3.3. Environmental impact and risk assessment

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Content

1. Environmental impact assessment

Environmental Impact Assessment (EIA) is a regulated process by which possible or significant impacts on environmental quality are identified. EIA, one of the most widely used environmental management tools, has focused from the beginning on assessing negative effects on environmental quality and human health (Sluser et al., 2022). Any investment, projects, development plans or programs, or policy can have negative effects on the environment and EIA has the role of identifying these consequences, quantifying and minimising them (Gilbuena et.al, 2013). At the same time, EIA is an important tool in environmental policies to counteract at a very early stage possible induced effects on the environment and to ensure the implementation of sustainable development.

Thus, the EIA procedure is based on tools for impact identification (delimitation) or impact prediction (impact assessment) having a common basis with risk assessment (ER), both being interdisciplinary areas (Sluser et al., 2022). One of the most recent approaches to defining the EIA process is given by Glasson and Therivel (2019), according to which EIA represents "the need to identify and anticipate the impact on the environment and on human health and well-being, of legislative proposals, policies, programs, projects and operational procedures, as well as to interpret and communicate information on the impacts generated and their level", with a major focus on preventing, mitigating and balancing the negative effects of proposed projects. Therefore, the IM becomes a major decision support tool for proper project planning (Khosravi et al., 2019; Rocha et al., 2019; Roos et al., 2020).

EIA can be achieved through several assessment methods (fig. 1), being applied to different activities, reliable both locally and nationally or internationally. EIA provides final environmental impact reports, namely: environmental report (in case of requesting Environmental Approval for development plans), environmental impact report (in case of requesting Environmental Agreement for investment projects, construction) or environmental balances and environmental risk assessment (in case of requesting Environmental Authorization) (Sluser, et.al, 2022).

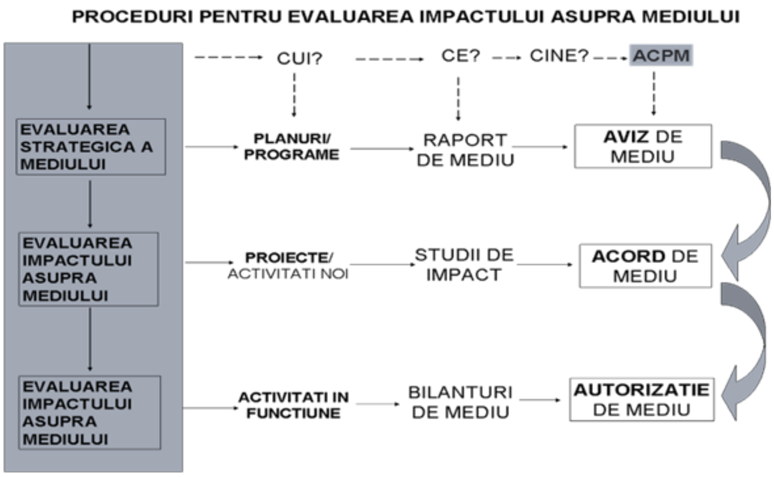

Fig. 1 Environmental impact assessment process
(after Robu and Macoveanu, 2010; Sluser et al., 2022)

Thus, for instance, in the case of EIA for new projects, the result is the environmental impact report, on the basis of which the Environmental Protection Agency will make a decision. In the case of industrial activities and processes in operation, the result of the EIA is to obtain the Environmental Permit based on environmental balances and environmental risk assessment, as appropriate. Strategic evaluation refers to the assessment of negative effects in the case of plans, programs or policies, so that the consequences that may arise are mitigated from the first stage of implementation (Robu et al., 2007; 2015, Sluser, et.al, 2022). Decision makers involved in the EIA process require stakeholder involvement as an integral part, so anyone with an interest can participate, from government authorities and public bodies to local communities and ordinary citizens. Ideally, as Yao et al. (2020) presents, the public participation procedure should involve a platform where more stakeholders can express their views and participate in decision-making in real time, eliminating the risk that EIA is more socio-political and less technical.

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2. Risk assessment

In general, environmental risk assessment complements the volume of information, quality and objectivity of the EIA procedure and has become an important tool for decision-making (Robu et al., 2007; Zelenakova et al., 2017; 2020). The scientific community recommends that environmental risk assessment (ERA) be a quantitative approach for comparing risks of degradation of environmental quality and human health due to natural and anthropogenic pollution (Fig. 2.). Environmental risk assessment involves identifying, analysing and quantifying the following types of effects that may affect environmental and ecological receptors:

- "Direct" effects are those caused by actions occurring at the same time and in the same place.
- "Indirect" effects are defined as those "which are caused by action and occur later in time or space, but are nevertheless reasonably foreseeable."
- The cumulative effect/impact is: "environmental impacts resulting from the accumulation of impacts of an action when additional to other past, present or reasonably foreseeable actions for the future".

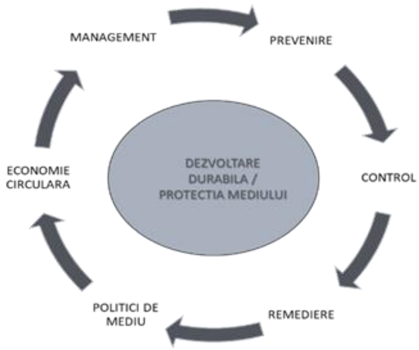

Fig.2. Environmental assessments and sustainable development (upon Cothern, 1996)

According to the Order of the Ministry of Environment, Waters and Forests nr. 184/1997, makes the analysis of the probability and severity of the main components of an environmental impact. The need for additional information on the risks of identified pollution or polluting activities carried out on a site may lead the competent environmental authority to request a risk assessment to determine the likelihood of damage and possible damage caused by this damage (Order, 1997).

The risk assessment aims to control risks from an establishment by identifying:

1. The most important pollutants or hazards;
2. Resources and receptors at risk;
3. The mechanisms by which the risk is realized;
4. Significant risks arising on site;
5. General measures necessary to reduce the degree of risk to an 'acceptable level'.

Qualitative risk assessment can be performed by means of control matrices, tree diagrams or identification and description of the source-pathway-receiver relationship, as follows:

Hazard/source – refers to the specific pollutants that are identified or presumed to exist on a site, their level of toxicity and their particular effects.

Pathway/route of action – is the pathway by which toxic substances reach the point where they have harmful effects, either by direct ingestion or direct contact with skin, or by migration through soil, air or water.

Target/Receiver – represents the objectives on which the harmful effects of certain toxic substances on the site act, which may include human beings, animals, plants, water resources and buildings (or their foundations and uses). They are called in protected objective legal terms.

According to the simplified model of environmental risk assessment, proposed by the Order of the Ministry of Environment, Waters and Forests no. 184/1997, the risk can be calculated by multiplying two factors (probability and

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severity) to obtain a comparative figure, for example probaility 3 (high) x severity 2 (average) = risk 6 (major). This allows comparisons to be made between different risks. The higher the result, the higher the priority that will have to be given in controlling the risk (Fig. 3).

Model simplificat

Probabilitatea	***Gravitatea***
3 = mare	3 = majoră
2 = medie	2 = medie
1 = mică	1 = usoară

Fig.3. Cuantificarea riscului de mediu (Ordin, 1997)

3. Good practices examples – case studies

A. Dynamic assessment of the risk of error of the treated wastewater treatment and recirculation plant - an industrial case study (Analouei et al., 2022)

Due to the increasing scarcity of water resources, wastewater reuse has become one of the most efficient solutions for industrial consumption. However, various factors can adversely affect the performance of a wastewater treatment plant. Thus, in order to ensure that quality standards for treated wastewater are met, it is essential to analyse the causes of system failures and their potential effects, as well as mitigation measures through a systematic, dynamic risk assessment approach (Analouei et al., 2022). The quality of treated industrial wastewater depends on the type of industries, including mining, food and agriculture, tanneries, refineries and pharmaceuticals. They could contain toxic pollutants such as ammonia, heavy metals, phenols, priority organic pollutants, solvents and other chemicals. In addition, the amount of use of recycled water varies from process to process depending on the type of industries and needs substantially higher quality for the pharmaceutical industry.
The treatment plant risk risk assessment is a relatively new approach, with no methodology that can manage the complex interdependence between contributing risk factors, their multilayer modelling, uncertainty and the dynamic nature of risks and reliability. In this case study, risk factors were identified for the first time through a comprehensive assessment using process flow diagrams, followed by network structure development and probability quantification (Analouei et al., 2022). The study was conducted for a period of 15 years (2016-2030), covering the stages of identifying past, present and possible future risks.
Based on the results obtained since 2016, a prevention strategy has been developed to effectively reduce risk factors and will continue to be applied for the next considered years of operation. The results suggest a significant improvement in reducing the risk of error when using the recommended measures. The analysed treatment plant consists of two main sequences: the first part contains primary and secondary biological treatment processes, and the second includes advanced treatment processes that provide high-quality reclaimed water for industrial use and has a capacity of 1000 m3/day, and the treated wastewater is fully reused. The questionnaires used for risk assessment generated mitigation measures of 0-100%, contributing to the prioritisation of estimated risks.

Table 1. Identification of risk factors and associated measures
(exemplification by Analouei et al., 2022)

Risk factors	Proposed measures
Operating errors	Increasing the level of technical knowledge of operators. Increase workforce productivity and accuracy to improve survey accuracy and equipment services. Online monitoring with the first part of the treatment plant.

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	Correct monitoring of parameters related to the MIC wastewater treatment plant. Conducting periodic tests of various parameters in accordance with industrial wastewater standards.
Design errors	Setting up an emergency tank to reduce high toxic input. Launch of the second MIC wastewater treatment module to reduce the load on the first module and increase efficiency.
Equipment/service errors	Regular and regular maintenance of the wastewater treatment plant and MIC equipment. Using direct-drive, high-speed, turbocharged blowers and ultra-fine bubble diffusers. Speakers control online. Laboratory equipment.
Errors generated by climatic conditions	Extensive and precise control of various treatment parts in wet weather conditions. Conducting regular and periodic tests of the reservoir's anaerobic effluent in wet weather conditions to prevent bad effluents from this part.

The purpose of this study was to assess past risk and identify factors that require attention to minimize the risk of failure of the treatment plant. The identification of the risk factor showed that operator error was the most serious risk factor. The risk for the future period (2022-2030) was predicted by considering the proposed mitigation measures based on prioritized risk factors. The suggested measures can reduce the risk of error from 33% in 2022 to 9% in 2030, by an average of 20%. The results of this study were also disseminated with economic agents and operators of wastewater treatment plants to improve their performance.

B. Assessment of representativeness of irrigation implementation projects in rural areas (Pathak et al., 2022)

Globally, the need to implement an irrigation system has been promoted for decades, as a method of improving agricultural growth, minimizing production risk and diminishing, minimizing poverty in rural areas. Despite its apparent advantages, implementation rates of irrigation systems are low. According to existing literature, the determinants of irrigation adoption often depend to a large extent on local cultural, contextual and/or institutional factors. However, studies across geographies identify a consistent set of factors. Thus, in order to be able to make decisions based on these studies, an assessment of the global geographical representativeness of irrigation systems implementation studies was carried out to determine whether the identified factors influencing irrigation were the result of geographical, cultural-religious or economic biases (Pathak et al., 2022).
The results of this study indicate that there are several intercultural and geographical biases regarding the study of the decision-making process of irrigation adoption by farmers. More research on this topic is being conducted in regions that have a low percentage of irrigation (slightly over 1%) because they receive moderate amounts of average annual rainfall and have moderate amounts of cropland cover. The results suggest the need to expand research efforts in areas with a very low to no irrigation system to identify constraints and contribute to economic growth, reduce poverty levels and increase food and livelihood security for rural communities in these regions.
Moreover, in most developing countries, agriculture provides the main means of subsistence and employment for the rural population and contributes significantly to national GDP. Therefore, any reduction in production will have a direct impact on the economy of agricultural sectors and will call into question the resilience of communities dependent on agriculture (Pathak et al., 2022). Despite the multiple benefits, the adoption of irrigation systems among farming communities has been slow or long delayed due to the long-term investments needed to adopt them. Studies in various geographical areas identify a set of factors, among which the cost of technology is considered the most common obstacle to implementing an irrigation system. The authors (Patak, et al., 2022) analyzed the geographical contexts in which irrigation adoption studies were conducted and the set of causal factors that were associated with irrigation adoption decisions, globally.
Usually, farmers in areas with a high percentage of cropland cover, due to the limited possibility of further expansion (of land), are more likely to use intensive agricultural practices (such as irrigation) to increase their crop productivity

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(Pathak et al., 2022). For example, if a region receives heavy rainfall, farmers might have a cultural inclination to rely on rainfall for agricultural activities rather than investing in new technologies, as irrigation is generally a substitute for rainwater. For regions with low average annual rainfall, although irrigation technology can still be very useful, reliable access to water could prevent its widespread diffusion and subsequent adoption of an irrigation system. The barriers identified were mostly classified into opposing factors generated by the framework of share capital and institutional categories (Pathak et al., 2022).
Similarly, another case study from Nepal used risk perception and motivation theory to understand farmers' preparedness to deal with the impacts of climate change-related hazards. In addition, this pressure on water supply systems will intensify in the coming years, not only by changing consumption patterns, but also by changing climatic conditions (Pathak et al., 2022). New investments in irrigation infrastructure, together with improved water management practices, can not only minimise the impact of water scarcity, but also help meet water demand for global food production (Pathak et al., 2022).

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