

Assessing Socio-Environmental Externalities of Big Hydro Power Projects: The Case of Skavica

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Abstract

The transition towards renewable energy sources has increased the interest in Hydro Power generation. The socio-environmental externalities produced from big HPPs have a significant impact on the local communities and on the overall economy of the country. There is consensus in the literature that small HPPs cause fewer and less severe environmental and social externalities than large HPPs. Anyway, the electricity supply is guaranteed by bigger investments and the trade-off is not quite simple to clarify. The study is based on a set of sustainability indicators which provide a life cycle analysis of the Skavica Hydro Power Plant and the relative investment scheme. The aim of this paper is to identify the general externalities related to the construction of a big HPP and to connect to the specific case study of Skavica HPP. Furthermore, the estimation of benefits and costs along with public discussions is integrated to evidence the legitimate social and environmental concerns of people living in areas where dams are planned. Policy options intended to adopt these externalities are also addressed.

Keyword: Hydro Power Plant, renewable energy, Skavica, externalities, policy, floodings prevention, electricity

1. Introduction

The economic feasibility of renewable energy sources is shown to be heavily dependent upon the removal of market distortions. Externalities are effects not evidenced in the economic transaction of an operator that is producing or purchasing it but interfere with parties not involved in the transaction. Hydropower is a renewable source of energy that typically generates several positive and negative externalities affecting multiple stakeholders. Commonly, in big HPPs (installed power of more than 100MB) the basin impoundment and occupation is the main component of the overall externality. In western countries the project and operation of big HPPs are quite regulated, so the potential environmental impact is relatively controlled. In developing countries, the risks connected to these kinds of projects can materialize in additional negative externalities. In the meantime the ability of democratic societies to implement coercive policies to pursue important strategic objectives, is limited due to balanced distribution of power between the elected institutions. This apparent vulnerability has given life to the 'not-in-my-backyard (NIMBY) syndrome, proliferating like wildfires in western countries. In the light of the current energy crises, most of the EU countries are downgrading their lenient policies in matter of environmental impacts due to threats to the overall socio-economic security. However, most of these "syndromes", are not valid for developing countries,

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being at the same time an opportunity or a threat. Several authors have argued that dynamic externalities induce key performance connotations in developing countries (Stewart & Ghani, 1991). (Baier, Dwyer, & Tamura, 2006). The mechanism is two-fold: know how transfer of mature technologies from industrialized regions, and lack of consolidated institutions that provides an opportunity for the investments to bypass environmental laws (not possible in consolidated democracies). In this context attaining sustainable energy development, while further preventing environmental degradation is a global externality that should not be relied only on local policymakers.

Ultimately there is a third group of complete authoritative countries, where the implementation of big hydro power plants is almost entirely on the discreet decision of the public administrations.

Typical negative externalities connected to a big hydro power plant are:

- Depletion of the water flow.
- Inundation of fertile terrains.
- Impoundment of cultural or religious sites
- Alteration of the habitat of the species
- Change of water quality
- Interference with upstream fish passage etc.
- Risks for the human population connected to dam security and maintainance.

Typical positive externalities connected to a big hydro power plant are:

- Public health benefits due to less greenhouse gas emissions from fossil fuels
- Employment benefits
- Improved infrastructure for remote rural communities.
- Electricity price stability, due to non-dependency from market variations.
- Irrigation benefits and improved water supply.
- Floodings Control

Other externalities are site specific varying from geographic and cultural factors. Definitively mitigation of some negative externalities depends on the correct application of the environmental legislation. The sustainability assessment of big HPPs, enables us to recognize borderline trade-offs among socio-economic and environmental goals of hydropower development.

2. The Scavica Hydro Power plant

Located in the north-eastern part of the country, this power plant would be the last to be built on the high waterfall of the Drin River, more specifically in the tributary Drini i Zi (Black Drin). The Black Drin valley undoubtedly represents one of the most important river corridors, with a watershed area of 5885 km² in the region of Dibra with a length of 75 km (Çina, 2010). Drini basin is the biggest basin in Albania, covering a quarter of the

country's surface and discharging half of the country's water quantity into the Adriatic Sea (Celo & Bualoti, 2010).

The installed capacity in the different project alternatives varies from 210 to 500 MW. Ultimately Skavica can be considered the last biggest venture of the hydroelectric sector in Albania. The characteristics of this work go beyond the energy use alone. The main goal of the power plant is to balance the waters of the River Drin. In recent years, climatic factors have upset the panorama of the plain of Shkodra in the north-western part of the country (Morelli, et al., 2019). Phenomena, which have affected the areas around the Drin delta. For several years 2010, 2011, 2018, 2021 the lowlands of Shkodra and Lezhe, including inhabited centers have been flooded by extraordinary inundations, with immense material damage (Aho, et al., 2020). The opening of the spillways of *Fierza*, *Koman*, *Vau i Dejës* on the river Drin, in order not to compromise the safety of the dams themselves, has further worsened the situation (Bualoti, Çelo, & Zeqo, 2012). The Albanian government has asked the international community for help to assist it in dealing with this natural disaster. The estimated damage is approximated to 500 million euros, with heavy repercussions on the already fragile economy of the north, in particular with reference to the agricultural sector. The Government has worked to partially compensate the damage to the populations affected by the disaster, with commitments that were partially fulfilled (Kuipers, 2018). This introduction serves to understand once again how energy policy choices can generate a serious impact on the socio-economic fabric of the country (De Stefano, Petersen-Perlman, Sproles, Eynard, & Wolf, 2017). The prevention of these types of disasters will never be possible, but the scaling of the damage can be subject to a minor volume. In this case, the Scavica HPP can act as a faucet tank for the waters of the Drin watershed in case of overflowing of the water basin. The Scavica power plant can serve both as a generator of renewable energy, and as a prevention tool for floods on Shkoder lowland (Hysenaj & Talani, 2012). We are in the presence of a potential positive externality produced by a public work, which deserves careful evaluation by policy makers. There are two objectives in carrying out such an achievement:

1. the ordinary optimization of profit (economic interest of the investor),
2. the prevention of floods on the Shkodra lowlands. (Public interest and disaster prevention).



Fig. 1 Hydrographic Basins in Albania.

Source: Hydro-Energetic Potential. Ministry of Infrastructure and Energy. infrastruktura.gov.al

These two needs cannot go hand in hand, due to unsustainable operational constraints. The prevention of floods needs to keep the water level in the basin below the normal level of activity, so that in case of heavy rainfall the reserve can be filled in order to prevent flooding in the valley.

Being a subject of delicate public interest, the Albanian government has constantly made efforts to find an operator willing to venture into the Skavica enterprise (Schwarz, 2020). The problem of floods (of different magnitudes) has regularly affected the plain of Shkodra. So far a dozen investors have taken an interest in the company, but once they became aware of the problem of water control they retired on time. Given the immense volume of capital to be committed, traders need certainty on expected returns. It is estimated that for the “small” version of 210 MW, approximately 750 million euros are needed, with an annual production ranging from 1.3 TWh in the best of scenarios to 450 GWh in the case of a dry season. The ever-increasing bill of energy in the last year and the historical damage from floods, on the other hand, pushes the Government to

seek a hasty and perhaps poorly thought-out solution. In the last 20 years, several tenders have been set up for the concession of the Skavica power plant.

The first was in 2004, completed with the signing of a concessionary agreement for the construction of HPP Skavica with a group of Italian companies. An SPV was set up *ad hoc*, TGK Skavica Srl, with a different project from the initial one. Total installed capacity: 500MW. Total value of the investment: 600 million euros . It was clear from the beginning that such a cost was negligible in the face of such an investment (1200 Euro / kW). The deal ended with the withdrawal of the TGK.

In 2008, another public tender managed to attract six energy multinationals , such as VERBUND and Kelag Group (Austria), Statkraft (Norway), Korea Electric Power Corporation, RWE AG (Germany), and the same TGK Skavica Srl. This race ultimately failed like the previous one. Main reason: the lack of collateral for a long-term PPA contract.

In May 2021 was signed the phase 1 contract between KESH and Bechtel and in April 2022 the Albanian Parliament approved the law on a special procedure for negotiations with Bechtel International, to design and build the Skavica Hydropower Plant.

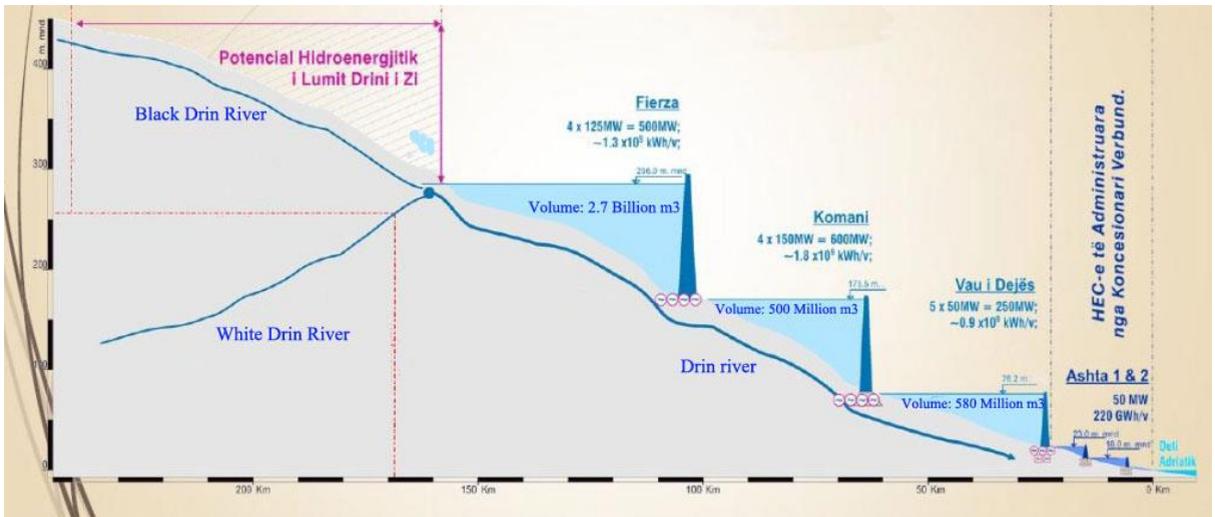


Fig. 2 Hydro Energetic Potential of the Black Drin

Source: Hydro-Energetic Potential. Ministry of Infrastructure and Energy. infrastruktura.gov.al

From a legal point of view, the BOOT contract, in this case, must include specific clauses, which oblige the concessionaire to submit to certain constraints of the maximum level invaded (Abazaj, 2019). These cases are atypical forms of Public Private Partnership (PPP), for which similarities can be traced in similar experiences around the region (KRAJA & al., 2014).

From the management point of view, water management must pass to a careful review of the historical data available on the seasonal dynamics of the climatic phenomena

of the water basin under consideration, previously evaluating the risks of flooding (European Commission, 2015). In the regulation of basins at risk, there are generally two types of management: the conservative one, and the dynamic one. In the first case, quota restrictions are set for a duration of more than one month. In the second, the management of the water level is monitored daily, in coordination with the meteorological service (Haase, et al., 2018).

The study of runoff formation mechanisms in mountain regions, where precipitation can occur in the snowy state for a good part of the year, has attracted the interest of hydrologists for years. All these studies have produced an enormous wealth of knowledge on the physics of processes on the basis of which different schemes have been proposed.

If we divide the power plants on the river Drin, the flow of the river under the *Vau i Dejes* power plant is our objective function, which must be kept below a predefined level (beyond which, the flood begins for the plain of Scuttari).

Table 3. Parameters of the HPPs of the Drin river flow:

unit	Features	Skavica	Fierza	Koman	Vau dejes
	Construction Year		1973-1979	1980-1988	1971-1973
MW	Installed capacity	210	4 X 125	4 X 150	5 X 50
GWh	Average Annual production	900	1150	1500	870
million m³	Maximum capacity	1300	2700	430	623
	Useful storage capacity	1215	2350	395	100
	Minimum storage capacity	438	1200	137	230
	Annual flow rate (average)	7350	10800	12930	15460
m³ / s	Average range	275	400	530	700
	Maximum capacity	1800	2010	2500	3000
	Minimum range	95	150	218	274
	Useful scope	290	494	720	565
	Deviation	2500	2600	3900	4170
level above sea	Maximum useful level	455	295	179	72
	Maximum level	443	297.2	182	75
	Minimum level	427	235		
	Crowning quote	443	312	185	79
m	Overall height of the dam	145	167	123	86
	Height at the base	72	152.5	115	46.4
	length of the crown	270	380	250	380

A very important constraint is the final outflow which must not persistently exceed the value $3000 \text{ m}^3 / \text{s}$, within 12 hours:

The physical volume of each of the cited blocks must be delimited so that the incoming and outgoing water quantities (*control volume*) can be clearly defined. For each of these volumes, the continuity equation of hydraulics must apply, which expresses the principle of conservation of mass: the difference between the quantity of water in an assigned time interval that enters the control volume and the one that comes out must equal the increase in quantity accumulated in the same volume. (Allamano, 2008).

If the onset of meteorological phenomena with an incidence greater than 20 mm per day according to historical data, 1st of November is considered the initial period the reservoir of Scavica should be kept under controlled observation (Haase, et al., 2018). The volume of the reservoir of Scavica is assumed in the constrained case (water equalizer) compared to an average year.

Sustainability assessment

Negative externalities connected to Skavica hydro power plant are:

- Since the volume of water in the Drini i Zi river is guaranteed at the the 275 m³/sec range the probability of water depletion is quite limited in exceptionally dry seasons.
- The dam will flood the most fertile terrains of the Dibra region, critically affecting the economy and the employment of a region that is mainly connected to agricultural activity. More than 10 000 inhabitants will be displaced, and more than 1500 buildings will be inundated, predicting high compensation costs.
- There is a long list of cultural and archeological sites that will be permanently inundated by the reservoir:
 - The tumulus areas of Draç-Reç, Zall-Dardha
 - The Eneolithic settlement "Kodra e Stadt" (Zall-Sinë)
 - The settlement of the Early Neolithic in Kronëza (Fushë-Alie)
 - The Roman road station in "Xirret e Prenzhe" (Fushë-Alie)
 - The prehistoric settlements of Bllaçe (Fushë-Alie), Cetush (Cetush), "Kodra e Balla" in Muhur, Ushtelenza, Topojan
 - The prehistoric settlement of the Early Bronze Age at Selane
 - Medieval church in Katundi Ri, "Tuma e Zojcë" (Mazhicë)
 - The ancient and medieval settlement of Gradec (Gradec)
 - The necropolis of the Roman period in Lower Gjorica
 - The Illyrian castle of Tuçepi or Lladomerica, etc.¹
- The impact on the ecosystem is quite difficult to achieve, anyway similar studies (Kostoski, Albrecht, Trajanovski, & Wilke, 2010) have shown that the riverbank wildlife can be critically distressed in the short-medium period.
- The change of water quality is highly plausible.
- In the previous investments upstream fish passage was completely blocked.

¹ <https://stopskavica.org/2022/03/08/argumentat-kunder-ndertimit-te-skavices/>

- Risks for the human population connected to dam security and maintenance are related to the life cycle of the other dams (Fierza, Koman, Vau i Dejes), built 30-50 years ago.

Positive externalities connected to Skavica hydro power plant are:

- Bigger autonomy of the Albanian electricity system on renewable energy sources
- Employment benefits for the area.
- Improved infrastructure, new roads, new transmission and distribution lines.
- Electricity price stability, due to non-dependency from market variations.
- Irrigation benefits and improved water supply for the area of Diber.
- Floodings Control for the Shkodra lowlands.

3. Conclusion and Discussion

Hydropower energy has been the main source of electricity in Albania, accounting for up to 95% of the electricity supply as of 2022. Although several studies have been published on the externalities generated from big HPPs (Cairns, et al., 2017), (De Stefano, Petersen-Perlman, Sproles, Eynard, & Wolf, 2017) the peculiarity of this analysis are the unique characteristics of the Drin basin and the Shkodra lowlands in between two important investment targets: the electricity generation and the prevention of floodings.

Some important recommendation, resulting from the analysis are as follows:

- The investor should propose a set of guidelines to guarantee the minimum impact of the project with specific duties and obligations, given the assumption that development is not possible with complete consensus.
- The institutions should put in place an efficient public discussion process that precludes endless negotiations.
- In order to avoid unforeseen threats and thus disputes, international contractors should pay close attention to the Black Drin river ecosystem continuity and conservation.
- With the current energy crises any limits placed on hydropower development would result in serious negative impact on the already fragile economy of Albania, with severe repercussions on the long term growth.

The present study differs for the special interest on the externalities generated from the socio-environmental impact of the investment, rather than considering only the economic benefit or the reduction of greenhouse gas emissions from renewable energy sources. By analyzing these externalities, we expand our assessment of the causes for the discrepancy conveyed in previous studies. Instead of the normal economic assessment, energy externalities are adopted as a basis for policy purposes, an antagonism between the economic efficiency principle and the disaster prevention policy can come into public attention. In contrast with the relatively abundant literature that treats regulatory and other issues concerned with energy and development, until very recently little focus was directed towards the relationships

between socio-economic impact and disaster prevention. A complementarity criterion should be addressed in the future between hydro power and solar energy potential in Albania.

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