ASSESSMENT OF THE FRESHWATER ECOSYSTEM SERVICES OF RESERVOIRS/HPP DAMS IN THE KURA-ARAS RIVER BASIN

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Assessment of Ecosystem Services of Water Reservoirs/HPP dams in the Kura-Araz Basin

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Keywords: sustainable ecosystem management, targeted scenario approach, irrigation, flood management

ABSTRACT

This study focuses on freshwater ecosystem services that support hydropower plants (HPP)/dams development in the Kura-Aras River Basin in Azerbaijan. The study assesses the HPP/dams sector, and reviews additional sectors including nature-based tourism, irrigated agriculture, and drinkable water supply. In addition, the study briefly discusses the role and value of ES that help to mitigate natural hazards related to poor ecosystems management.

The study used a basic Targeted Scenario Analysis (TSA) approach. The TSA assesses current "business as usual (BAU)" ecosystems management practices and its current value of ecosystems services under BAU. It uses sector output indicators and compares with potential "sustainable ecosystems management (SEM)" outputs to assess losses and potential gains (or losses) of shifting from BAU to SEM. The BAU approach is characterized by a focus on short-term gains (e.g., < 10 years), externalization of impacts and their costs, and little or no recognition of the economic value of ES, which are typically depleted or degraded. Under SEM, the focus is on long-term gains (> 10 years); also under SEM, the costs of impacts are internalized. Ecosystem services are maintained, thus generating potential for a long-term flow of ecosystem goods and services that can enter into decision making. SEM practices tend to support ecosystem sustainability as a practical and cost-effective way to realize long-run profits.

1. INTRODUCTION

The hydropower dams/ reservoir in Azerbaijan provide a preferred cultural, regulatory, and provisioning ecosystem services [1]. The study aims at: 1) Demonstrate the value of contribution of biodiversity and ecosystem services to hydropower/dams development in the Kura-Aras River Basin; 2) Support the introduction a Sustainable Dams Assessment and Planning Methodology; and, 3) Mobilize key stakeholders, secure their support and launch the Caucasus Sustainable Dam Initiative [9].

The study stresses that joint-effort of key stakeholders at the river-basin-scale can support sustainable ecosystems management to ensure that the benefits of the hydropower sector, both financial and economic are secured for the long-term.

The study assesses the HPP/dams sector, and reviews additional sectors including nature-based tourism, irrigated agriculture, and drinkable water supply. In addition, the study briefly discusses the role and value of ecosystem services that help to mitigate natural hazards related to poor ecosystems management.

2. METHOD

The study used a basic Targeted Scenario Analysis (TSA) approach. The TSA assesses current "business as usual (BAU)" ecosystems management practices and its current value of ecosystems services under BAU. It uses sector output indicators and compares with potential "sustainable ecosystems management (SEM)" outputs to assess losses and potential gains (or losses) of shifting from BAU to SEM. The BAU approach is characterized by a focus on short-term gains (e.g., < 10 years), externalization of impacts and their costs, and little or no recognition of the economic value of ES, which are typically depleted or degraded. Under SEM, the focus is on long-term gains (> 10 years); also under SEM, the costs of impacts are internalized. Ecosystem services are maintained, thus generating potential for a long-term flow of ecosystem goods and services that can enter into decision making [4]. SEM practices tend to support ecosystem sustainability as a practical and cost-effective way to realize long-run profits.

It is expected that the TSA approach will serve multiple purposes:

1.Analyze the HPP/dams sector and determine the potential economic gains or losses of undertaking productive activities by comparing "poor" with "sound" environmental management practices.

2.Inform policy makers and businesses about the economic risks and opportunities of undertaking productive activities that impact ecosystem services.
3.Assist government officials and the private sector to incorporate ecosystems' management policy into economic planning, corporate business plans, and investment policies at sectoral level.
4.Provide economic (and social) arguments to mobilize political will to increase financial support to improve fresh water and forestry ecosystems management [2].

3. RESULTS

During 2005-2009 large investments were made in HPP sector, including new and advanced generators installed in several HPP. Contribution of these new generators rapidly increased electricity production, however, over the last two years a considerable reduction of the electricity produced is noticeable. However, during this period, little or nothing was invested in watershed management (the water factory). This is typical BAU scenario; it may include deforestation, intense silting, and poor dam management. Despite the increasing trend for this period, total amount of investments is rather low [6]. Under BAU, investment in infrastructure and equipment is high; Economic losses in electricity production for the period of 2003-2012. Actual production of HPPs in Azerbaijan is much lower than the installed capacities of all HPP. E.g. the Mingechaur HPP the installed capacity is 402 Mw, while actual production in 2012 was only 159 Mw. This difference may be explained by the impact of various factors. One and very simple explanation is related to the effective dam management. This large difference between installed capacity and actual production is considered as an indicator that HP dam management in Azerbaijan is under BAU.
A total economic loss 2003-2012 under BAU makes nearly 4.5 billion USD (for 2000-2012 it makes 6.4 billion USD), which is considerably higher than market value of produced electricity for that period. The optimal annual level of productivity assumed under SEM is nearly 2000 kWh per year, while under BAU we observe sharp fluctuation of productivity.
Comparison of total actual productions and total installed capacity of HPP and Economic loss from reduced HP generation sector 2003-2012 under BAU
The current BAU situation contributes to create conflict amongst stakeholders; i.e. reduced electricity production, less water available for irrigation leads to a decrease in agricultural output, and inadequate flood management that leads to flooding in downstream regions. For instance, the Mingechaur dam and reservoir has a purpose of hydropower generation, irrigation, and flood management. So, at least three stakeholders have an interest on management of the dam and reservoir.
Well-managed reservoirs should be operated to be able to storage water during high flows [5]. However, state owned HPP/Dams operators are interested in maintaining energy flow and little is invested in maintenance on dams. For example, during the high flow seasons, Mingechaur Reservoir serves as a flood prevention depository, reducing the risk of floods. However, in 2010, before high flow season, Mingechaur reservoir was not emptied to prevent reduction in electricity generation. Thus, during the high flow the reservoir did not function as a depository and it resulted in floods and inundation of 50 ha of irrigated lands, and destruction of homes. By the end of 2013, Azerbaijani hydro power plants decreased electricity generation by almost 75%. This is a strong case for promoting a shift from BAU to SEM.
Simultaneously, the government reported that the hydropower plant crisis in Azerbaijan started in the end of 2012 and continued in 2013. According to the information, power generation at HPPs for January-October 2013 reached only $1.209 \bullet 10^6$KW/h that is by 24.5% below that for the 2012 same term[1]. According to estimations, this makes additional economic loss equal to USD 184,292.000 only in 2011-2012. Estimated total economic loss in hydropower sector over the period of 2002-2012 is nearly USD 4.5 billion.
Poor dam and watershed management started to cause big floods since 1993. Recently, floods in the target region affect lives of 200,000-250,000 people on average per year. E.g. in May 2010, more than 240,000 people were affected, with tens of thousands of homes flooded or destroyed and 50,000 hectares of farmland inundated. The damage was estimated at $591 million. The main reason for this flood damage was a combination of poor upper basin management and dam management (flow regulation).
In 2010, the GoA increased its state budget up to USD 425 million to eliminate consequences of flooding. In 2013 USD 180 million has been spent to reduce consequences of floods. In 2014, the projected costs will be nearly USD 185 million. Total spending over the last four years slightly exceeds USD 1 billion. The Figure 12 shows the annual costs for elimination floods. The high cost of the 2010 flood is linked to BAU. This cost could be reduced by shifting to SEM management; for instance, only USD 20

million annually. The data to support this estimation was provided by the government.

4. DISCUSSION

BAU practices in fresh water ecosystem management have a high cost to the economy of Azerbaijan. Part of this high cost can be avoided by shifting to low cost SEM practices. Despite the availability of several laws and regulations governing the administration and management of HPP and Dams in Azerbaijan, enforcement is weak. The legal framework is also incomplete, there are no means for law enforcement, and no measurable indicators or means to collect and evaluate it. Therefore no results of evaluation are fed into policy making or to improve HPP/Dams management.

5. CONCLUSION

Because of different priorities, poorly planned BAU management generates conflict amongst fresh water ecosystems' stakeholders [3].

The current environmental impact assessments of HPP/Dam projects (small and large) neglect to assess the potential impact of current ecosystems management practices in the upper river basin. This in turn will have a negative impact on HPP/Dams performance that may result in additional negative externalities affecting other sectors such irrigated agriculture, tourism, fisheries, and drinkable water supply. The aggregated cost of these negative externalities often surpasses the current benefits deriving from the HPP/Dams sector.

Because improving ecosystem management in the upper watershed requires the participation of multiple sectors, e.g., HPP/dams, agriculture, forestry, fisheries, tourism, water supply, a comprehensive package of interacting policy reform measures is needed, both at national and at regional level. This is defined as a "policymix" package that is indispensable to introduce sustainable HPP/Dams development in the Southern Caucasus [10].

The lack of information and data limited the scope of this study; therefore, further research is needed, and it may include developing of primary data baselines. However, basic scenarios (BAU/SEM) were constructed where possible to inform policy makers and businesses about the economic risks and opportunities of undertaking productive activities that impact ecosystem services.

It is evident that BAU scenario causes huge economic losses in all sectors, reducing long-term gains. In contrast, the SEM could help to gradually increase ecosystem values and related benefits. For illustration purposes, a rough aggregate of the economic losses in various sectors under BAU and shows how costly BAU management can be, USD 18,6 billion. It also shows how economic losses may continue to increase, unless SEM management is provided.

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