

The Federal Environmental Protection Authority



Integrated Environmental And Social Impact Assessment Guidelines on Hydropower Production, Transportation And Distribution

NOT FOR CITATION

This guidelines is still under development and shall be binding after consensus is reached between the Environmental Protection Authority and the Environmental Units of Competent Sectoral Agencies

**2004
Addis Ababa**

Ethiopia

Table of Content

	Page
INTRODUCTION.....	1
1. MAJOR TYPES OF INTERVENTION IN THE HYDROPOWER SUB-SECTOR.....	1
2. SPECIFIC CHARACTERISTICS OF A HYDROPOWER PROJECT.....	2
3. MAJOR ISSUES RELATED TO A HYDROPOWER PROJECT.....	4
4. POTENTIAL IMPACTS, ENHANCEMENT AND MITIGATION MEASURES....	5
4.1 POVERTY.....	5
4.2 ENVIRONMENT.....	7
4.3 POPULATION.....	9
4.4 HEALTH OUTCOMES.....	11
4.5 GENDER.....	13
4.6 PARTICIPATION.....	14
5. EXTERNAL FACTORS.....	15
6. HAZARD MANAGEMENT.....	15
7. Environmental and Social Monitoring.....	15

Introduction

These guidelines focus on hydropower projects. They consider the construction and operation of powerhouses and associated infrastructures (canals, sluices, etc.), substations, as well as power transmission and distribution lines. Hydropower projects imply the construction and operation of dams and reservoirs whose impacts are discussed in the Dams and Reservoirs Guidelines.

These guidelines highlight major issues and potential impacts that should be taken into account during the preparation and assessment phases. The appropriate enhancement and mitigation measures should be integrated as early as possible, preferably in the project design.

1. Major Types of Intervention in the Hydropower Sub-Sector

In general, a powerhouse includes the following main hydraulic and electric components:

- The water intake in the reservoir, which is normally equipped with grills to prevent debris entering into the system.
- The water conveyance canal that brings the water to the pressure pipeline.
- The pressure pipeline in which the water is directed to a turbine on a steep slope.
- The turbine consisting of a hydraulic wheel turning with the pressure of the water; the electricity is produced with an alternator, before being directed to electric transformers and a substation.
- The water discharge canal that brings the water downstream into a waterway.

A hydroelectric complex is normally equipped with sluices, which are works allowing the water to flow out of the reservoir when the maximum capacity is reached.

The design of hydropower projects varies according to local characteristics and energy needs. For example, to avoid problems related to the creation of a reservoir, the construction of a run-of-river powerhouse might be preferred.

Power transmission and distribution lines aim to transport and distribute the power generated by a hydroelectric powerhouse. The main structures of power lines include electric wires, conductors, towers, transformers and substations. Access roads are also required for constructing and maintaining the line.

The size of the electrical structures depends on the voltage and the capacity of the power line. Wood poles are often used for low-voltage distribution lines in urban and rural areas. H-frame wood pole structures are often used for higher voltage lines up to 231 kV. High-voltage transmission lines of 161 kV and more are usually built on self-supporting and guyed-wired pylons.

The length of power lines, which can vary from a few to hundreds of kilometres, depends on the purpose of the line. Low-voltage lines, used for power distribution, are usually much shorter than high-voltage lines, which are used to carry the energy from power plants located in remote areas.

The width of the power line right-of-way also ranges according to the voltage. The distribution line right-of-way in urban or rural areas is usually narrow (5 to 20 meters), whereas the right-of-way of high-voltage power transmission lines can be hundreds of meters wide, particularly when there is more than one line in the right-of-way.

2. Specific Characteristics of a Hydropower Project

The description and justification of a hydropower project shall cover the following elements:

- Spatial requirements (rights-of-way and other sites required for works).
- Project layout characteristics (including site location map).
- Land tenure and ownership.
- Affected groups (directly or indirectly).
- Resettlement requirements and proposed transition and compensation means.
- Socio-cultural factors or constraints, such as customs and beliefs.

- Natural and human resources needs.
- Water regulation works (dams, dykes, sluices, etc.).
- Powerhouse characteristics.
- Reservoir characteristics (area, volume and levels).
- Hydraulic components (water intake, canals, pipelines, turbine, etc.).
- Electric elements (alternators, transformers, power lines, etc.).
- Power line design elements (voltage, capacity, structures, substations, dimensions, etc.).
- Other permanent infrastructures (roads, local airports, telecommunications network, etc.).
- Temporary infrastructures (cofferdams, materials storage areas, waste areas, labour camps, etc.).
- Existing and proposed location of human settlements and public services such as health centres and accident and emergency units.
- Construction activities (land clearing, burning, excavation, blasting, extracting, dredging, filling, compacting, waterways crossing, use of heavy machinery, etc.).
- Anticipated liquid, solid (including waste) and gaseous emissions, and sources of nuisances (at construction and operation stages).
- Construction schedules and costs.
- Maintenance works and associated costs.
- Reservoir management.
- Security measures.
- Consultation approaches and participation mechanisms.

3. Major Issues Related to a Hydropower Project

The main issues related to hydropower projects can be summarised as follows:

Crosscutting Theme	Major Issues	Relevant or not
Poverty	<ul style="list-style-type: none"> • Economic activity, employment and incomes. • Compensation for losses. • Access to benefit, particularly for adversely affected populations. • Knowledge on project implications and opportunities. • Availability of and access to infrastructures and services, particularly to electricity. 	
Environment	<ul style="list-style-type: none"> • Ecosystems of particular interest and/or ecologically sensitive areas. • Wildlife habitat, especially fish habitat. • Level of noise (substations and transmission lines). • Vegetation conservation (transmission lines). • Water quality. • Heritage and cultural sites. 	
Population	<ul style="list-style-type: none"> • Involuntary resettlement and migration. • Population characteristics and dynamics (size, density, age, ethnies, life expectancy, gender, employment, etc.). • Land uses. • Agricultural practices and natural resources exploitation. • Quality of life. • Traditional lifestyle and local customs. • Landscape and aesthetics. 	
Health Outcomes	<ul style="list-style-type: none"> • HIV and sexually transmitted infections. • Vector-borne and other communicable diseases. • Accidents and injuries. • Electrocutation. • Poisoning from pesticides. 	
Gender	<ul style="list-style-type: none"> • Women's workload. • Control over land and land use proceeds. • Income-generating activities for women. • Women's specific needs. • Access to the new infrastructures and services. • Women's involvement in decision-making processes. 	
Participation	<ul style="list-style-type: none"> • Participation of affected groups in consultations. • User/customer organisation. 	

4. Potential Impacts, Enhancement and Mitigation Measures

As mentioned in the “Generic Approach” document, the IESIA Guidelines were developed to provide guidance on how to adequately consider the Bank’s priority crosscutting themes while preparing and assessing a project. Consequently the potential impacts outlined below are presented by crosscutting theme (one table per theme) to clearly identify the potential interactions between a hydropower project (excluding dams and reservoirs impacts) and a specific transversal issue. The components considered under each crosscutting theme were selected for their relevance to the particular issue.

4.1 Poverty

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Economy	<ul style="list-style-type: none"> • Diversification of income generating activities due to a better access to energy (e.g. establishment of energy-intensive industries). • Increase in revenue opportunities for men and women due to the presence of non-resident workers and new settlers. • Job creation. • Disruption of some economic activities such as tourism. • Benefits not accessible to people adversely affected by the project. • Losses for affected people who cannot maintain their normal activities (temporary in most cases). 	<ul style="list-style-type: none"> • Give preference to local employment (men and women) and local inputs (food, basic material) to the extent possible. • Try to minimise land expropriation and compensations by considering alternative project designs. • Establish appropriate compensation mechanisms, recognising income and asset losses. • Encourage the pursuing of agricultural activities in rights-of-way after construction. • Whenever possible, facilitate access to energy to men and women adversely affected by the project. • Avoid tourist sites.
Information, education and communication	<ul style="list-style-type: none"> • Exclusion of specific groups due to a lack of knowledge. • Uncertainty and increased perturbations due to a lack of information and communication. • Limited knowledge on safety measures and behaviours that can lead to accidents. 	<ul style="list-style-type: none"> • Assist groups of individuals who may lack the capacity to apply for a job to prepare an application, if they want to. • Inform men and women affected by the project on project activities, schedule and potential derangement, as well as on means to reduce perturbations. • Develop and implement a literacy program especially aimed at poor people and women. • Plan information, education and communication activities during and after project implementation to increase awareness of all users (men and women) on dangerous behaviours and safety measures that shall be taken.

Poverty cont...

<p>Access to infrastructures and services</p>	<ul style="list-style-type: none"> • Better access to energy. • Development of new infrastructures or improvement to existing ones. • Unequal access to hydroelectricity due to a lack of financial means. • Increased pressures on existing social services with the arrival of non-resident workers and migrants. 	<ul style="list-style-type: none"> • Include an access component in projects to favour a broader distribution of electricity to households. • Involve the population (men and women) in the maintenance and management of new infrastructures to ensure their sustainability. • Before construction, consult concerned ministries to verify the adequacy of current and proposed infrastructures. • Ensure adequate social services for addressing the basic needs of host and migrant populations (men and women).
---	---	---

4.2 Environment

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Air	<ul style="list-style-type: none"> • Limited effects on climate (greenhouse gas production) in comparison to alternative power generating projects. • Degradation of air quality by dust and vehicles emissions. • Increase in ambient noise near the substations. 	<ul style="list-style-type: none"> • Install and operate air pollution control equipment. • Near residential areas, avoid noisy works after regular working hours. • Maintain vehicles and machinery in good condition in order to minimise gas emissions and noise. • Use appropriate means for minimising dust dispersion during construction. • Use noise attenuators, such as vegetation hedges around substations, in order to minimise noise.
Water	<ul style="list-style-type: none"> • Interruption of surface water flows during construction. • Variations in the level of groundwater table resulting from changes in the drainage. • Contamination of surface and underground water quality by wastewater, hazardous materials, and pesticides used for the maintenance of the transmission line rights-of-way. • Erosion of riverbed downstream of the dam. • Salt-water intrusion in estuary and upstream. 	<ul style="list-style-type: none"> • Do not hamper drainage of surface water and plan for restoration measures after construction. • Plan and set up on-site sanitary facilities for the disposal of wastewater. • Maintain vehicles, machinery and equipment in good condition in order to avoid leaks and spill of hazardous materials (hydrocarbons, chemical products, etc.). • Ensure a safe management of hazardous materials (hydrocarbons, chemical products, etc.). • Take all precautions during the refuelling of vehicles and machinery, and forbid the refuelling near water bodies. • Avoid crossing permanent waterways with machinery; if necessary, locate the crossing where the banks are stable and the waterway the most narrow. • Conserve the vegetation along water bodies and near wetlands. • Plan emergency response measures in case of accidental spill. • Favour the use of mechanical maintenance techniques rather than pesticides. • Select herbicides with minimal undesired effects. • Do not apply herbicides by aerial spraying. • Maintain natural herbaceous and shrubby vegetation. • Maintain a minimum flow to prevent salt water intrusion.

Environment cont...

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Soil	<ul style="list-style-type: none"> • Runoff erosion resulting in sedimentation problems. • Soils contamination from hazardous materials spills during construction. • Soil compaction. • Reduction in soil fertility. • Soil destabilisation as a result of excavation. • Risk of soil contamination from substations. 	<ul style="list-style-type: none"> • Avoid areas sensitive to erosion. • Carry out the construction works in the dry season. • Avoid high-productive soils. • Limit the circulation of heavy machinery to minimal areas. • Avoid establishing access roads along steep slopes; instead, locate access roads perpendicularly or diagonally to the slope. • Use existing borrow pits rather than creating new ones; after the works, restore borrow pits by stabilising slopes and facilitating vegetation regeneration. • Stabilise the soils in order to reduce potential erosion. • At the end of construction works, level off the soils and facilitate vegetation regeneration.
Ecosystems	<ul style="list-style-type: none"> • Encroachment into ecologically sensitive and protected areas. • Reduction of the biodiversity. • Increased access to ecosystems of particular interest. 	<ul style="list-style-type: none"> • Design the right-of-way layout avoiding ecologically sensitive and protected areas. • Establish a perimeter of protection around sensitive ecosystems such as wetlands and unique habitats sheltering endangered species. • Minimise the length of work in ecologically sensitive areas. • Minimise the right-of-way layout in forestland.
Flora	<ul style="list-style-type: none"> • Destruction of the vegetation cover. • Loss of forest products (fuelwood, timber, non timber forest products, medicinal plants). 	<ul style="list-style-type: none"> • Minimise land-clearing areas. • Recuperate the forest products extracted from land clearing and identify mechanisms to distribute the products to the local population. • Protect trees from machinery along rights-of-way.
Fauna	<ul style="list-style-type: none"> • Derangement or fragmentation of wildlife habitats. • Birds hazards from transmission lines and pylons. • Increase in poaching due to an easier access for the local population and non-resident workers. 	<ul style="list-style-type: none"> • Maintain wildlife habitat beneath transmission line. • Avoid important bird habitats. • Install deflectors on lines in areas with potential for bird collisions. • Design the right-of-way layout by taking into account wildlife reproduction areas. • Do not carry out any work in reproduction areas during the reproduction periods. • Control illegal fishing and hunting, particularly by non-resident workers.
Natural and cultural heritage	<ul style="list-style-type: none"> • Change in, encroachment, destruction or degradation of sites of cultural, archaeological or historical importance. 	<ul style="list-style-type: none"> • Before construction, carry out an archaeological survey of the project area. • Involve traditional authorities in monitoring cultural, religious, historical and aesthetic sites and resources during the various phases of the project. • In the case of the discovery of any artefact of cultural, archaeological or historical importance, interrupt construction works in the concerned area and contact the relevant authorities.

4.3 Population

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Demographic trends	<ul style="list-style-type: none"> • Increase in the population due to migrants attracted by new economic opportunities (energy-intensive industries, trade) and an easier land access. • Increased ethnic diversity after migration. • Temporary imbalance between men and women due to male workers, which can lead to an increase in sexually transmitted diseases. 	<ul style="list-style-type: none"> • Work closely with host communities to facilitate the integration and acceptance of migrants (men and women). • Establish labour camps at a reasonable distance from villages. • Whenever possible employ women or married men with nearby families. • Assist non-resident workers in order to encourage their families to join them.
Migration and resettlement	<ul style="list-style-type: none"> • Decreased conditions of living for involuntarily displaced people. • Inappropriate living conditions for non-resident workers and their families. • Constraints in adjusting to resettlement and changes in productive activities. • Population pressure due to the arrival of non-resident workers and new settlers. • Unplanned human settlements. 	<ul style="list-style-type: none"> • Provide equivalent or better housing and accompanying facilities to involuntarily displaced men and women in accordance with consultation results. • Plan adequate settlement areas with appropriate housing, services (water and sanitation) and food supply for non-resident workers and their families. • Provide temporary food supplies to involuntarily displaced people, as needed. • Provide complementary training /support to adversely affected men and women in order to facilitate adjustment during the transition period. • In accordance with priorities of displaced men and women, ensure appropriate funding for resettlement and compensations, in particular for productive land owned, occupied or cultivated. • Establish access mechanisms in order to control unorganised settlements.

Population cont...

<p>Natural re-sources and land management</p>	<ul style="list-style-type: none"> • Development of agricultural and pastoral land due to an easier access. • Access to new territory and migration leading to an increased pressure on natural resources. • Disruption of agricultural and natural resources exploitation activities. • Loss of productive land (at least temporarily). • Loss of territory for local people. • Change in land ownership rights and uses along access roads and rights-of-way, which can lead to social conflicts. 	<ul style="list-style-type: none"> • Take into account the various land uses while designing the project in order to minimise the loss of land, particularly productive land. • Coordinate project works with the various land users (men and women). • Involve traditional authorities in the design of the project, particularly in siting settlements and defining the rights-of-way. • Offer compensation or alternative revenue opportunities to men and women deprived from their land, e.g. to owners and to those occupying/cultivating the land. • Encourage the pursuing of agricultural activities in rights-of-way after construction. • Integrate land management priorities into land planning instruments to take into account various land uses. • Integrate the project infrastructures into land use and development plans. • Plan land occupation along access roads and rights-of-way in order to preserve agricultural and pastoral land.
<p>Quality of life</p>	<ul style="list-style-type: none"> • Improvement in quality of life due to new economic opportunities and an increases access to electricity. • Deterioration of the quality of life due to nuisances such as noise, dust and traffic related to construction works. • Visual degradation of the landscape due to land clearing, construction works, new infrastructures, etc. • Social conflicts due to the venue of non-resident workers and migrants (divorces, ethnic tension, etc.). 	<ul style="list-style-type: none"> • Establish a formal consultation mechanism with local authorities to discuss issues disturbing inhabitants and to find solutions satisfying all parties. • Train workers (men and women) in the field of environmental protection. • Implement a communication plan to inform men and women on project activities and potential nuisances. • Involve local authorities in monitoring implementation activities and compensation agreements, ensuring a good representation of men and women. • Favour an architectural design integrating project infrastructures into the landscape. • Avoid building access roads across local people tracks or pathways. • Ensure appropriate support from social services to facilitate the transition and to prevent conflicts within families or among groups.

4.4 Health Outcomes

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Communicable diseases	<p>Changes in exposure to:</p> <ul style="list-style-type: none"> • Water borne diseases e.g.: diarrhoea and cholera associated with poor sanitary conditions and loss of water for domestic purposes • Water related diseases e.g.: malaria, onchocerciasis, filariasis associated with increases in vector breeding and contact. • Water contact diseases e.g.: schistosomiasis and swimmer's itch associated with domestic and occupational behaviour. • Water washed diseases e.g.: scabies and skin infections associated with poor sanitary and hygienic conditions. • Sexually transmitted infections e.g.: HIV/AIDS associated with migration, construction, economic change. • Zoonoses associated with project location e.g.: trypanosomiasis. • Respiratory infections e.g.: TB associated with crowding. 	<ul style="list-style-type: none"> • Provide appropriate domestic water supply to address additional needs. • Facilitate the implementation of appropriate latrines and other sanitation facilities. • Provide information, education and communication about safe uses of water and occupational safety. • Environmental management for vector control; contact avoidance via settlement location and design and use of bednets and repellents; rapid diagnosis and treatment; focal insecticide and molluscicide application. • Strengthen medical services to ensure rapid diagnosis and treatment. • Safe food storage and handling. • Implement HIV/AIDS prophylaxis for men and women, through appropriate health promotion as well as wide distribution and use of condoms; employment opportunities for project-affected women; provision of family accommodation for workers. • Project settlement housing designed to avoid crowding, and provide ventilated kitchens and efficient stoves. • Refer to measures proposed under Environment and Poverty crosscutting themes as they address many health determinants of communicable diseases.
Non-communicable diseases	<ul style="list-style-type: none"> • Uncertain effects of electromagnetic radiation. • Dust induced lung diseases during construction. • Herbicide poisoning. 	<ul style="list-style-type: none"> • Locate the right-of-way to avoid areas of human activities. • Implement appropriate work-site practices. • Plan appropriate storage, use and disposal of herbicides.
Malnutrition	<ul style="list-style-type: none"> • Deterioration in nutritional status due to disturbed production and markets. 	<ul style="list-style-type: none"> • Ensure food markets function efficiently during project implementation.

Health Outcomes cont...

<p>Injuries</p>	<ul style="list-style-type: none"> • Increased risk of accidents on working sites and roads due to increased traffic. • Increased risk of accidents due to aircraft colliding with transmission lines and pylons. • Increased risk of electrocution associated with illegal abstraction. • Work injuries. • Increased risk of drowning near the powerhouse. • Appearance of or increase in domestic and communal violence, for example resulting from influx of non-resident workers. 	<ul style="list-style-type: none"> • Develop, communicate and implement safety and preventive measures for the population (such as traffic calming devices). • Control access to working sites. • Install and maintain appropriate signs. • Provide rural electrification opportunities. • Control illegal abstraction. • Plan stabilisation and evacuation of injured. • Locate the right-of-way to avoid airport flight paths. • Install markers to minimise risks of low-flying aircraft. • Ensure that downstream villages are informed in advance of water fluctuations. • Restrict public access to intake and outlet points. • Develop, communicate and implement safety and preventive measures for workers (men and women). • Plan equipment for moving heavy loads such as donkey carts and ergonomic equipment for men and women. • Design operating rules to safeguard human health.
<p>Psychosocial disorders and well-being</p>	<ul style="list-style-type: none"> • Stress and anxiety associated with involuntary resettlement, rapid social change, loss of traditional authority, loss of spiritual assets, uncertainty and locus of control, severance, exclusion, and marginalisation, gender related problems and domestic disputes leading to suicide, physical and mental abuse, child marriage, labour and sale, and communal violence. • Well-being associated with improved income, stability, work opportunities, settlements, health, empowerment, education and training. 	<ul style="list-style-type: none"> • Refer to measures proposed under other crosscutting themes as those address many causes of psychosocial disorders and factors contributing to well-being.

4.5 Gender

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Division of labour (paid and unpaid work)	<ul style="list-style-type: none"> • Decreased workload for women and children whose households can access and pay for electricity. • Increase in workload due to development pressures on natural resources. 	<ul style="list-style-type: none"> • Include an access component in projects to favour a broader distribution of electricity to households. • Ensure that access to natural resources used for domestic purposes is maintained (e.g. same or reduced supply time and distance).
Income generating activities (money or kind)	<ul style="list-style-type: none"> • Local jobs obtained by women during construction or operation phases. • Opportunities to increase income and diversify revenue sources through induced development. • Loss of revenues due to perturbed agricultural and natural resources exploitation activities. • Limited participation of women in project benefits due to cultural barriers. 	<ul style="list-style-type: none"> • Offer project employment opportunities to men and women, encourage women to apply and select candidates according to their competencies. • Ensure that women have access to existing and planned facilities to take advantage of new opportunities. • Provide appropriate compensation or income-generating alternatives to both women adversely affected by the project. • Ensure that project promoters do not reinforce cultural barriers affecting negatively women.
Access to and control over productive factors	<ul style="list-style-type: none"> • Project priorities do not respond to women needs (limited access to electricity). • Loss of control over energy supply. 	<ul style="list-style-type: none"> • Provide women with an opportunity to make their needs known to project decision-makers. • Recognise the specific energy demands of women, who are the primary energy collectors and users.
Involvement of women in societal organisation	<ul style="list-style-type: none"> • Women get organised to make their energy needs and priorities better known to decision-makers. • Exclusion of women in decisions related to energy distribution and management. 	<ul style="list-style-type: none"> • Facilitate the creation of women groups when women express an interest in being better organised and represented. • Ensure women involvement in user/customer organisations, if they want to.

4.6 Participation

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Consultations	<ul style="list-style-type: none"> • Integration of men's and women's concerns into the project design. • Increased support for the project among affected populations. • Exclusion of specific groups from consultations, particularly women. 	<ul style="list-style-type: none"> • Consult affected men and women at all phases of the project. • Provide the opportunity to all affected groups to participate in consultations by offering adapted consultation mechanisms. • Inform consulted men and women on how their concerns were taken into account.
Civil society strengthening	<ul style="list-style-type: none"> • Creation of electricity user/customer organisations. • Development of local maintenance organisations to encourage employment and empowerment within the communities. • Loss of power for traditional leaders. 	<ul style="list-style-type: none"> • Ensure that men and women have the opportunity to organise themselves in groups representing their collective interests. • Ensure the participation of men and women in local maintenance organisations. • Establish a consultation mechanism with traditional authorities to ensure that their views are considered during the planning and implementation phases.

4.2.2 Construction

5. External Factors

The major factors that may jeopardise the outcomes of a hydropower project are natural disasters such as earthquakes, landslides, cyclones and tropical storms. In addition, social instability such as community violence, vandalism, civil war, border raids and boundary disputes can lead to the failure of a hydropower project. Good governance and poverty alleviation policies are means to prevent social instability.

6. Hazard Management

The main hazard associated with hydropower projects is **health hazard** such as injury. High voltage electric power can cause electrocution through inappropriate connection. Moreover, unpredictable draw down and downstream flow rate fluctuation can lead to drowning and injury.

In order to prevent or minimise this hazard, appropriate risk management measures shall be designed and implemented.

7. Environmental and Social Monitoring

The following table presents potential indicators that could be used to monitor the implementation of a hydropower project. The appropriate indicators for a specific project shall be selected according to the project context, major anticipated impacts and the cost of data collection and processing.

Component	Indicators
Poverty	
Economy	<ul style="list-style-type: none"> • Number of jobs created (directly and indirectly) and occupied by men and women. • Share of the benefits going to adversely affected men and women.
Information, education and communication	<ul style="list-style-type: none"> • Understanding of safety measures (survey).
Access to infrastructures and services	<ul style="list-style-type: none"> • Number of households having access to electricity. • Number of breakdowns and hours without service. • Change in energy prices (evolution over time).
Environment	
Air	<ul style="list-style-type: none"> • Level of noise near substations.
Water	<ul style="list-style-type: none"> • Parameters of WHO <i>Guidelines for Drinking-water Quality</i>.
Soils	<ul style="list-style-type: none"> • Evolution of erosion signs along power lines. • Soils contamination around substations.
Ecosystems	<ul style="list-style-type: none"> • Area of particular ecological interest affected by the project.
Flora	<ul style="list-style-type: none"> • Cleared area for the project. • Quantity of pesticides used for vegetation maintenance.
Fauna	<ul style="list-style-type: none"> • Variation in species populations.
Natural and cultural heritage	<ul style="list-style-type: none"> • Number of natural and cultural sites affected by the project.
Population	
Demographic trends	<ul style="list-style-type: none"> • Population growth and ethnic composition.
Migration and resettlement	<ul style="list-style-type: none"> • Type of housing and accessible services to displaced men and women before and after project implementation. • Number of informal settlements built by migrants.

Environmental and Social Monitoring cont...

Natural resources and land management	<ul style="list-style-type: none"> • Area of land developed due to easier access. • Distance and time to access natural resources such as firewood before and after the project. • Conflicts among land users. • Change in the price of land.
Quality of life	<ul style="list-style-type: none"> • Level of satisfaction of displaced men and women (survey). • Number of complaints by local people on noise, dust, landscape, additional traffic, etc. • Number of conflicts among migrants and local people.
Health Outcomes	
Communicable diseases	<ul style="list-style-type: none"> • Prevalence rates (evolution over time) for diseases such as malaria, schistosomiasis, diarrhoea and HIV. • Number of vector breeding sites and vector density. • Availability of condoms, impregnated bednets, mosquito repellents. • Outpatient attendance records. • Quantity of drugs supplied and used from health services and local shops.
Non communicable diseases	<ul style="list-style-type: none"> • Prevalence rate of poisoning cases. • Inventory of exposure sites including pesticide storage sites.
Malnutrition	<ul style="list-style-type: none"> • Change in local market food prices. • Height/weight monitoring of children.
Injuries	<ul style="list-style-type: none"> • Number of violent events reported by police and social services. • Number of injuries and deaths involving electricity or water. • Construction site occupational health and safety records. • Number of illegal connections to electricity supply.
Gender	
Division of labour	<ul style="list-style-type: none"> • Time allocation of women before and after the project.
Income generating activities (money or kind)	<ul style="list-style-type: none"> • Proportion of women involved in construction and/or maintenance activities. • Proportion of the family income earned by women before and after the project.
Access to and control over productive factors	<ul style="list-style-type: none"> • Level of satisfaction of women toward project investment decisions and management methods (survey).
Involvement in societal organisation	<ul style="list-style-type: none"> • Number of women and men involved in user/consumer organisations.
Participation	
Civil society strengthening	<ul style="list-style-type: none"> • Number of local maintenance groups created.

8. References and Further Readings

- Asian Development Bank (1993). *Environmental Guidelines for Selected Infrastructure Projects*. Office of the Environment.
- Birley, M. H. (1995). *The Health Impact Assessment of Development Projects*. HMSO, London.
- Birley, M. H. and K. Lock (1999). *The Health Impacts of Peri-urban Natural Resource Development*. Liverpool School of Tropical Medicine, Liverpool.
- Government of Quebec (2000). *Guidelines for the Preparation of an Environmental Impact Assessment of a High-Voltage Electric Power Line Project*. Department of Environmental Assessment, Ministry of Environment.
- World Bank (1991). *Environmental Assessment Sourcebook – Volume III: Guidelines for Environmental Assessment of Energy and Industry Projects*. World Bank Technical Paper number 154. Environment Department.
- World Health Organisation (1993). *Guidelines for Drinking-water Quality*. Second edition, Geneva, Switzerland.