



## HYDRO POWER PROJECTS: SOCIO-ECONOMIC IMPACTS AND SUSTAINABLE DEVELOPMENT

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### Abstract

*The concept of living in harmony with nature is as old as humankind. However, a modern conception emerged in the term 'sustainable development' with the rise of green movements in the late 1960s and early 1970s. Sustainable development can be defined as an approach to the economic development of a country without compromising with the quality of the environment for future generations. This definition captured the spirit of the times whereby government, business, and civil society have strived to make development sustainable. Hydropower accounts for 16% of all global electricity production and it is one of the world's most widely used renewable, low-carbon energy resources. It plays an important role in enabling communities around the world to meet their power and water needs. In some regions the pace of hydropower growth has been rapid but with little guidance to ensure development is sustainable. However, some of the most promising and influential initiatives to improve development, such as the Hydropower Sustainability Assessment Protocol, have been driven by the hydropower sector itself. This paper addresses the progress that hydropower has made in the context of sustainable development over the past 15 years. The concept of sustainable development does imply limits, not absolute limits but limitations imposed by the present state of technology and social organizations on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can both be managed and improved to make way for a new era of economic growth.*

**Keywords:** *Hydro Power, Environment, Sustainable Development, Technology.*



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### Introduction

Hydropower is one of the oldest and largest sources of renewable energy, which uses the natural flow of moving water to generate electricity. Hydropower relies on the endless, constantly recharging system of the water cycle to produce electricity, using a fuel—water—that is not reduced or eliminated in the process. Hydro Power is a critical infrastructure for the Socio-Economic development. We also need to understand the value of natural resources

and their conservation for sustainability. Thus, Hydro Policy drives its goal of generating power without harming the true essence of nature and its value for human society and mitigates the Social, Economic and Environmental impacts. Hydropower projects accounts for 16% of all global electricity production and it is one of the world's most widely used renewable, low carbon energy resources. It plays an important role in enabling communities around the world to meet their power and water needs. India's total hydropower potential of about 250000 MW and till date 46000 MW power capacities has been installed. Hydro power development is the key engine to economic growth .as it makes a direct and significant contribution to economy in terms of revenue generation, employment opportunities and enhancing the quality of life of the people. In some regions the pace of hydropower projects growth has been rapid but with little guidance to ensure development is sustainable. However, some of the most promising and influential initiatives to improve development, such as the Hydropower Sustainability Assessment Protocol have been driven by the hydropower sector itself. This paper addresses the progress that hydropower has made in the context of sustainable development over the past 15 years.

“The concept of sustainable development does imply limits, not absolute limits but limitations imposed by the present state of technology and social organizations on environmental resources and by the ability of the biosphere to absorb the effects of human activities . But technology and social organization can both be managed and improved to make way for a new era of economic growth.” The concept of living in harmony with nature is as old as humankind. However a modern conception emerged in the term sustainable development with the rise of green movement in the late 1960s and early 1970s sustainable development as development that meet the needs of the present without compromising the ability of future generations to meet their own needs. These definitions captured the spirits of the times whereby government business and civil society have strived to make development sustainable.

Socio-economic development was seen to be constraints by the environment. This concept developed towards concepts where economic environment and social dimensions were all pillars of the same house and needed equal attention. The most current concepts are that a dynamic interplay between social economic and environment promote and invest in sustainable livelihood and foster economic growth. This balance is best shown by three integrated circles, which imply that none of the sustainability dimensions can be promoted without establishing tradeoffs with the two others.

The three dimensions of sustainability i.e. (social, economic and environment) and how they should be balanced is the subjects of much debate across academic and professional discipline and the public and private sectors. Corporative approach therefore recognizes the necessity of trade-offs if development is to be achieved. However, it does not in itself provide application sustainability indicators or a practical guidedance for policy makers and the private sector when making decisions on investment and infrastructure development. Sustainable Development dimensions of hydropower “diversify energy supply by developing advance cleaner, more efficient affordable and cost effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included and their transfer to developing countries on concessional terms as mutually agreed.

### **Hydro Power Project Systems:**



There are four main types of hydropower projects. These technologies can often overlap. For example, storage projects can often involve an element of pumping to supplement the water that flows into the reservoir naturally, and run-of-river projects may provide some storage capability.

**Run-of-river hydropower:** a facility that channels flowing water from a river through a canal or penstock to spin a turbine. Typically a run-of-river project will have little or no storage facility. Run-of-river provides a continuous supply of electricity (base load), with some flexibility of operation for daily fluctuations in demand through water flow that is regulated by the facility.

**Storage hydropower:** typically a large system that uses a dam to store water in a reservoir. Electricity is produced by releasing water from the reservoir through a turbine, which

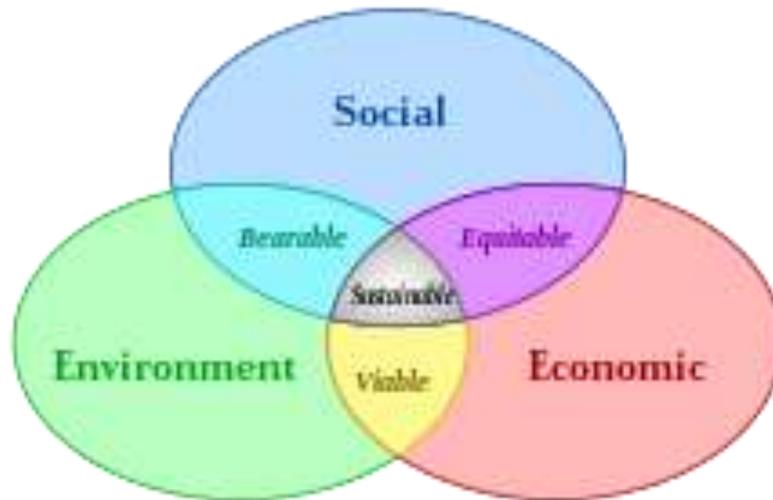
activates a generator. Storage hydropower provides base load as well as the ability to be shut down and started up at short notice according to the demands of the system (peak load). It can offer enough storage capacity to operate independently of the hydrological inflow for many weeks or even months.

**Pumped storage hydropower:** provides peak-load supply, harnessing water which is cycled between a lower and upper reservoir by pumps which use surplus energy from the system at times of low demand. When electricity demand is high, water is released back to the lower reservoir through turbines to produce electricity.

**Offshore hydropower:** a less established but growing group of technologies that use tidal currents or the power of waves to generate electricity from seawater.

Hydro Power Projects sustainability needs to consider its many faces and effects. Hydro Power projects can be run of river, include storage reservoirs or recycle water between reservoirs in the form of pumped storage. Hydro power projects can be in densely populated areas requiring resettlement and rehabilitation. A dam can fragment a river where fish is plentiful and require conservation measures or a dam may impact river of marginal biodiversity. Dams and reservoirs can be located in different climate zones, which will have different impacts on water quality, vegetation, and other operational challenges. A hydro power projects might be the mere addition to generate electricity and income for a water provision or flood control reservoir or the reservoir might primarily be a result of a hydro power development. This approach neglects the complex multiple economic, social and environmental implications of hydro power projects. **Saghir** states that “hydro power has a powerful contribution to make two regional co-corporations and development to the allocation of increasingly scarce water resources.” Hydro power projects are complex and bring risks of economic, social and environmental risks. Some are inherent in the sector and must be addressed by the thoughtful implementation of good practices and a commitment to a sustainable triple bottom line approach.

**Socio-Economic and Environmental approaches:**



Hydro power is generated by water flowing through turbines and as long as the reliability of the water resources is maintained, economic sustainability is not an issue. In terms of inter generational equity, one of the main sustainable development aspect hydropower has a major contribution to make, since a significant part of the economic cost comes at the construction state yet power projects have a very long life. Once constructed and capital expenditure amortized a project is virtually immune to further inflationary pressure, operational and maintenance cost remain low while electricity can be produced very cheaply over many human generations. A cost factor for older hydro power projects may be rehabilitation or upgrading, but they are seldom decommissioned. Economically sustainable projects also have favourable energy pay back ratios. In other side hydro power projects alter the natural habitants of fresh water species in the area they are located. It changes the concentration of nutrients, water temperature and the river flow. Downstream river flow suffers a loss of water and silt loads reducing water quality. These changes directly affect the ecological characteristics of the river that harms native's plants and fish species.

Besides environmental impacts reservoir construction can have social costs as well. The land needed for building dams may directly be occupied by people or affect their livelihood. Research has proven that one consequence of hydroelectric facilities is imparted estuarine livelihood. This can cause displacement of ethnic groups and human right violations. Hydro power projects have the ability to significantly reduce poverty and enhance quality of life in the communities they serve. Families with little excess to water and energy services spend a disproportionate amount of money and time on these two resources and their reliance on poor quality fuels along with a lack of excess to sanitation and drinking water present health risk.

Poverty is commonly associated with wood gathering and deforestation. Excess to electricity promotes new economic activity, empowers women and improves the quality of the family life by reducing mental, domestic chores such as firewood collection, improves health, and education services which provides a cleaner and healthier home environment. Hydro power can be developed on a wide range of scales to meet diverse needs and market power conditions. While small scale decentralized development can bring light and power to remote and rural communities and provides multiple use benefits, particularly through increased availability, reliability and quality of fresh water supplies and reduce flood risk. Negative consequences for human population include resettlement related impacts; reduce fish resources, loss of fertile conservation areas due to reservoir but also river bank erosion or insufficient water release downstream. While many of the social impacts are directly related to environmental effects, the significance of social topics has been underestimated in past hydro power developments. It is increasingly being recognized that social responsibility cannot be achieved without systematic community participation. It has become a sectoral focus to draw on the negative lessons by introducing a new approach to project implementation, where a hydro power project become linked to regional and rural development and maximise the additional benefits to the communities or other stakeholders. Hydro power projects do not export impacts such as rain or atmosphere pupation and rarely increase greenhouse gases. Therefore, hydro power has a valuable contribution to make global warming and can enhance inter and intra generational equity. Furthermore as an infrastructure strategy to address water storage and management, hydropower reservoirs will help adapt to decrease water reliability and more frequent floods and droughts. While hydro power projects can have impacts on their local environment where, for example the basin and ecosystem are sometimes permanently altered, these changes can be mitigated if well managed and have to be considered in relation to the hydrology and to create opportunities for recreation and ecotourism as well as mitigate ecosystem disruption through multiple strategies.

#### **Improvement and Promotion in Environmental and sustainable Development issues:**

In 1955 the international hydro power association was formed under the auspices of UNESCO as a forum to promote and improve good practice and further knowledge about hydropower. The association represents the hydropower sector internationally and has the mission to champion continuous through strong partnerships with other stakeholders and driving initiatives to increase the contribution of renewable, especially hydropower projects .

This paper aimed to increase awareness of the role hydropower projects can play in sustainable development as an important source of renewable energy as well as provider of reliable water resources. The beneficial side of hydropower projects while proposing ways to mitigate or avoid detrimental effects. The guidelines of IHA promote good practice in an effort to fill the gap of missing implementation guidance for sustainable hydropower and have been an internal tool for the sector to adjust its practices in the environment, social and economic spheres.

In order to overcome the lack of a tool by which to assess hydropower's sustainability performance, IHA developed the IHA sustainability Assessment Protocol to assist the hydropower sector in evaluating performance against criteria in the IHA Sustainability Guidelines. The Protocol promotes and makes measurable the consideration of environmental, social and economic sustainability in the assessment of new energy supply options, new consideration of environmental, social and economic sustainability in the assessment of new energy supply options, new hydro projects and the implementation, management and operation of new and existing hydropower facilities.

### **Conclusion**

Hydropower is a renewable, clean energy source that helps to minimise global warming effects, avoiding the increasing demand for energy generated by fossil fuels and thus leaving a cleaner world to future generations. Hydropower does not deplete natural resources and is paid for by the same generation that build it. It constitutes a lasting source of electricity and often water management with long viability and very low maintenance cost, which one generation passes on to several future ones. By enabling present generations to meet their needs without compromising the ability of the future generation to meet their needs therefore hydropower projects fulfils the essential criteria of sustainable development. In order to assure sustainable hydropower development, the public and the private sectors will have to intensify dialogue with stakeholders, share success stories and commit to orientate actions with sustainability principles. In the fight against poverty and climate change there is no single solution, but in the ever changing global context, with rapid growth of developing countries and associated increase in essential energy and water services, it is reasonable and prudent to assume that sustainability managed hydropower will remain part of the solution. The adoption of an approach that allows for trade-offs, yet respects socio- economic and environmental bottom-lines and enables meaningful dialogue between stakeholders is now prerequisite.

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