ENVIRONMENTAL IMPACT OF MICRO-HYDROPOWER - A PURELY ROMANIAN PERSPECTIVE

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Abstract*: The construction and commissioning of micro-hydropower plants is a solution for obtaining cheap electricity, but it also has a not negligible impact on the environment. Romania, like any of the member states of the European Union, has committed itself to a share of energy, in the sense of obtaining electricity in the most environmentally friendly way possible. Micro-hydropower plants also fall into this category. From our point of view, their construction started with too much exuberance because we not only have some European rules that we must obey about the green energy quota, but we also have some European rules provided by directives that refer to the protection of ecosystems. And then we must judge a balance between getting the share of green energy we are committed to, but at the same time protecting our ecosystem. We have synthesized, reported, and analyzed the impact of micro hydropower plants according to good practice guidelines aimed at the harmonious development of communities about nature.*

1. INTRODUCTION

Water as an environmental factor is a limited global resource and an essential condition of human existence. Today's society, under the auspices of globalization and the human-environment relationship [1], uses water resources to generate and support the economic growth of communities through activities such as agriculture, commercial fishing,

energy production, transportation, tourism, and more [2, 3]. In recent decades, it is becoming more and more common that the water demand is increasing, which puts a lot of pressure on both sustainable community development strategies about the diagrams reproduced in Fig. 1 [4], as well as on the resources available [5].

Being a limited resource, water can be damaged if no concrete protection measures are taken. To prevent the degradation of water resources, it is necessary to find coherent ways of managing water resources, to ensure its assessment, conservation, protection of its quality and quantity [2].

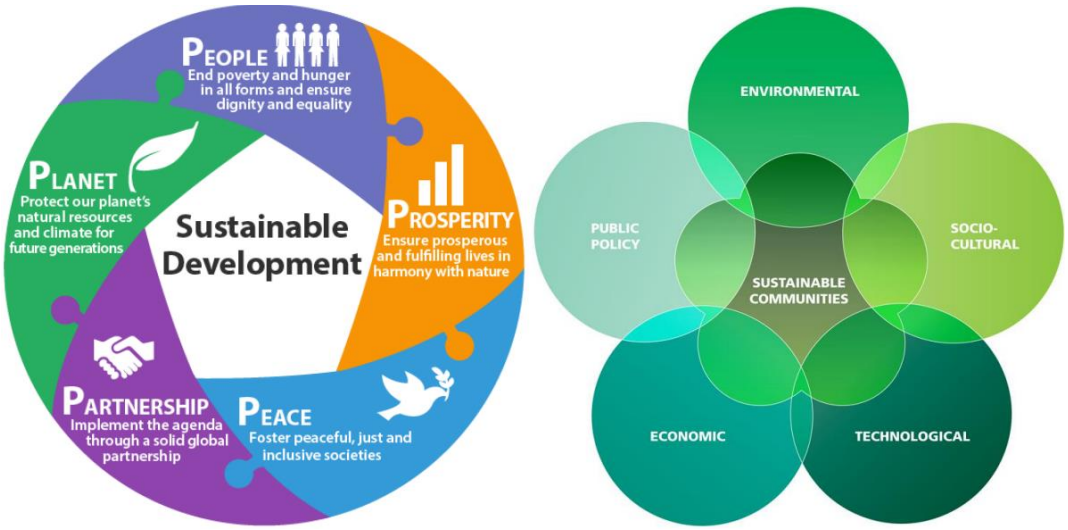

Fig. 1. Sustainable Development diagrams with 5 parameters (sustainable communities)

In fact, in the hitherto wild valleys of the Carpathian Mountains, we have a devastating war going on that exterminates the naturalness of the mountain waters, advancing on hundreds of fronts: bulldozer squadrons, excavators, dynamite experts and finally pouring concrete. Crawler's crush and tarnish life on natural watercourses. Each watercourse receives several deadly injections of reinforced concrete, which destroys the watercourse in question for a century (at least) and the biodiversity is affected [2, 3]. Even in Natura 2000 sites with fish species and other living things of Community interest, such concrete constructions appear, which cause the waters in some places to be captured, leaving entire sectors of the courses almost completely dried up.

From the beginning of the production and use of electricity, the benefits of electricity have been recognized worldwide. Gradually, however, several shortcomings were revealed, negative effects that accompany electricity from the extraction and exploitation of energy resources to its use [6].

In these steps, regarding the stage of design, construction, and use of power generation facilities through micro-hydropower plants, we set out to look at the perspective of the impact they have on the environment. It is known in the literature that there are many forms of impact that the energy sector has on the environment. Of these, an important part is due to electricity,

their presence being identified throughout the life cycle of electricity generating installations, both in the phases of energy production and in the stages of transport, distribution, and domestic or industrial use.

2. MICRO-HYDROPOWER BETWEEN ENERGY HUNGER AND ENVIRONMENTAL DAMAGE AND DESTROYING

Promoting the production and consumption of electricity from renewable sources is an imperative of the current period and an important Community priority motivated by environmental protection strategies, increasing energy independence from imports by diversifying energy sources, as well as economic and cohesion reasons. social [7]. As such, Romania was among the first European countries to transpose into its legislation the provisions of Directive 2001/77/EC on the promotion of electricity produced from renewable sources (by GD 443/2003 with subsequent amendments and completions) [8] and established that over 33% of gross domestic electricity consumption be covered by such sources [9, 10].

Obtaining energy from renewable resources is a global trend in the age of growing energy demand. Hydropower has some potential in this area, especially for low-power locations. However, the construction of such installations requires high costs, which is why some attempts have been made to reduce costs, by proposing alternative solutions to the classic ones [11, 12].

Regarding the design of underground structures associated with micro-hydropower plants, it must be thought out and configured cost-effectively and optimally. The design itself is a challenge and requires gradual investigations into the geological engineering status of the area where these structures will be located [13]. The orientation, modeling, and sizing of the micro-hydropower plant play an important role in the overall stability of each structure, both in terms of hydraulic requirements and in terms of long-term stability.

Micro-hydropower plants are hydropower plants with an installed capacity of less than 10 MW, thus mitigating the environmental problems associated with hydropower plants [14]. Micro-hydropower plants are based on a reliable and proven technology, which is suitable for rural electrification and for supplementing the supply of electricity at the industrial level. Capacity building, long-term financing, and improving the livelihoods of the local population are the key challenges and benefits of such structures. The structures and equipment associated with micro-hydropower plants can be easily built and implemented, often using local, national, and regional resources. Multi-skilled labor is needed for the operation and maintenance of the micro-hydropower plant [15], and if its zoning is on the border with other states, then special control and a multi-national team are required.

Micro-hydropower will not have the same negative effects on the environment as large hydropower systems, as microsystems require a much smaller water tank to operate

efficiently. Micro-hydroelectric systems will have a similar negative impact on the environment but will be significantly smaller than conventional hydroelectric systems that require a large water tank.

There is no doubt that the impact of hydropower on the environment can be positive if a system is properly planned and managed. The hydropower ecosystem can be very sensitive to change, but there can be a net benefit to society and nature, in the first instance even as an alternative to fossil fuels.

The most well-known negative effects of micro-hydropower plants are manifested on environmental factors (air, water, soil/subsoil, biodiversity) by modifying their characteristics through noise, electromagnetic and visual pollution, discharges of harmful substances, vibration generation, and waste (see Table 1) [6].

Table 1. Different types of activities and impacts associated with energy production and transport (adapted and updated after [6]*)*

Types of activities	**Air pollution**	**Electromagnetic pollution**	**Impact on biodiversity**	**Land use and pollution**	**Noise**	**Use of hazardous materials**	**Vibration**	**Visual pollution**	**Waste generation**	**Water use and pollution**
Electricity transport	X	X	X	X	X			X		X
Geothermal plants	X			X						X
Hydropower plants*	X		X	X	X		X	X	X	X
Nuclear power plants	X		X	X		X		X	X	X
Solar power plants	X			X		X				
Thermal power plants	X		X	X				X	X	X
Wind power plants			X	X	X			X	X	

*micro-hydropower plants are included in this category

The negative impact of micro-hydropower plants also affects the local communities, by affecting the groundwater and, implicitly, the water sources. In Romania, over 430 micro hydropower plants are in different stages of planning, authorization, and construction, and over a quarter of them are in protected areas, in the cross-border area, or at their border.

While the use of energy from renewable sources is promoted in the European Union, it is known that hydropower infrastructure has major negative effects on aquatic ecosystems and thus on the services they provide locally and regionally, while watercourses with very good ecological status and floodplains have become increasingly rare in Romania.

The remaining ones urgently need protection to maintain their good and very good ecological status, while the negative actions on the watercourses, which are in the process of altering at a fast pace, must be stopped urgently, and where possible ecological reconstruction must be carried out following the provisions of the Water Framework Directive.

The potential impact of the construction and operation of micro hydropower plants is mainly represented by:

- alteration of surface water quality and deterioration of aquatic ecosystems;
- bank degradation;
- intervention works in the minor riverbed for the installation of water catchments and supply, coupled with the reduction of the flow of the watercourse;
- modification of the hydromorphological characteristics and segmentation of the continuity of the watercourse.

Micro-hydropower plants significantly affect river ecosystems and cause irreversible damage. A dammed or captured watercourse almost completely loses many of its original features and can never be compared to a natural river that has healthy habitats and functional ecosystems. Micro-hydropower plants also fragment habitats along rivers and prevent the recovery of aquatic species populations in areas downstream of catchments or isolate individuals from species found only in mountain rivers. The devastating effect of micro-hydropower plants is permanent, dramatic during construction with dynamite, bulldozers, concreting, etc., and persistent during operation that can extend over a century with the interruption of natural ecological flows on the watercourse.

Sediment retention and clogging also change sediment flow and other geomorphological and landscape aspects. Such disasters also occur in protected areas, Natura 2000 sites designated by the implementation of European legislation for the protection of certain species and habitats of Community interest. However, there is a real conflict of interest between biodiversity conservation and renewable energy production. The problem is that to produce green energy there is the financial interest produced by green certificates and subsidies, related to investment and political interests, while for the conservation and protection of biodiversity there is disinterest, neglect, and ease.

By upgrading the existing power plants in Romania, a significantly higher increase in installed power and energy can be obtained than by investing in new micro-hydropower plants. But the construction of micro-hydropower plants is much more economically advantageous due to the support scheme, with green certificates. That's one of the economic benefits. The other economic advantage of micro hydropower plants is their potential to solve problems locally. The main reason for micro-hydropower plants would not be their minor energy contribution, but the supply of isolated hamlets or houses.

3. CONCLUSION

There is a struggle between ecological, naturalistic thinking, and the technical-aggressive, rude, detonating and concreting approach. Who will win? Do they help communities, or do they lack the benefits of nature? Does it contribute to national energy

production, or does it inflate the pockets of some businessmen? Is it green energy or does it have serious, long-term environmental costs? Do we prefer the new ones or the old ones? These are questions that we are still waiting to answer. However, we believe that micro-hydropower plants are far below their impact, even if they affect all environmental factors.

The highest value of micro-hydropower plants is the local value. It raises the area, the locals have some work to do, the investor, through the specifications, is obliged to help people, to raise their standard of living a little, to sell them electricity directly. At the same amount of electricity produced, a micro hydropower plant has a 5-8 times greater impact on biodiversity, compared to a dam hydropower plant.

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