchy. In fisheries, the cost management segments will depend on the organizational production and technological features of the enterprise which are highlighted in Table 4.

In order to solve the third problem, it is necessary to ensure that cost information is objectively presented in space and time. Accounting security is of particular importance for the management mechanism. Ya. Ishchenko (2016b) notes: «The concept of information security is broader and includes all the information used in the management system. As well as a complex of information technologies, hardware and software to ensure the receipt, processing and movement of information flows, while accounting and analytical support is an integrated accounting and analysis system that systematizes information to substantiate business strategy, coordinate directions of prospective development of the enterprise, systematic evaluation of the effectiveness implementation of tactical and strategic management decisions».

External information does not reflect the performance of an enterprise, but has a significant impact on its activity, because the enterprise operates not within an isolated space, but within the country, industry, certain territory. External information includes indicators of macroeconomic development of a country or industry; indicators that characterize the activities of counterparties and

Table 4:
Influence of organizational and technological features of biological transformations in fisheries on accounting of cost management

Features of accounting organization	Characteristics of the cost management accounting system
General features of fisheries as an industry	
1. Territorial location of the enterprise	Due to the number of days with moderate air temperature, water quality, the nature of soils, the natural fish productivity of the ponds depends on the reduction of the costs volume per unit of production.
2. Seasonality	Cost accounting in accordance with the stages of technological processes: 1) preparation for stocking; 2) stocking; 3) cultivation; 4) rounds, etc.
3. Number of production cycles	Depending on the length of the production cycle (2-year or 3-year), full-scale fisheries can calculate the cost of 1-year and 2-years.
4. The finished product is a special type of assets - biological assets	Organization of accounting of finished products (fries, commercial fish) and changes occurring in the process of biological transformation (increase in live weight).
Production and technological features	
1. Type of farm 1.1 Complete system	The presence of several cost accounting and costing items (fries, commercial fish). Organization of cost accounting in accordance with the stages of technological processes with increasing results. The presence of work in progress (the cost of this year's wintering joints). Organization of cost accounting using a detailed system of analytical accounts. Allocation of costs of basic, auxiliary and service industries.
1.2 Incomplete	Keeping records in one analytical account without division into technological groups. No work in progress. Applying one-tier method of cost accounting.
2. Form of reference 2.1.Extensive	There are no separate costs (feed, fertilizers).
2.2. Semi-intensive	Few feed costs (cost of grain waste from harvesting).
2.3. Intense	Significant increase in the share of costs for feed, fertilizers, aeration of water, mechanization of production processes and other measures aimed at improving fish productivity.
3. Method 3.2. Monoculture	Cost attribution for one species (breed) of farmed fish.
3.2. Polyculture	When calculating the cost, there is a problem of choosing a method of cost sharing between different species (species) of fish. Wide range of material resources used in production.
4. Species composition of fish	The presence of specific types of costs associated with the individual biological characteristics of individual fish species.

Source: Compiled by the authors based on findings by N. Vdovenko et al. (2007, 2017), M. Pravdiuk (2005), and O. Busenko (2005)

competitors; marketing research information. Internal management information system is formed through the planning, accounting and analysis of the enterprise (Figure 7).

Ya. Ishchenko (2016b) indicates that cost accounting in a management system is the process of obtaining, preparing, and transmitting cost information used by management to plan and control production situations and assess possible development trends within an organization.

It should be noted that the surveyed countries have introduced accounting for agricultural activities under IAS 41. However, in Poland, the Ministry of Agrarian Policy has undertaken the task of promptly bringing fair prices to each farmer. Whereas Belarus and the Czech Republic did not dare to take such a radical step as a complete abandonment of cost estimation. So, in Ukraine, it was decided to keep the cost estimate as a possible alternative valuation (V. Zhuk, 2007). There is therefore a need to account for direct and indirect costs of production. The algorithm for obtaining direct cost information in their exclusive presence is as follows: «Cost accounting object → direct cost information → general production cost information». Obtaining information on indirect unit costs is a more laborious process and requires a justification of the method for allocating such costs.

In fisheries, when growing products in monoculture, the share of direct costs will exceed the share of general production costs (overhead costs), and when growing in polyculture, a significant share of costs will be the overhead ones. IAS 2 - «Inventories» provides periodic distribution of overhead costs at the end of each calendar month. We propose to distribute the production costs of fisheries at the end of each stage of biological transformation. This will allow you to reliably determine the cost of the finished product or biological asset that is obtained upon completion of the production redistribution.

The procedure for allocating overhead costs is shown in Figure 8.

The algorithm for obtaining overhead costs is illustrated with a numerical example in Table 5.

In Table 5, the cost of fish-stock material for the stocking of a pond with an area of 20 hectares has been calculated according to the scheme of polyculture cultivation for the natural-climatic zone, characterized by an air temperature above 15 °C during the year 106-120 days (Ukraine - Forest-steppe). The calculation was made in accordance with the National Bank of Ukraine exchange rate USD 1 = UAH 27.42. The cost of fish-stocking material is the direct costs incurred in producing a particular product. The planting density is calculated for production at normal capacity.

The rest of the costs that will be incurred during production will be considered as overhead costs. The volume of such costs is directly proportional to the volume of production of commodity products. The consumption of feed and the protection of fish against disease, as well as the cost of loading and transportation when changing the location of fish products, depend on its quantity in natural meters. Cost will not be a factor in the impact of overhead costs.

Therefore, it is advisable to consider the total volume of production in natural meters as the basis for the distribution of indirect costs of fisheries.

We propose to calculate the share of the distribution base of individual accounting entities in the total volume of the distribution base by dividing a particular type of production by the total volume of manufactured products in natural meters (Table 6).

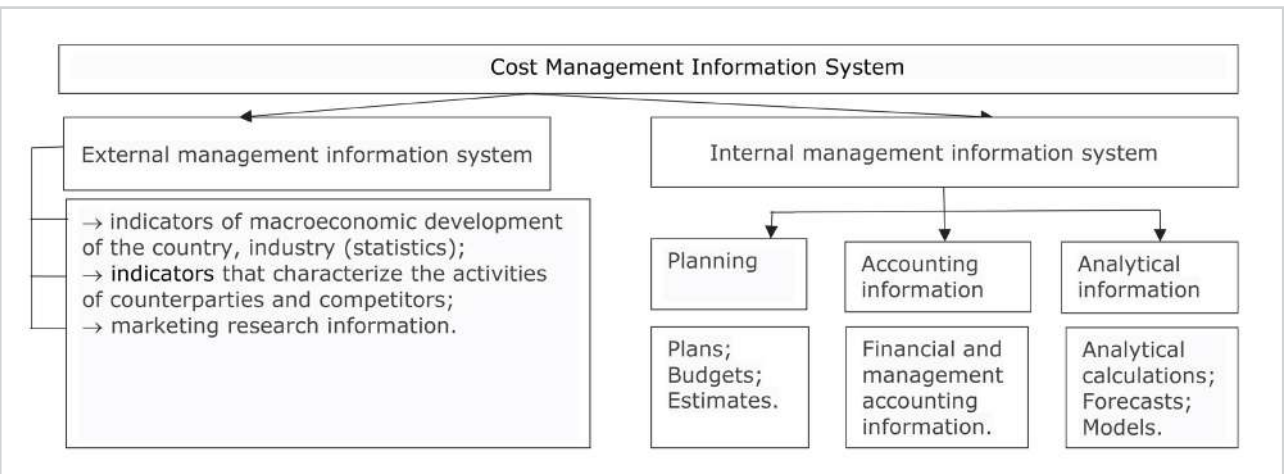

Figure 7:
Structure of information support of cost management
Source: Ya. Ishchenko (2016b)

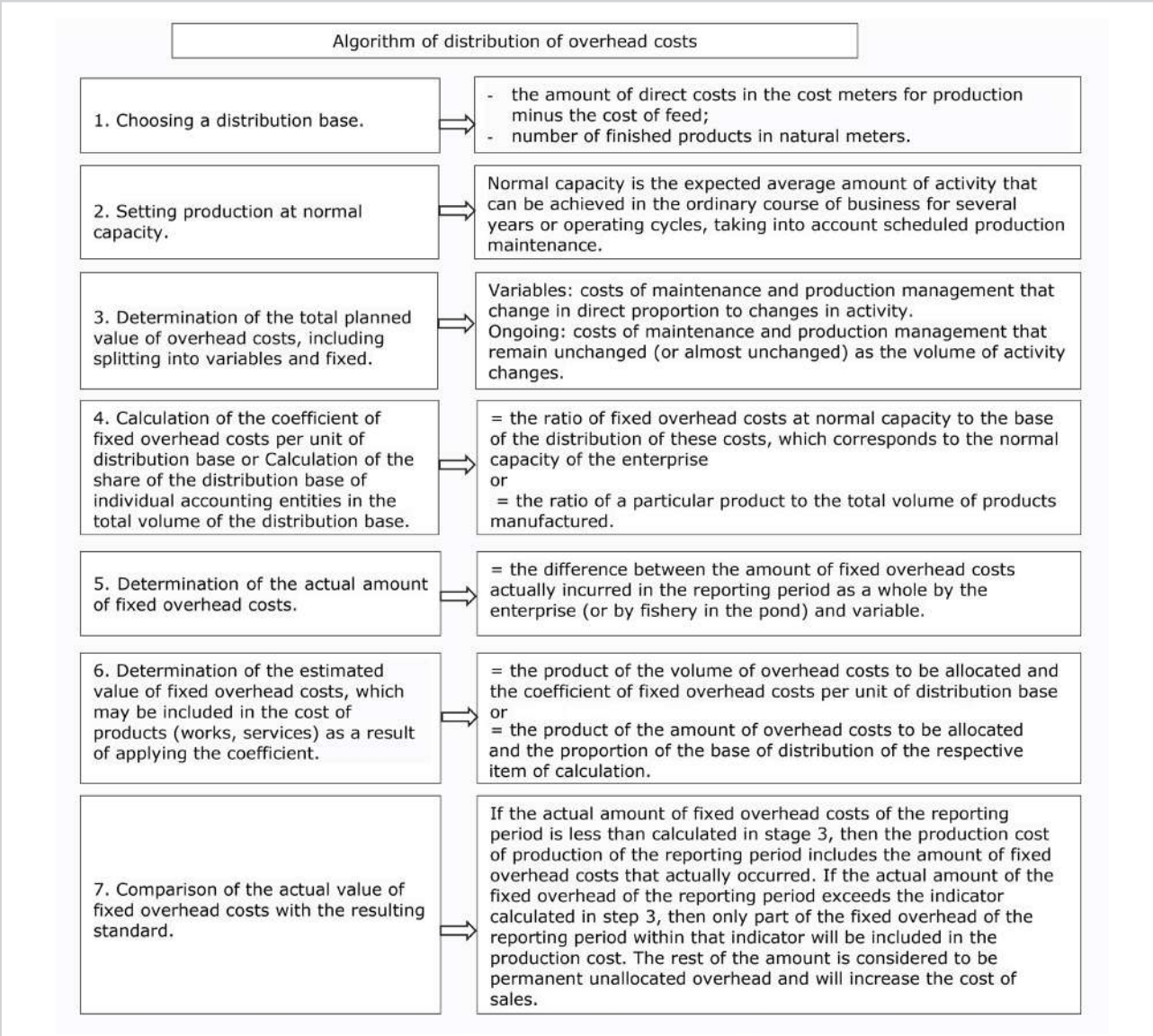

Figure 8:
Procedure for allocation of overhead costs in fishery
Source: Accounting Standard 16 «Costs»

Table 5:
Calculation of the cost of fish-stocking material for stocking

No.	Type of fish	Fish age, years	Density, thousand pieces / 20 ha	The total volume, kg	Price, USD	Cost, USD	Average final weight of 1 individual, kg	Output, %	Fish products, kg / 20 ha
1	Carp	1	30	750	1.53	1148.80	0.400	80	9600
2	Silver carp	1	40	1000	1.46	1458.79	0.400	80	12800
3	White cupid	1	4	120	0.84	100.66	0.400	80	1280
4	Pike	larvae	2	80	2.55	204.23	0.250	30	300
Total	X	X	X	X	X	2912.47	X	X	X

Source: Calculated by the authors

Table 6:
Calculation of the cost of farmed fish in polyculture

No.	Type of fish	Fish products, kg / 20 ha	Specific gravity (base of distribution)	Price, USD	Cost, USD	Costs at the point of sale, USD
1	Carp	9600	0400333	1.28	12253.83	-
2	Silver carp	12800	0.533778	1.09	14004.38	-
3	White cupid	1280	0.053378	0.84	1073.67	-
4	Pike	300	0.012510	1.82	547.05	-
Total	X	23980		X	27878.92	1557.99

Source: Calculated by the authors

Fixed overhead costs for fish production in polyculture are: depreciation of fixed assets, share of the cost of renting hydraulic structures, costs of labour of fish farmers and security guards at the ponds and accrual to the payroll fund (total USD 23380.11 see Table 7). The standard volume of these costs at normal capacity is USD 23705.32. When comparing the normative and actual index of fixed overhead costs, it is concluded that fixed overhead costs are subject to distribution in full, since their amount at actual capacity was less than the standard indicator.

Management accounting for the cost of producing fish is shown in Table 7.

Using this methodology will ensure that one of the functions of management accounting is to provide objective information about the cost of production for a particular type of product. As a result, management will be provided with information on the production cost of each type of production in the polyculture. This segment of information will provide objective pricing and the ability to analyze the efficiency of production of each type of fish products.

Table 7:
Accounting for general production costs, USD

Type of Costs	Cost Articles	Manufacturing «Carp»	Manufacturing «Silver carp»	Manufacturing «White Cupid»	Manufacturing «Pike»
Direct	Cost of fish material	1148.80	1458.79	100,66	204,23
Normative fixed overhead costs		*23705,32*			
Constant general production	Depreciation of fixed assets	137.86			
	Share of the cost of renting hydraulic structures	547.05			
	Costs of labour of fish farmers and guards	18602.63			
	Payments to the payroll fund (22%)	4092.58			
All incurred constant overhead costs		23380.11			
General production variables	Material costs (including protection. feed)	5689.28			
	Labour costs of workers when changing the location of fish products	688.99			
	Payments to the payroll fund (22%)	151.58			
	Losses within the natural loss (10% of the amount earned)	291.25			
All incurred variable overhead		6821.09			
Production at normal capacity	kg	9600.00	12800.00	1280.00	300.00
	USD	12253.83	14004.38	1073.67	547.05
Calculation of the share of the distribution base of individual accounting entities in the total volume of the distribution base		*0.400334*	*0.533778*	*0.053378*	*0.012510*
Distributed fixed overhead costs		9359.85	12479.79	1247.98	292.49
Distributed variable overhead costs		2730.71	3640.95	364.10	85.33
Total production costs for certain types of products		13239.36	17579.52	1712.74	582.05

Source: Calculated by the authors

Conclusions

According to the results of the study, it is concluded that the main problem regarding the accounting and analytical support of biological transformations in fisheries is the lack of theoretical substantiation and the imperfection of the methodology of accounting management of the costs of biological transformations in the field. The basic condition for effective management of costs for the production of fishery products and providing accounting information about them is the existence of sound accounting methodology for managing the costs of biological transformation.

Controlled (relevant) segments in the fisheries sector are identified to solve the problem, with their simultaneous division into separate production processes (redistributions). The application of the proposed classification of production redistribution will improve the system of synthetic and analytical accounting of biological assets and biological transformations and will provide information needs of managers. The influence of organizational and technological peculiarities of the aquaculture production process on the construction of the accounting system of fishery enterprises has been investigated, which gives the opportunity to develop and implement an adequate accounting system of cost management at the enterprises of the branch.

It is stated that the main prerequisite for effective cost management is the objective display of cost information in space and time. It is suggested that the cost of production of fishery products should be apportioned at the end of each production redistribution. At the end of the calendar year, the costs of each redistribution, the cycle of which has not been completed, shall be considered as an unfinished production of the fisheries industry. The expediency of accepting the total volume of production in natural meters as the basis for the distribution of indirect fisheries costs is substantiated.

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