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The evolution of Environmental and Social Impact Assessments in Hydropower

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Declaration

I, Guillaume Thomas Quigley, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Date: 01.08.2021

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Main supervisor: Dr Lars Kåre Grimsby Professor at the Norwegian University of Life Sciences (NMBU) Noragric department.

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List of Acronyms

ADB - Asian Development Bank

CEA - Cumulative Effect Assessment

CIA - Cumulative Impact Assessment

EA - Environmental Assessment

EIA - Environmental Impact Assessment

EIB - European Investment Bank

EIS - Environmental Impact Statement

EP - Equator Principles

ESF - Environmental and Social Framework

ESMP - Environmental and Social Management Plan

ESMS - Environmental and Social Impact Statement

GHG - Greenhouse Gasses

HSAP - Hydropower Sustainability Assessment Protocol

IAIA - International Association for Impact Assessment

IFC - International Finance Corporation

IHA - International Hydropower Association

IUCN - International Union for Conservation of Nature

MRC - Mekong River Commission

NEPA - National Environmental Policy Act

NOG – Non-Governmental Organisation

OD - Operational Directive

OP – Operational Policy

PS - Performance Standards

SDG – United Nations Sustainable Development Goals

SEA - Strategic Environmental Assessment

ToR - Terms of Reference

UN - United Nations

UNESCO - United Nations Educational, Scientific and Cultural Organization

USA - United States of America

WCD - World Commission on Dams

Abstract

Environmental and Social Impact Assessments or ESIA's are one of the main project decision-making tools in use to address environmental and social externalities related to project development. They have evolved in response to the ever-growing need to better acknowledge and mitigate negative environmental and social impacts of human development that began with the so-called environmental awakening in the 1960s. This movement led to the first impact assessment tool being developed and implemented in the USA under the National Environmental Policy Act (NEPA) and is known as the Environmental Impact Assessment (EIA). The ESIA today is found in numerous national legislations, international agreements, lending institution requirements and is viewed as key to addressing the problem of sustainable development. This study will try and understand how ESIA has evolved by using hydropower development as a case study. This is particularly relevant as hydropower faces a paradox in that they are viewed as bought merely a renewable source of energy and a source of negative local or regional environmental and social impacts. Through a literature review and interviews with relevant experts in the field, this study will look at the evolution of the ESIA in hydropower to better understand what has made the ESIA what they are today, how they fit into the changing agendas and how they address the issue of sustainability in hydropower. The findings were that the evolution of the ESIA was driven by changing environmental agendas due to growing awareness of the scope of environmental and social issues. Furthermore, the interaction between different actors such as legislators/regulators, developers/investors, practitioners, academics, and civil society is what has shaped the ESIA into what it is today. Despite this long evolution, however, in practice ESIA's have encountered some limitations due to scoping, cumulative impacts, timing of their intervention and putting them properly into practice in hydropower development projects. This has led to questions in the role of ESIAs regarding the future of sustainable hydropower development. The hydropower industry is evolving into a more integrative approach where Strategic Environmental Assessment (SEA) and Basin Management Plans (MBP's) are being strongly advocated by key international and regional actors in hydropower such as the International Hydropower Association (IHA) and the Mekong River Commission (MRC). ESIA's are still an integral part of hydropower development and are developing new methods of valuation to better address some limitations and to address sustainability for better cost-benefit analysis. These two organizations cited above, along with international lenders (World Bank, International Finance Corporation, EIB etc.) have over the past two decades advocated, integrating project-related ESIA's into a larger-scale assessment

that allows for better sustainability assessment of hydropower development on a national or regional scale and thus satisfy their safeguard policies that allows them to confirm or not whether they will lend money to developers or not. This is in line with the growing understanding and acknowledgment that the scope of environmental and social issues is usually beyond what a single project assessment can address.

1 Introduction

There is mounting global recognition of the growing major impact human activity and development is having on the environment and how this is threatening the wellbeing of our society. The evidence is suggesting that the recognised period of the last 10’000 years of a relatively stable climate (called the Holocene), where civilization as we know it arose, is coming to an end due to human actions (Roberts, 2013). One of the main reasons is the increasing emissions of Greenhouse Gases (GHG) from fossil fuel use in industries, transportation, and energy production (Yoro & Daramola, 2020). Furthermore, land-use changes, damming of rivers, pollution and climate change are resulting in loss of biodiversity as well as crucial ecosystem services. Consequently, this directly threatens human population and health (Karl, et al., 2009) as is evident in the numerous environmental disasters and climate extremes experienced in the last 20-30. The threat posed by the loss of biodiversity and climate change has prompted the government and international institutions to develop stronger and more firm environmental guidelines and policies to ensure sustainable development.

In the energy sector, there is a push to further develop new renewable energy to meet the world's energy demands in a cleaner way than traditional fossil fuel based energy production. The International Energy Association (IEA) has identified hydropower as one of the major contributors to achieving renewable energy goals (REN21, 2020). Hydropower is considered to be a low carbon emission energy source and a form of renewable energy production. This is particularly important in today's context of climate change mitigation by reducing GHG emissions worldwide (Makkanen & Plummer Braeckman, 2019). It is also seen to be essential by the International Energy Agency (IEA) in meeting the Paris agreement’s goal of keeping the global average temperature under the 2°C increase and is expected to contribute to United Nations Sustainable Development Goals (SDG) numbers as follows: that is to say, 6 “*Ensuring availability and sustainable management of water for all*”, 7 “*Providing access to affordable, reliable, sustainable and modern energy for all*”, 9 ”*Upgrading infrastructure with clean, environmentally sound technologies*” and 13 “ *Taking action to combat climate change and its impacts*” (Makkanen & Plummer Braeckman; 2019; Peters, et al., 2021; IHA, 2020). Hydropower is currently the renewable technology producing the largest amount of energy (Amponsah, et al., 2014) and supplying 58% of the world renewable energy and 15.9% of total electricity production as of 2019 (REN21, 2020). Hydropower is expected to keep growing in capacity in order to meet the energy demands and renewable goals (Zarfl, et al., 2015). However, hydropower is faced with a paradox. On the one hand, it is viewed as a renewable source of energy and is important in reducing the global GHG emissions but on the other, on a local or regional level, there are several environmental and social externalities from hydropower development. Even with the best intentions there still are negative environmental and social impacts associated with all hydropower development (Baird, et al., 2021).

Damming of rivers for hydroelectric purposes will severely affect the connectivity of the river, including changing the hydrology and geomorphology of the river system. This will in turn affect the biodiversity of the river system as well as the population dependent on the river and these effects can be far-reaching (Botelho, et al., 2017). However, in the early 2000's, the hydropower industry underwent a shift towards a more sustainable approach. The World Commission of Dams (WCD) produced a report that addressed many environmental and social issues hydropower developments experienced (Locher, et al., 2010). This report strongly advocated the use of impact assessment in hydropower development. For these reasons, ESIA's and other forms of impact assessments are now an essential part of hydropower development as they provide decision-makers with tools to make informed decisions to mitigate environmental and social impacts of a planned hydropower project or projects and to allocate the needed budget to put in place these measures. (Dendena & Corsi, 2015).

The proper implementation of a hydropower development project is particularly important in large river basins supporting a vast amount of biodiversity and livelihoods. This is the case, for example, of the Mekong River Basin. This basin boarders the countries of China, Myanmar, Laos, Thailand, Cambodia, and Vietnam and is spanning a length of 4909km (Soukhaphon, et al., 2021). The Mekong River is the third most biodiverse river system in the world and it is also the biggest freshwater fishery in the world. 70 million people depend on the ecosystem services provided by this river (Intralawan, et al., 2018). However, this river also has a lot of unexploited hydropower potential and several hydropower projects have already been built with more being planned. If not properly planned and executed, however, it could be disastrous for the Mekong River's environment and the livelihoods of millions of people dependent on the ecosystem services provided by it (Schmitt, 2019; Li, 2008; Intralawan, et al., 2018). Hence it is necessary to conduct a proper environmental and social impact assessment and good planification to avoid potential negative effects of hydropower development, not least is the Global South where most of the planned projects are found.

The adoption of the ESIA in hydropower as a decision-making tool for projects is a relatively recent innovation. However, the field of impacts assessment has been evolving incrementally since the 70s. The origin of this field can be traced back to when the United States of America (USA) adopted the National Environmental Policy Act (NEPA) that introduced the Environmental Impact Assessment (EIA). Since the introduction of EIA, there have been numerous changes in the theoretical basis, practices, enforcing mechanisms, and agendas that have led to the creation of not only the ESIA but a whole spectrum of other impacts assessment. The numerous forms of current impact assessment have arisen in answer to some form of dissatisfaction in the original EIA process (Cashmore, 2004).

An ESIA, however, is one of the widely used tools for project decision-making. There are several definitions of an ESIA (Glasson & Riki, 2019) but one of the most accepted definitions is given by the International Finance Corporation (IFC) (Corsi, et al., 2015) and is defined as "*Environmental and Social Impact Assessment (ESIA) is a comprehensive document of a Project's potential environmental and social risks and impacts. An ESIA is usually prepared for greenfield developments or large expansions with specifically identified physical elements, aspects, and facilities that are likely to generate significant environmental or social impacts*" (IFC, 2012).

Despite the many years of evolution that have led to the adoption of the ESIA, there still is some dissatisfaction in the ESIA. Issues relating to the difficulty of geographical and temporal scoping, addressing cumulative impacts and less tangible secondary impacts in the ESIA are observed (Mandelik, et al., 2005). This affects the quality and effectiveness of ESIA's (Petts, 2009). There also appears to be a gap between the theoretical best practices in the ESIA and the real-world implementation of hydropower (Morgan, 2012). Furthermore, there are questions surrounding the effectiveness of ESIA's as the scope of environmental and social issues being address is growing. This is the case in the hydropower industry where there are issues relating to the scope of ESIA's, timing in the implementation of the study and the lack of ESIA effectiveness in many projects (Li, 2008). Simultaneously, the role of hydropower has been shifting with the international sustainability goals. On the one hand, hydropower is a source of renewable energy and has been identified by the IEA as necessary to achieve carbon emission target (REN21, 2020). On the other hand, there has been a growing understanding of the complexity and scope of hydropower externalities. Furthermore, with the advent of sustainability as an issue, larger-scale impact assessments such as Strategic Environmental Assessments (SEA) and Cumulative Impact Assessment (CIA) have come to the stage over the past two decades (Mandelik, et al., 2005). This also poses the question of the role ESIA's will play in sustainable hydropower development within these larger-scale impact assessments above.

Taking an evolutionary framed approach to investigate how tools for impact assessment in large hydropower development have evolved can allow for a better understanding not only of the complexity and scope of how ESIA is currently practiced, but also opens for possible future developments of assessment tools. An analytic approach looking into the history of impact assessment tools can help highlight changes, complexity, and variability not only in the field of impact assessment but also in the institutional and social environment it is set in (Orion & Steinmo, 2012). The institutional and social environment changes as society shapes institutions and institutions, in turn, shape society in an ever-evolving process of institutionalisation. Environmental governance can be seen as developing in a similar manner, with actors, norms and institutions being in an inter-dependent, dynamic and evolving relationship (Vatn, 2015). ESIA is an important tool in environmental governance. To understand the evolution of ESIA it is important to understand the institutional and social environment it is set in and how different actors play a role.

The main research objectives is to understand: *How has the ESIA in the hydropower sector evolved to be what it is today?* The field of impact assessment has evolved in response to the world as it becomes more aware of environmental and social issues and the complexity of addressing these issues. For this reason, it is important to explore the historic background of the ESIA to better understand the general worldwide context that has pushed the evolution of the impact assessment field and to understand: *What are the social and normative ideas that have driven the evolution of hydropower?* This study will also be looking at: *What actors are involved in the evolution of ESIA's in hydropowe*r? Finally, at: *How do ESIA's address the ever-increasing demand for inclusivity and sustainability in hydropower?* The information will be gathered by doing a literature review and interviewing relevant international academic and industry experts and influencers in the field of hydropower, ESIA's, and water resource management.

This study will be structured by initially giving some basic background information on the history of hydropower as well as some of the impacts. A description of the ESIA process itself with the different steps and how different actors might be involved in the process will follow. Then the methodology used will be addressed and the different methodological processes employed to gather data and ensure good research ethics and trustworthiness will be detailed.

The main part will be the findings chapter where the relevant information found on the changing agendas, actors, and the current process will be presented. Then comes the discussion where the research question will be answered and compared findings from other research and finally the conclusions that I have drawn and my understanding and appreciation of the main research objectives above.

2 Background

2.1 Hydropower

2.1.1 Scale and worldwide adoption

Hydropower has been present throughout human history. There is archaeological evidence of water-powered mechanisms from the Greeks, Egyptians as well as many other cultures, and may stretch back as far back as to 4000 BC during ancient Mesopotamia. Most of the mechanisms were similar in principle and harness the kinetic energy of water through the use of wheels to power diverse mechanisms (Breeze, 2018). For example, in 202 BC, in China, during the Han Dynasty, the kinetic energy from the water was harnessed by vertical wheels that were used to power trip hammers for crushing ore, husking, and pounding grain as well as papermaking (IHA, 2020).

Today, however, the scale by which hydropower is used to harvest energy is much different. The main use of hydropower is for electricity production and as of 2019, hydropower accounted for the majority of current renewable energy production (Moran, et al., 2018; REN21, 2020). This capacity, however, was built over more than a century starting in 1878 in England where the first hydroelectric power project was developed and that was used to power a single light bulb! This marked the start of hydropower as we know it today. In 1892, the first hydropower plant to serve private and commercial customers was established in Wisconsin, USA and within the next decades, hundreds of hydropower plants were in put operation around the world (IHA, 2020). By 1940, the USA was producing 40% of its electrical needs from hydropower. This is thanks to new policies enacted during the 1930s to promote dam building and the construction of large multipurpose dams such as the Hoover Dam built in 1937 (Moran, et al., 2018). Between 1940 and 1970, we see a major increase in hydropower development and capacity in North America, Japan, Western Europe, and the Soviet Union

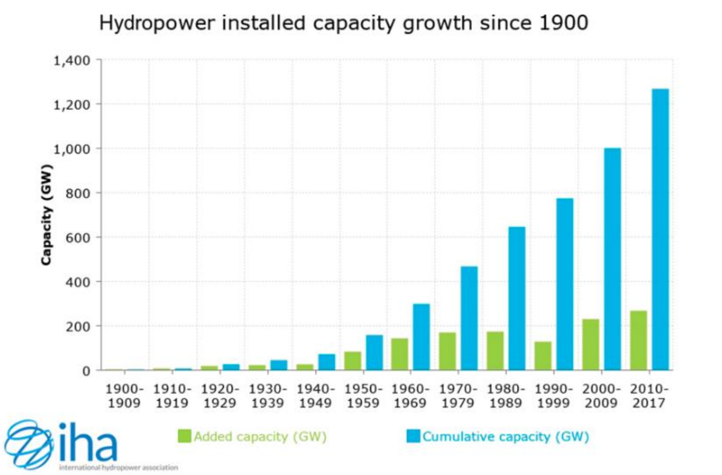

Figure 1: Hydropower installed capacity growth since 1900. Source (IHA, 2019)

spurred on by strong post-World War II economies and population growth (IHA, 2020). Hydropower was linked to the development of these countries as the relatively low cost of hydropower was particularly beneficial in meeting the nation's growing energy needs, particularly in energy-demanding heavy industries that were driving the post war recovery (IHA, 2020). However, starting in 1970 there is a marked drop in new hydropower capacity building worldwide (Figure 1). However, since the beginning of the 21st century, there has been a boom in hydropower development mainly in Asia, South America, and Eastern Europe (Figure 2) (Zarfl, et al., 2015; Peters, et al., 2021). According to the International Commission on Large Dams ICOLD (2011), only 22% of the technically feasible hydropower potential has been developed throughout the world. However, the remaining potential is mainly situated in Africa, Asia, and South America (NCEA, 2018). In Europe and North America most, of the best dam sites have already been exploited and combined with stronger environmental policy has actually led to more dams being removed than being built in these regions of the world (Moran, et al., 2018 and O'Connor, et al., 2015). Nevertheless, thanks to GHG reduction policies and the push towards more sustainable hydropower there has been a renewed interest in hydropower development. Additionally, the World Bank has increased its lending from a few million in 1999 to 2 billion USD in 2014 (IHA, 2020). As a consequence, during the last 2 decades, hydropower generation has increased by 50% and supplies around 15.9% of the world’s energy needs (NCEA, 2018; REN21, 2020). This growth is continuing as can be seen in Figure 2, there is a great number of new dams under construction or planned around the world (Zarfl, et al., 2015). In particular, in East/China and Central Asia (the Himalayas), South America, Eastern Europe/ Balkans/Turkey/Georgia, and Central/ Southern Africa are experiencing the largest amount of growth.

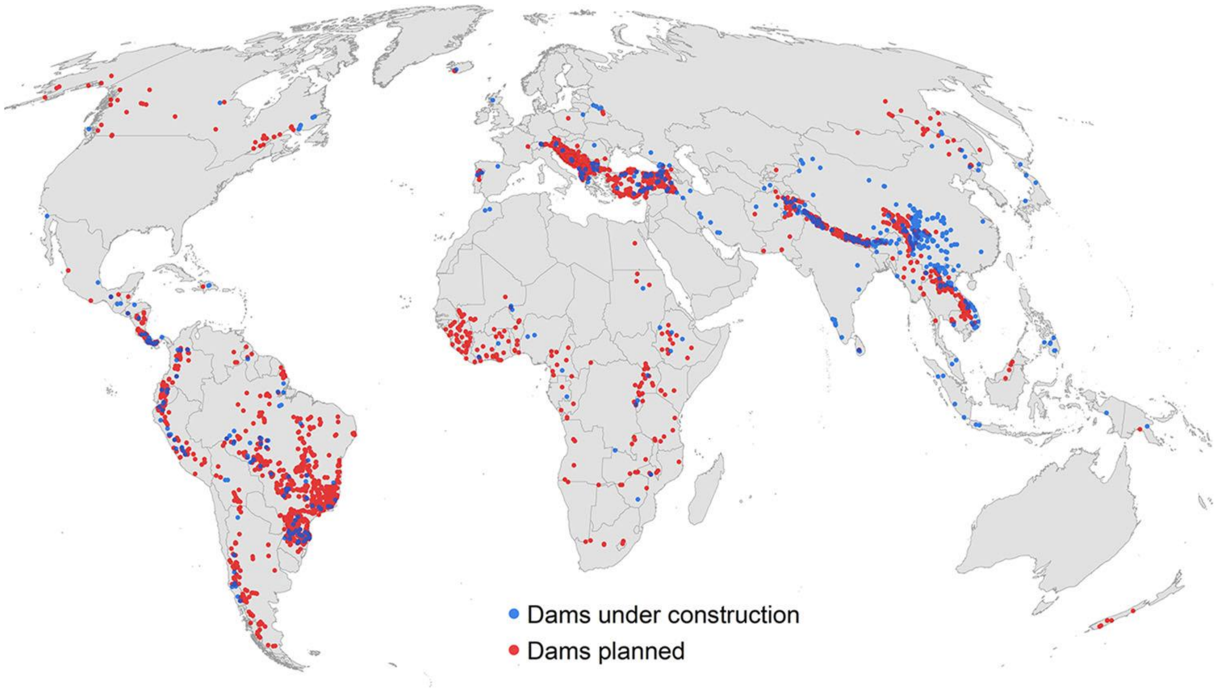

Figure 2: Distribution of hydropower dams under construction (blues dots 17%) or planned (red dots 83%) as of 2014
Sources: (Zarfl, et al., 2015)

2.1.2 Hydropower technology

Hydropower today has not strayed too far from the basic principle used in China during the Han Dynasty. It harnesses the kinetic energy from flowing water and uses it to turn a wheel that is in turn connected to a generator. Where it does differ from the early use is that this generator converts this kinetic energy into electricity (Bronsor, 2001). Furthermore, the method used to harness the flowing water has changed as well. Currently, there are 3 main types of hydroelectric systems implemented around the world, the first is the so-called **run-of-river**, the second is **storage hydropower** and the last is **pumped storage hydropower**. All work by diverting water from a river or reservoir through an intake and channelling it through a penstock (pipeline) to turbines situated in the powerhouse (set topographically lower than intake of water) where the water will turn the turbines connected to a generator that will, in turn, produce electricity to inject into the national grid (Fichtner, 2015)(Figure 3).

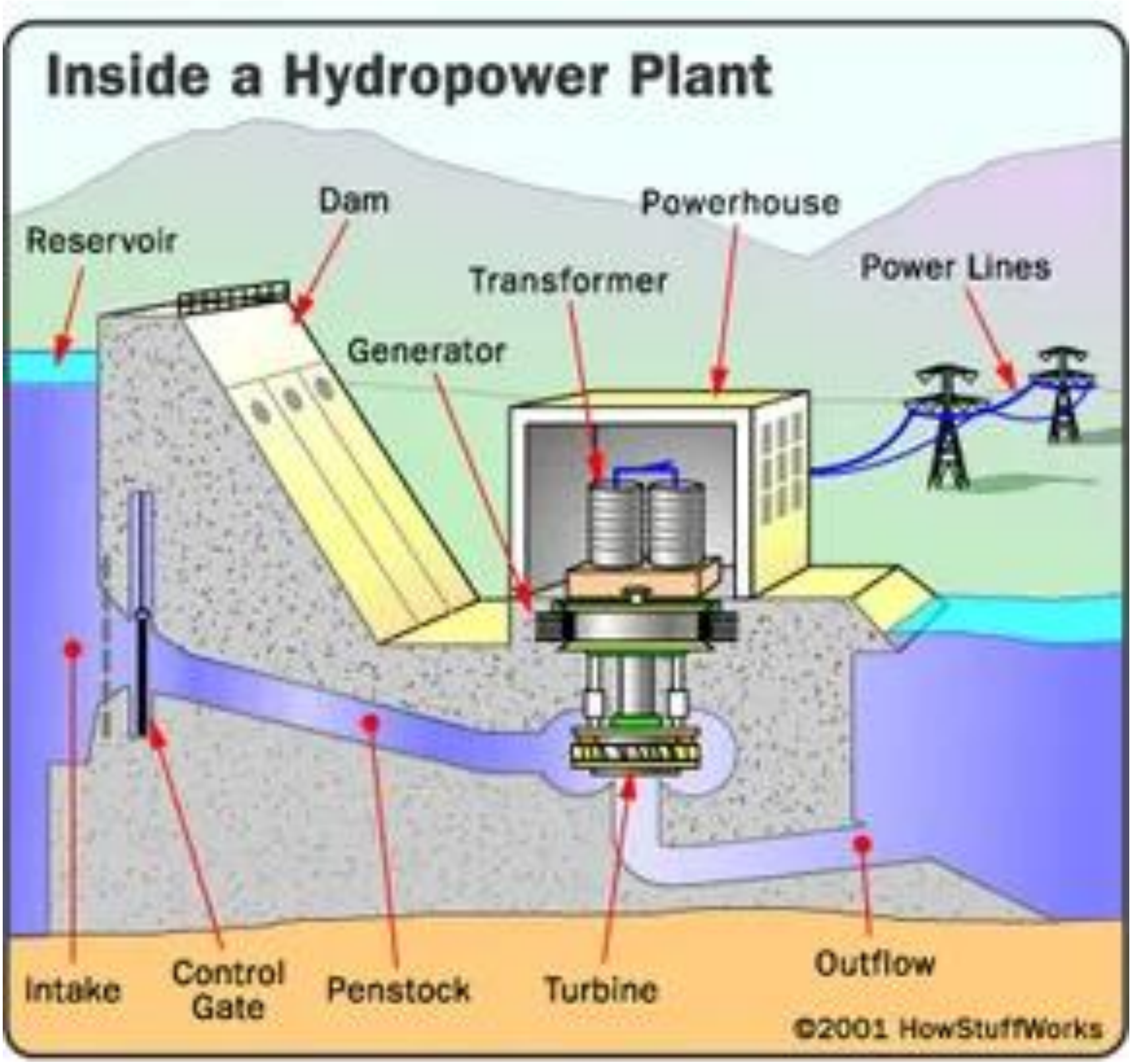

Figure 3: Schematic representation of hydropower plant. Source (Bronsor, 2001)

A run-of-river hydropower most often diverts part of the flow of a river and directs it through a canal, tunnel or penstock to the powerhouse. Typically, this system will have little to no storage or water and provides a continuous supply of electricity related to the water flowing in the river and not regulated at all. Storage hydropower is often a large system that dams rivers and thus, creates a reservoir to store water, and then releases this water when electricity is needed – thus not totally dependent on the natural flow of the river as for a run-of-river plant. This is useful in peak electricity demand periods (daily or seasonally) as they can easily increase or decrease electricity production by opening or closing valves leading to the turbines. Pumped storage hydropower is a bit different as it circulates water between two reservoirs at differing topographically elevations in tun turbining and pumping the same water. This is useful as it can produce electricity when needed by opening valves, however, it also has the capacity of using excess electricity in the power grid to pump water back up to its upper reservoir thus, when electricity prices are cheap, storing this excess electricity via potential kinetic energy (IHA, 2020). Hydropower plants are further divided into size groups by capacity of electrical production in Megawatts MW. There are 3 main categories small 0.1 MW<p<10MW, medium 10MW<P<100MW, and large P>100MW (Fichtner, 2015). However, this classification is only valid in the case of World Bank related projects as size classification varies from country to country and local legislation.

All of these systems have varying impacts on the river flow and connectivity depending on the type and size of the hydropower project. It is noted that the most impactful is the storage hydropower facilities as they tend to have the biggest reservoirs (Yüksle, 2009).

2.1.3 Hydropower Impacts

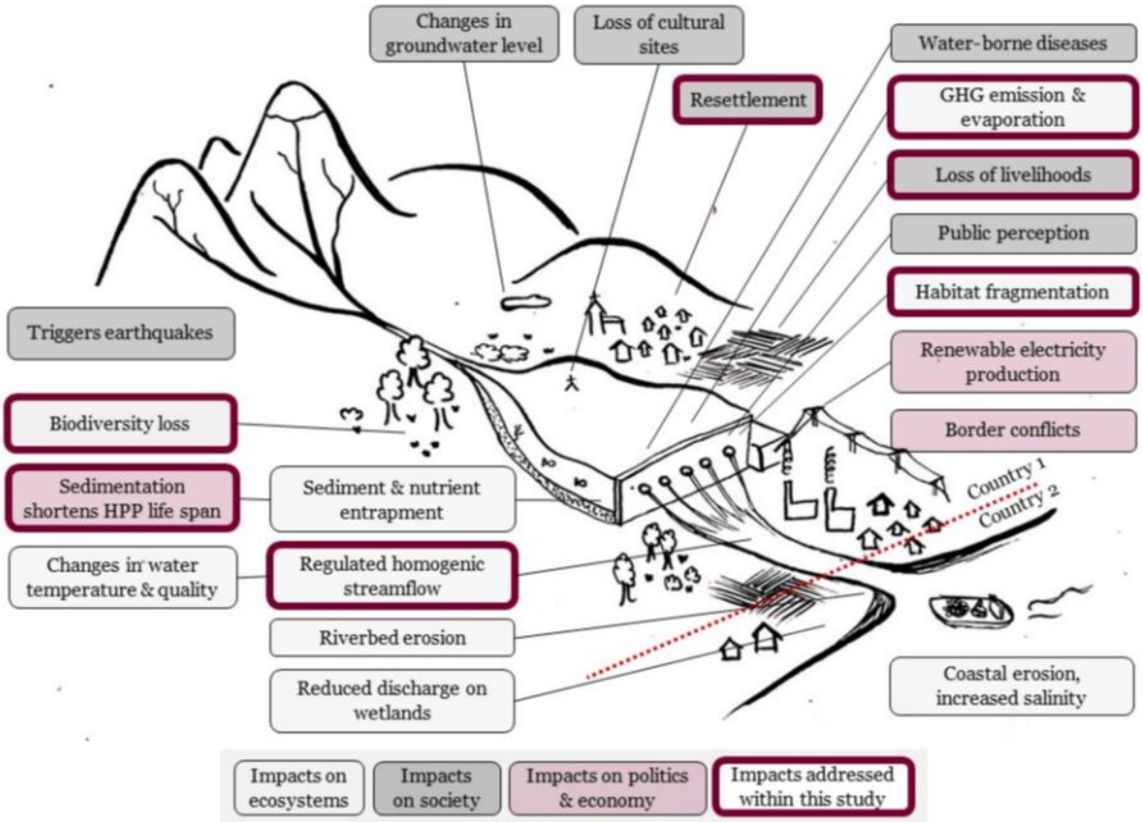

Figure 4: Impacts associated with hydropower construction. Source: (Peters, et al., 2021)

As previously mentioned, hydropower is the world's largest provider of renewable energy due in part to its gradual development for over a century. However, hydropower does present unique advantages over other forms of renewables such as wind and solar which make it still interesting today. Firstly, hydropower is a continuous energy supply, this means that it does not fluctuate with night and day cycles or is dependent on wind strength or sunshine (IHA, 2020). This gives it flexibility when operating in the electrical grid as it does not require a storage facility to store the excess energy production. It can generate power on demand as it is most often just a case of opening a valve to let the water enter the turbine for energy production to start (IHA, 2020). Also, when combined with other electricity production means, it can be used to store excess energy production to be released later using pump & storage facilities – in effect a "battery". Lastly, even if often the primary use of hydropower is for electricity production (Figure 4), it can also be used for water storage, flood control and irrigation in the case of multipurpose hydropower dams. Hydropower has been proven to help countries develop their infrastructure, economies and industries as well as develop their electrical grids. Some of the biggest hydropower plants today successfully producing thousands of MW's of power such as the Three Gorges Dam in China (22'500 MW), and the Itaipu Dam in Brazil and Paraguay (14000 MW), (Loucks & van Beek, 2017). This makes it very attractive for all nations as not only does it have the potential to produce large amounts of relatively cheap electricity but as it is considered renewable and clean. This allows nations possessing hydropower to apply for carbon credit and to compete in the carbon trading market offsetting their more carbon based economies (Nautiyal & Goel, 2020).

However, this can come at an environmental and social cost (Figure 4) and this is particularly the case with "mega" hydropower projects like Itaipu and Three Gorges Dams. These issues arise during the construction phase where, amongst others, air and water pollution arises from construction and the use of heavy machinery and also when the hydropower project enters operation where other issues can arise. The damming of the river will have impacts in the immediate vicinity as well as changes to the connectivity of the river system and the downstream environment. In the immediate vicinity, the dam will create a reservoir that will flood the area behind the dam. The size of the reservoir will depend on topography and the design of the dam itself. This has social and environmental effects. From a social perspective, we are looking at the relocation of settlement, loss of arable lands, and cultural heritage sites (Athayde, et al., 2019). Furthermore, there are impacts to local economies with the influx of foreign workers that can create social tensions, bring diseases and other undesirable issues. From an environmental point of view, there will be perturbation to the terrestrial ecosystem and biodiversity that can potentially cause the irreversible loss of species and damage to the environment (Li, 2008). Another major effect of dams is the impassable barrier it represents to migratory fish species such as salmon. This can prevent this species from reaching their spawning grounds or other important habitats for their life cycles and can lead to a reduction in population numbers or even lead to the disappearance of species in the affected river system. This will in turn affect the economy, food security and water security of the population along the river (Pang, et al., 2015). Another important consideration is that the vegetation present in the water reservoir will decompose, producing GHG in the form of CO_2 and CH_4, two of the main GHG contributing to global warming. This means that hydropower is not a totally carbon-neutral source of energy and produces on average 18.5 grams of CO_2 per kWh over its useful life span when accounting for the GHG emissions from the construction phase and operation phase (IHA, 2018). Particularly tropical areas are affected by this, as the amount of vegetation is much higher (NCEA, 2018). The change in the connectivity of the river and flow rates will impact downstream ecosystems, the natural flood cycles and sediment transportation. This will have impacts on the biodiversity of the downstream ecosystems and sometimes all the way to the delta and estuary areas of the rivers system where this will affect the interaction of salt water and fresh water thus cause salinization of the area. The damming of the river affects sediment transportation as a large amount of sediment is trapped in the reservoir. This can lead to increase erosion of the riverbanks due to higher speeds of the water, modification of the physical properties of the river system but also to coastal erosion as the sediment load arriving in the oceans and coastal areas are decreased thus the flow is more agressive (Botelho, et al., 2017).

Nevertheless, the severity of the environmental and social impacts are generally down to the location of the dam site and the size of the project itself. A bifurcation is then useful to integrate in order to classify hydropower projects according to size. Whereas small hydropower most often is situated on tributaries or smaller river and have a relatively small reservoir, large hydropower is often situated in the mainstream part of the river and have large reservoirs inundating large areas (Nautiyal & Goel, 2020). Furthermore, whereas a single project is more confined to local impacts, multiple dam development's on a river system or a river stretch (cascades) will induce cumulative impacts at the catchment scale and puts the river system at risk (MRC, 2019).

2.2 Environmental and Social Impact Assessment

An ESIA is a multi-analytical tool for project implementation and decision-making that arises from an EIA. The shift from EIA to ESIA as the main decision-making tool for projects was brought about by a need to acknowledge in the same relevance social and environmental externalities arising from different projects. The aim is to have a holistic perspective of environmental and social project-related impacts. This is due to the growing awareness that discord due to project development is not only environmentally related, but lively hoods are also threatened (Marshall, et al., 2005). Furthermore, in recent years there has been more and more opposition by local communities to industrial development, energy projects such as hydropower dams, and new infrastructure development thus the social aspect seems to be taking a leading role. The need to recognize the environmental and social externalities of projects has made the ESIA the reference tool for project decision making as it promises to better incorporate and evaluate all dimensions of sustainability (Figure 5) impacted by the project (Corsi, et al., 2015; Dendena & Corsi, 2015).

Figure 5:Dimensions of sustainability
Sources: (Glasson & Riki, 2019)

2.3 ESIA implementation process and actors involved.

The implementation of ESIA is dependent on several actors. Firstly, the content of the ESIA is defined by national regulatory legislation of the country where the project is taking place. Then, in the case where there is 3rd party financing by a lending institution (World Bank or other), the guidelines in place and safeguard policies will further define the content of the ESIA. Developers/Investors will then apply the content defined in legislation and by financial institutions as well as adding their own in-house policies in the Terms of Reference (ToR) of their project. The current ESIA process is different around the world. These regulatory actors are responsible for setting the predefined content of the ESIA (Li, 2008). Then it is down to the practitioners, in many cases a consultant company, to address the requirement of the ESIA content on a project specific basis. The IFCs requirements and methodological processes for ESIA establishment are widely recognized (Morgan, 2012) and will serve to explain the general steps expected from an ESIA. By referring to the IFCs we can see the different steps in an ESIA establishment (Figure 6).

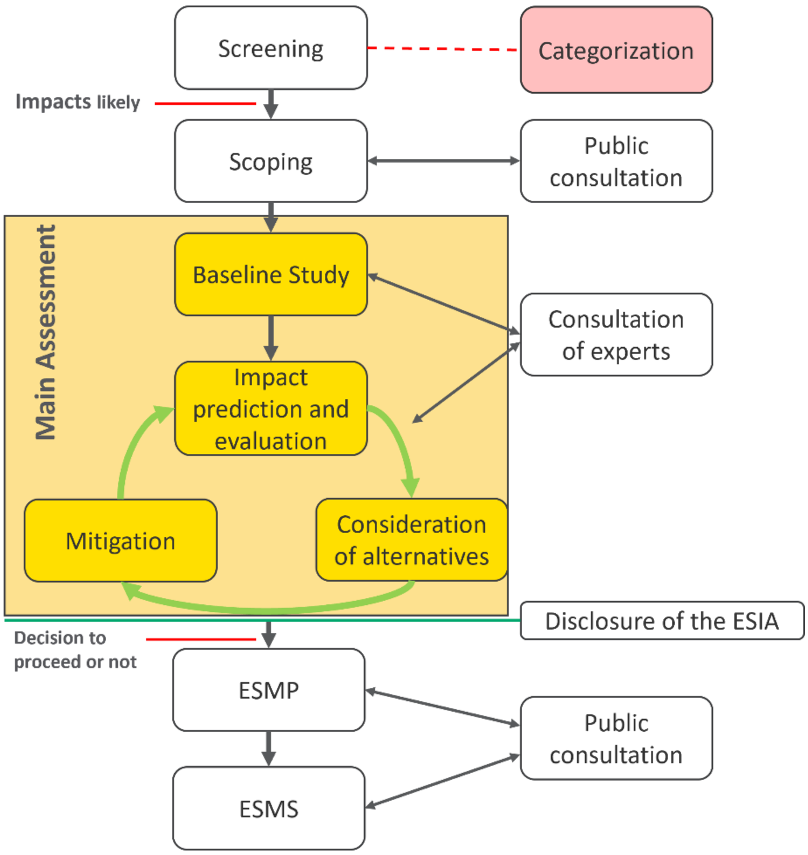

Figure 6: Basic ESIA Process. Adapted from (IFC, 2005)

The first part before the actual ESIA process starts is the **Screening**. This phase identifies the extent to which an ESIA will be needed in a given project. The IFC uses an ABC categorization to categorize projects according to environmental and social risk (Equator Principles, 2020).

This categorization will also determine the extent of the ESIA needed. The screening process serves to identify potential environmental and social risks and the key stakeholders involved and affected. Public participation, a more an more important aspect, is implemented in this phase and will be present in some form or another during all phases of the ESIA. Building off the screening process, the **Scoping** phase identifies the most important environmental and social impacts that will be the main focus of the ESIA study. At this stage, public consulting is necessary to inform affected stakeholders and to help identify the potential key impacts to be addressed. Furthermore, the scoping phase will determine the spatial/geographical and temporal scope of the study. The **Baseline studies** phase is where the pre-project environmental and social status are recorded to be used as a frame of reference once the project is underway and will help to identify changes. Furthermore, the gap in data should be addressed in this phase. **Impact prediction and evaluation** will be made using data gathered during the scoping and baseline study phases. This will be used by relevant professionals or consultants such as Biologists, Ecologists, Sociologists, Economists, etc… to make informed predictions on the scope and scale of impacts and evaluate them accordingly. Furthermore, at this phase, it is again essential to conduct consultation with local stakeholders (IFC, 2005). Consideration of alternative processes will ensure that the proponents of the project have fully assessed alternative project design such as location, processes, scale, operating conditions, and even the option of not doing the project at all. Next comes the **mitigation** phase. This phase will apply the now widely used Mitigation Hierarchy (Figure 7) (Phalan, et al., 2018) by looking to introduce measures to avoid in priority any impacts, to minimize them when it is not possible to avoid and remedy or compensate when the two other options are not feasible.

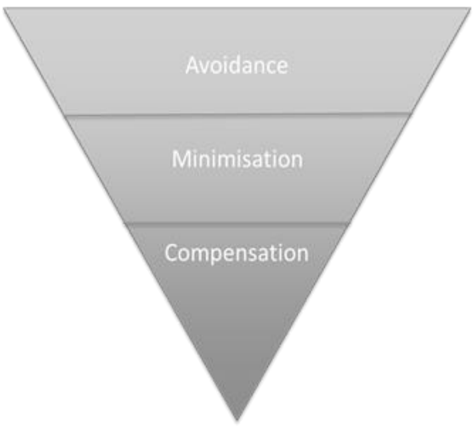

Figure 7: Mitigation Hierarchy. Sources (MRC, 2019)

Furthermore, at this stage, enhancement can be put forward where possible (Glasson & Riki, 2019). The Impact prediction, evaluation, mitigation and consideration of alternatives are phases that are interactive and there is a back and forth between them to identify the optimum project design (IFC, 2005). Once the optimum project design has been identified (the project design with the least amount of negative impacts) the **Environmental and Social Management Plan (ESMP)** will be drafted and submitted for the key phase of public consultation and participation. In this phase, project design will be scrutinized and participation of the stake holders where welcome comments can be made for improvement as well as opposition to the project can be voiced by the different stakeholders. Stake holders can include environmental and social NGO's if they feel that the project does not satisfy environmental and social safeguards. Finally, if the project decision-makers decide to go forward with the project they will release an **Environmental and Social Impact Statement (ESMS)** that is publicly disclosed (IFC, 2012; International Finance Corporation, 2012). According to the most recent release of the Equatorial Principles from July 2020, the list of potential environmental and social issues to be addressed can be found here.

3 Methodology

This chapter will present the methodological approach that was applied during this study. It will first detail how the data was collected in chapter 3.1, the steps are taken to ensure ethical research will be outlined in chapter 3.2, and finally what processes were utilized to ensure the trustworthiness of this study in chapter 3.3.

3.1 Data collection methods

To understand the evolution of the ESIA with the specific context of hydropower, it was first necessary to do a qualitative systematic literature review to gain an overview of present literature (Bryman, 2012). To conduct a systematic literature review it is most common to define certain key search terms to better define the scope of the search and produce more relevant data to the research (Bryman, 2012). As the main objective of the study is to understand the evolution of ESIAs in hydropower, the key search words were "environmental and social impact assessments", "ESIA, hydropower", "ESIA evolution", "ESIA limitations", "EIA", and "Social Impact Assessment (SIA)". The data was mainly gathered through personal interactions, an internet search where all types of literature were considered as this helps gain a comprehensive view of a subject (Bryman, 2012), In my case, it helped me gain an overview of the current practice, knowledge and data related to ESIA’s and hydropower literature. However, by doing this it became quickly apparent that there were many complexities involved in the evolution of ESIA’s in hydropower. Notably, the numerous other forms of EIA intertwined in the diverse national regulations, laws, protocols, *etc*, regulating ESIA’s and in turn individual hydropower development projects. To accommodate for the unforeseen complexities, the research criteria were updated during the entirety of this research. This in turn led to the literature review becoming a non-systematic literature review, which is useful to identify underlying trends, currents and a better general understanding of the research topic (Huelin, et al., 2015). As the goal is to understand the current state of the ESIA implementation in hydropower projects, this approach was well suited.

To better understand the ESIA development, it is essential to gather the experience, ideas, and thoughts of professionals working in the elaboration and implementation of ESIA’s in hydropower. This allows for real-world insight into the evolution of ESIA's over the years as well as why ESIA’s are the way they are today and how the hydropower industry is evolving in general. Not only will the interviews give relevant information, but they will also be useful to corroborate the general literature or counter some of the literature with real time state of the art ideas. This also helped bolster some claims made by increasing the thickness of the data gathered. Bryman (2012) suggests using purposive sampling as this facilitates the selection of relevant research participants. The goal of the purposive sampling technique is to ascertain relevant data to the research topic from a knowledgeable sample population (Tongco, 2007). Participants were then selected for interview according to their expertise and experience in the ESIA evolution, implementation as well as their knowledge of the current challenges faced in the proper implementation of ESIA’s in hydropower. Due to the difficulty of getting in contact with relevant professionals in the field I had to go through a personal contact that introduced me to several of these professionals. This also had the benefit of producing interviews with highly relevant material and highly motivated professional. The participants interviewed worked or had worked in the World Bank Group, IHA, the Norwegian Energy and Water Directorate (NVE), The Mekong River Commission (MRC), Consulting Companies, and Academics. Due to varying geographical locations and the restrictions imposed by Covid-19, the interviews were conducted using online video conferences platforms. Zoom and Teams for example were the preferred platforms used. This brought about its own challenges but in general I was very satisfied with the results achieved thanks to the willingness of the professionals interviewed.

In order to gather relevant data from the participants, a semi-structured interview is the preferred technique for collecting this type of qualitative data (Bryman, 2012). This form of interview is based on the structured interview method, with an interview guide and schedule, but have more flexibility in their procedure. The nature of semi-structured interviews means that they cannot be reproduced and are dependent on the underlying social interaction between the interviewer and the subject (Bryman, 2012) again made a little tricky by COVID 19 restrictions. The sequence of questions as well as the schedule were adapted throughout the interview to better fit the natural flow of the conversation. This allowed for better exploration of questions and more liberty for both interviewee and interviewer (Bryman, 2012). Furthermore, as the aim is to bring out the subjects' own view, this less rigid structure allows the exploration of themes or questions that the subject feels are relevant, and that the interviewer has not thought of thus really “picking” the brains of the professionals. To achieve this freer type of conversation, the questions on the interview guide were more general than in a structured interview guide (Bryman, 2012). The interview guide (Appendix B: Interview Guide) is be based firstly on the research question as well as sub-research questions. Secondly, the findings from a previously done literature review will be addressed as themes and questions (Bryman, 2012). The interview guide was produced using the results from the literature review and revolved around questions regarding the evolution of ESIA's, hydropower development/evolution, and the actors involved. Relevant questions to be asked were discussed and formulated with the help of my supervisors. Furthermore, as the participants all come from different backgrounds, I adapted the interview guide by adding questions to address certain aspects more in detail depending on the area of their expertise.

The data was gathered between August 2020 and July 2021. The literature review preliminary constituted mainly of peer review papers available through google scholar, documentation produced by big entities such as the World Bank, International Finance Corporation (IFC), International Hydropower Association (IHA), and International Union for Conservation of Nature (IUCN) and grey literature. As for data gathered during interviews, in total 8 interviews were conducted. The interview participants were all highly knowledgeable and highly rank and respected professionals in the domain of water resource management and hydropower development. They come from financial institutions, national institutions, academic institutions, consulting firms, and non-governmental institutions. The findings will be presented in three different chapters.

The last source of information used during the research is my own experience. This experience comes from a one-year internship done in the Energy & Environment department at Multiconsult, a Norwegian consulting company, thus the immersion into the study domain and for a more or less long period was invaluable. This approach offered me in-depth an understanding through direct observation and access to relevant data thanks to "informants" (Bryman, 2012). Understanding and data of the ESIA process and hydropower development was obtained through direct observation while participating in project ESIAs and a Basin Management Plan proposal as well as through discussions with colleagues. A field journal was kept, this was used to structure the methodology, determine relevant research direction, ideas and impressions from literature and interviews, and thoughts from general observations as this aid in reflexivity (Hennink, et al., 2020). It is important to keep in mind that this information has come about with a certain selection bias. As it is the only representative of the views and discussion with personnel from Multiconsult and hence cannot be generalized. Furthermore, my own personal bias can have involuntarily influenced the type of information that was retained.

3.2 Research ethics

Hydropower is a highly debated and sometimes controversial subject, on the one hand, it is a source of clean renewable energy as well as water security and flood prevention that can be beneficial for a nation or region. On the other hand however, dam building for hydropower can also have considerable negative effects if done wrongly with non-respect of environmental and social good practice. This is important to keep in mind during the research as the interviewees are all professionals working in this discipline. Hence, I had to ensure that their participation would not jeopardize their position or reputation and that I would not present findings or information that they do not want to be made publicly available. This is also important to ensure the quality of information given during the interview (Bryman, 2012).

To better protect the privacy of the interviewees and increase the likelihood of them openly sharing their points of view during interviews, the proposed research method was first approved by the Norwegian Centre for Research Data (NSD). NSD verified that the data collected during the interview would be handled ethically, legally, and securely. Participants were informed of the research topic and scope prior to the interview. Confirmation of consent form (Appendix A: Confirmation of Consent) was also signed by them detailing what NSD does, how their information will be processed during the whole of the research and writing process. The participants were then given the option to be quoted in name or to be anonymous. The interviews were conducted through online meetings and the participants were asked for consent to record the interview. Online interviews were the most effective means of contact as the participants were located in several countries around the world. To accommodate both anonymous and non-anonymous participants, interviews from those that expressed their desire to remain anonymous were coded using a scrambling key that only the researcher possessed. Lastly, all participants regardless of anonymity or not could ask to review the quotes relating to themselves that were used. This process ensures the quality of the data collected and strengthens the trustworthiness of the study (Bryman, 2012) while ensuring that participants are well informed and comfortable with the processing of their data. This is also more likely to produce more relevant data. This approach worked well.

3.3 Trustworthiness

In qualitative research, it is difficult to apply criteria of validity and reliability in the same terms used for quantitative research. Validity is a measure of how close to reality the results are, and reliability describes how reproducible and generalizable those results are (Bryman, 2012). While qualitative studies might allow for an in-depth understanding of the study population, due to the often-small sample population involved and the focus on case studies this inhibits generalization and reduces the validity of the research. Moreover, the nature of semi-structured interviews will mean that they cannot be reproduced and are dependent on the underlying social interaction between the interviewer and the subject (Bryman, 2012). To address this issue, Noble & Smith (2015) proposes to incorporate methods and design that ensures "trustworthiness" of the finding. This can be achieved by accounting for and acknowledging personal biases in sampling and critical reflections, record keeping such as by a field diary, respondent validation of transcript as well as data triangulation through different methods. To achieve the depth of knowledge and triangulation of the data, I decided to use a literature review, interview, and participant observation as sources of information. I also made sure to use all forms of literature as well as selecting participants with relevant insight into the subject. This was done in an effort to increase the trustworthiness of the research and findings presented.

Reflections on the reflexivity and reactivity of the researcher and participants are an additional way to increase trustworthiness (Krefting, 1991). Reflexivity refers to an acknowledgment of the influence of the researcher's own background, interest, and perception on the process during qualitative research (Krefting, 1991). Reactivity is an understanding that the participant might be subconsciously influenced by the researcher (Bryman, 2012). To minimize issues relating to reflexivity, I was conscious to remain neutral. However, as it is a discussion that was based on my own interview guide, I am aware that this in itself represents a biased choice already. I am also aware that the findings presented reflect in part my own view of the matter. For this reason, I have kept a maximum amount of transparency with the methods selected as well as keeping a field journal to record the thought processes and possible influences from my part as this helps to reflect on reflexivity (Krefting, 1991). To minimize the reactivity of the respondents I have was conscious to avoid reacting too strongly to participant answers and keeping my behaviour friendly and approachable.

It is important to reflect on issues regarding positionality during the analysis and interpretation of my findings. Positionality refers to one’s own experience and background and how these will intentionally or not colour research outcomes. This is also where objectivity and subjectivity meet (Bourke, 2014). I kept in mind that the participants might be biased to some degree as they are involved in different ways to hydropower development and the ESIA establishment. This can influence the presentation of different issues. I must also be aware of my own bias. I come from a natural sciences background and have always been interested in sustainable development in order to protect nature. I am of the idea that sustainable development is necessary for the present and future prosperity of human civilization. There are many examples where "sustainable" development has created environmental and social disasters and conflicts. Therefore, I think that the ESIA is an important tool but must be updated to reflect the latest understanding of environmental and social project-related impacts. As the aim of this study is to better understand the evolutionary forces that have resulted in the adoption of ESIA’s and not critically assessing the ESIA tool it's self's, this should not influence my objectivity in the study. The objectivity is also be strengthened by the transparency in the methods used and my recognition of potential issues in reflexibility, positionality, and the credibility of the sources used.

4 Findings

Firstly, to fully understand the evolution of the ESIA in hydropower we must first understand the general context regarding the appearance of the EIA process in 1970. The first part of the chapter, Findings 4.1, will look at the changing global agendas and social norms that push the evolution of the impact assessment discipline and how the hydropower industry was affected by this. The second part, 4.2, of the findings will explore the different key actors that were involved in the evolution and the development of the new EIA processes and other forms of impact assessment. Finally, in 4.3, I will be presenting some of the findings about the current direction the ESIA and impact assessments are taking in the hydropower sector and why they are happening with example from the Mekong River.

4.1 Changing agendas

4.1.1 Global trends in impact assessment

The EIA tool first appears in the 1970s following a period of so-called environmental awakening in the 1960s (Modak & Asit, 1999). This period of environmental awakening can be contributed to the publishing of "*Silent Spring"* by Rachel Carson in 1962 and growing pressure from environmental groups. During this period, in a bid to address human impact on the environment, many countries started to implement environmental protection legislation (Abdul-Sattar, 2007). However, these legislations were focused on specific problem such as air and water pollution, pesticides, or soil erosion (Modak & Asit, 1999). The warnings from scientist, legislative actions taken by different countries combined with the media actively reporting on environmental problems created incentive for the development of more elaborate environmental management plans and tools by the end of the 1960s.

It is in the USA in 1970 with the implementation of the National Environmental Protection Act (NEPA) that the first EIA framework was established (Cashmore, 2004). This is widely regarded as a landmark moment in environmental management policy. NEPA is different than previous legislations as it approached cross-sectoral issues. The act made all federal agencies in the USA use a systematic and interdisciplinary approach to establishing environmental impacts for projects. This ensures a systematic use of both natural and social sciences as well as environmental design in the decision-making process of any new development (Modak & Asit, 1999). Moreover, NEPA introduced the opportunity for the public to influence the implementation of the proposed project. This means that project proponents are accountable for environmental impacts and should be transparent with regards to the environmental impacts that may occur. Consequently, they must detail alternatives to the design or compensation. This was done through production of an EIA and subsequent Environmental Impact Statement (EIS) that was publicly available. The legislation established by NEPA and the subsequent EIA tool has become the blueprint for most of the worlds current EIA and environmental management policies (Modak & Asit, 1999). During this period the first "United Nations Conference on the Environment" took place in June 1972. It was the first world conference that focused on environmental issues and stated the need for better assessment and management of human development. The result was the formation of the United Nations Environmental Program (UNEP) (Modak & Asit, 1999). Arguably one of the most important conferences is the "UN World Commission on Environment and Development" of 1987, also known as "Brundtland Report". This is where we see the first integration of sustainability as a concept. Sustainability was defined as *"development which meets the needs of the present generation without compromising the ability of future generations to meet their own needs"* (WCED, 1987). This marks the start of the shift towards sustainability with large temporal and geographical scopes of environmental and social issues and shifting away from singular environmental and social issues (Modak & Asit, 1999). EIA was further given legal and institutional power by being included in several international protocols, conventions and international agreements such the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991), the United Nations Framework Convention on Climate Change (1992), Convention on Biological Diversity (1993) and Kyoto Protocol (1998) (Table 1).

Table 1: EIA evolution and adoption.

Sources:(Abdul-Sattar, 2007; Dendena & Corsi, 2015; Modak & Asit, 1999; Equator Principles, 2020; World Bank, 2020)

Time period	**Examples of development**
Pre-1970 Initial development	• Project feasibility based on engineering, technical and economic analysis • Little environmental impacts taken into project feasibility
Early/mid-1970s Methodological development	• EIA introduced by NEPA • Stockholm Conference (first world conference on the environment 1972) • Basic principles; guidelines; procedures; including public participation • Adoption by several other developed nation of the NEAP-based approach (e.g., Canada, Australia, France)
Later 1970s to early 1980s Increasing scope	• Adoption of EIA legislation in certain developing countries (e.g., Brazil, Philippines, China, Indonesia) • SEA (Strategic Environmental Assessment) and risk analysis included in EIA processes • Introduction of SIA • Greater emphasis on ecological modelling, prediction, and evaluation methods
Mid-1980s-1990 Process strengthening and policy integration	• Increasing efforts to address cumulative effects • Ecosystem and landscape level approaches applied (e.g., to assess wetland losses) • World Bank, Asian Development Bank and other international lending institutions adopt EIA in lending requirements • Increasing numbers of developed and developing countries adopted EIA legislation (e.g., Germany, New Zealand, Norway)
1990-2000 Towards sustainability	• Espoo Convention require transboundary affects consideration • UN conventions on climate change and biological diversity identifies EIA as required for implementation • Increase attention to global issues and sustainability principles. • EIA, SIA, SEA, CIA and other impact assessment developed and in use.
From 2000- 2010 Growing Scope of Impact assessment	• Strategic Environmental Assessment (SEA) further developed to overcome problems of EIA • Principles of sustainability are now fully incorporated into any step or stage involved in the EIA system • Stronger focus towards an integrated social and environmental assessment • Implementation of the Equator Principles by the World bank and adopted by several international financial institutions
2010-2021 Full integration of SIA and EIA as well as strengthening of climate change and other larger scall environmental and social issues	• ESIA as a tool for project related impact assessment • Paris agreement • UN Sustainable Development Goals (SDG) • Stronger focus on high level management planning incorporation SEA and CIA at catchment and basin scale

Financial institutions such as the World bank with strong environmental policies also adopted the EIA as a central part of their lending policies (Morgan, 2012).

This wide adoption of the EIA in many countries' legislation and different international protocols, conventions and agreements was a sign of acceptance of the values of environmental assessments in development (Modak & Asit, 1999). However, there rapidly was some dissatisfaction how single project EIA application addresses the growing scope of environmental and social issues (Dendena & Corsi, 2015). To answer this dissatisfaction new forms of impacts assessment under the EIA umbrella appeared. For example, cumulative impact assessment (CIA) also known as Cumulative Effect Assessment (CEA) that started to be implemented in 1995, Strategic Environmental Assessment (SEA) between 1990-2000 and social impact assessment (SIA) between 1975-1980 as well as other forms by the year 2000 (Modak & Asit, 1999); Gunn & Noble, 2011) (Table 1). All these new forms of impact assessments similarly respond to some level of dissatisfaction in the original EIA (Pope, et al., 2013 and Morgan, 2012). In particular, the lack of social facets in EIA was sources of dissatisfaction as I have previously noted. This led to the introduction of SIA. However, despite the introduction and implementation of SIA it remained a subordinate (Esteves, et al., 2012). In consequence, there has been a call from regulators, practitioner, and civil actors for the establishment of a more inclusive project related impact assessment that integrates both environmental and social impacts to the same degree and acknowledgment. This push was evident during the International Association for Impact Assessment (IAIA) conference in 2005 where two papers were presented. The papers argue for the growing interest and experience in follow-up socio-economic matters and the incorporation of health and cumulative impacts to the "traditional" follow-up of biophysical impacts (Morrison-Saunders & Arts, 2005) (Table 1). One of the frameworks proposed for such a tool is the current ESIA that merged EIA and SIA. ESIA promised to better establish the multifaceted impact of projects, better public participation (Dendena & Corsi, 2015), and potentially offers a holistic and more inclusive decision-making tool. This reflects the demand for an ever more inclusive tool for project decision making (Dendena & Corsi, 2015). ESIA are part of a bigger family of the Impact Assessment that reflect the need for different assessment methods.

In recent years the understanding of the connectivity and scope of ecosystems and how their change affects society, has grown. This is evident by the focus on climate change in the Paris Agreement in 2015 and the introduction of the UNs Sustainable Development Goals (SDG) in

2015 (Table 1). Innovation and work was focused on the development of larger scale assessments such as SEA and CIA (Glasson & Riki, 2019). Furthermore, the perception of the underling sustainability dimension of impact assessment has shifted. Sustainability is a normative term and is subject to contextual and individual perception and can only be determined case-by-case (Bond, et al., 2012). There is an underlying sustainability assessment in most impact assessments. It is the first step to guide decision making towards sustainable outcomes. At the core of all project development and impact assessment is the management of sustainability trade-off (Figure 5 in Chapter 2.2). There has long been a concern that in impact assessments practices the environment gets traded off for socio-economic gain (Morrison-Saunders & Fischer, 2010). However, Bond, et al., (2012) proposes certain trade-off decision guidelines to better account and deal with sustainability trade-offs (Table 2).

Table 2: Trad-Off Decision Guidelines. Adapted from (Bond, et al., 2012)

Net gains	*Any acceptable trade-off must deliver net sustainability gains (over the long term).*
Burden of argument	*The proponent of the trade-off must be required to provide justification.*
Avoidance of significant adverse effects	*No trade-off involving significant adverse effect is acceptable unless all alternatives are worse.*
Protection of the future	*No displacement of significant adverse impact from present to future can be justified unless all alternatives are worse*
Explicit justification	*All trade-offs must be explicitly justified (including a context-specific account of priorities and sustainability decision criteria)*
Open process	*Stakeholders must be involved in trade-off making through open and effective participatory processes.*

This can be found in many forms of impact assessments including ESIA and has been strengthening with the increasing attention to environmental and social sustainability since the 2000’s (Pope, et al., 2013). As the national agendas are increasing the scope of policies the impact assessment field this has led to more focus on SEA, CIA in early phase management planning.

4.1.2 Change in the perceived value and role of hydropower

The changing global agendas explored in chapter 4.1.1 have impacted and are reflected in the hydropower industry. Historically, hydropower has been viewed as a source of cheap and reliable electricity generation to support national economic growth and increasing energy demands from industries in developed countries. Very little environmental, let alone social consideration, was at the fore from the beginning of hydropower development and up to the late 1960's (Moran, et al., 2018). Particularly after World War II the main political agendas were focused on growth of industry and national capita (IHA, 2020) - environmental and social impacts were rarely acknowledged by policies.

With the growing public demand for better environmental assessments and criticism of the impacts of hydropower, new capacity building in developed nation reduced from 1970 . The causes of this drop can be attributed to the growing environmental movement and the acknowledgment of environmental and social externalities incurred by large dams. In addition, most of the economically viable and technically easily achievable dam sites had been exploited (Moran, et al., 2018). Social pressure as well as economic, social, and environmental cost of building in particular big hydropower projects made these unattractive or unacceptable. This prompted a shift of hydropower capacity building to developing countries mainly Asia, Africa, and South America. We see the development of the two worlds biggest dams in this period with the Itaipu Dam (construction between 1971-1984) bordering Brazil and Paraguay with an installed capacity of 14'000MW and the Three Gorges Dam (construction between 1994-2003) in China with an installed capacity of 22'500 MW (Nautiyal & Goel, 2020).

In most cases, the lessons learned about environmental and social impacts of dams were not applied to new projects being built in these developing countries. In the case of the Three Gorges Dam for example, millions of peoples had to be relocated from the reservoir area. Considerable environmental damage was also incurred and the hydrology of the river was totally changed (Yang & Lu, 2013). This is linked to the relative lack of strength of the environmental laws and regulations and the EIA capacity in these countries (Li, 2008). Hydropower fell out of favour with financial institution, such as the World Bank which had reduced its funding to just a few million USD by 1999. The loss of international funding and awareness of externalities from hydropower development is what led to the marked drop observed in global new capacity building of hydropower between 1970 and 2000 as shown in Figure 1 from chapter 2.1.1 (IHA, 2020).

Following the general trend of growing awareness, understanding and acknowledgement of environmental impact on human development, the values and role of hydropower in national development was reassessed at the beginning of the 21st century. Improvements to guide the environmental and social aspects of hydropower development were produced by the IEA (Helland-Hansen, 2008). This was strengthened by the World Bank and other institutions like ADB and the European Investment Bank (EIB), that were updating and implementing their environmental policies. The 2000 World Commission on Dams (WCD) report, sponsored by the World Bank and the International Union for Conservation of Nature (IUCN) (Baird, et al., 2021), brought the biggest changes to the industry (Helland-Hansen, 2008). This landmark report challenged the existing practices of hydropower development including EIA and SIA and initiated the change towards more sustainable planning and practices in hydropower development. The report encourages a better focus on the affected communities and overall sustainability of hydropower development (IHA, 2020). The reassessment of the role of hydropower was also influenced by new international policies such as the Kyoto Protocol (Table 1) and the following agreement and international policies, the most recent being the Paris Accords. These protocols and agreement are meant to address the issues surrounding climate change and environmental damage and to set national and international goals for the reduction of Green House Gases (GHG) emissions and promote sustainable development (Nautiyal & Goel, 2020). The use of hydropower for achieving these goals was apparent and has been integrated in the SDGs as well as the Paris agreements (IHA, 2020), as hydropower is viewed as a relatively mature technology and cheap source of renewable energy (Moran, et al., 2018).

The IHA, founded in 1995 under the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Locher, et al., 2010), produced its Hydropower Sustainability Assessment Protocol (HSAP) in 2006. This protocol built upon WCD, the World Banks Safeguard Policies, the Equator Principles and the IFCs Performance Standards to form one of the most comprehensive tools of the time regarding all phases of hydropower development (IHA, 2020). As a result of the renewed interest as a renewable source of electricity, there was a dramatic increase in hydropower development in the last two decades. The worlds installed hydropower capacity increased from 625 GW in 1995 to 2150 GW in 2019 (IHA, 2020). Best practices have also been improved to make hydropower more sustainable thanks to institutions like WCD and IHA. However, it is important to keep in mind that there is a shift in new capacity of renewable power installation. Wind and solar, in particular, are gaining traction as sources of renewable energy. Their technology itself is getting cheaper and they have less far reaching environmental and social consequences than hydropower (REN21, 2020).

4.2 Actors involved in evolution of ESIA

The evolution of the ESIA was an iterative process that stemmed from the interaction of several actors within the general changing social and institutional agendas (Figure 8). Economic actors such as the World Bank, Political actors that set goals such as national legislators or international policies and agreements, institutions that address the policy process such as IAIA or in the case of hydropower the IHA and MRC, and finally the civil society actors have played different roles in the evolution of impact assessments. Civil actors and political actors have been important in pushing for better environmental and social assessment tools and setting new sustainability goals. However, the institutions regarding policy process and the economic actors have been instrumental in developing the impact assessment methods used to achieve the goals and requirements set by the civil and political actors in a best practice way. For example, the IHA was formed with one of its goal being to produce a tool for sustainable hydropower development. One of the tools they have produced that contains impact assessments at its core is the HSAP. The HSAP itself was based on the WCD report. They invited representatives from national policy makers, developers, expert within the hydropower field, NGOs and the financial sector to formulate the HSAP (Locher, et al., 2010). Furthermore, the IHA also aids policymakers by producing tools and advising on hydropower development planning at national or regional scale. One of the major actors in developing and disseminating good EIA practice are financial institutions. The World Bank and the IFC, have developed their own assessment tools, safeguard policies and performance standards. The World Bank contributed to the establishment of both the WCD and the HSAP (Locher, et al., 2010). Furthermore, they are crucial in the dissemination of good EIA practices around the world (Li, 2008). For this, in the next chapter the evolution of the impact assessment tools in financial institutions will be explore in further detail.

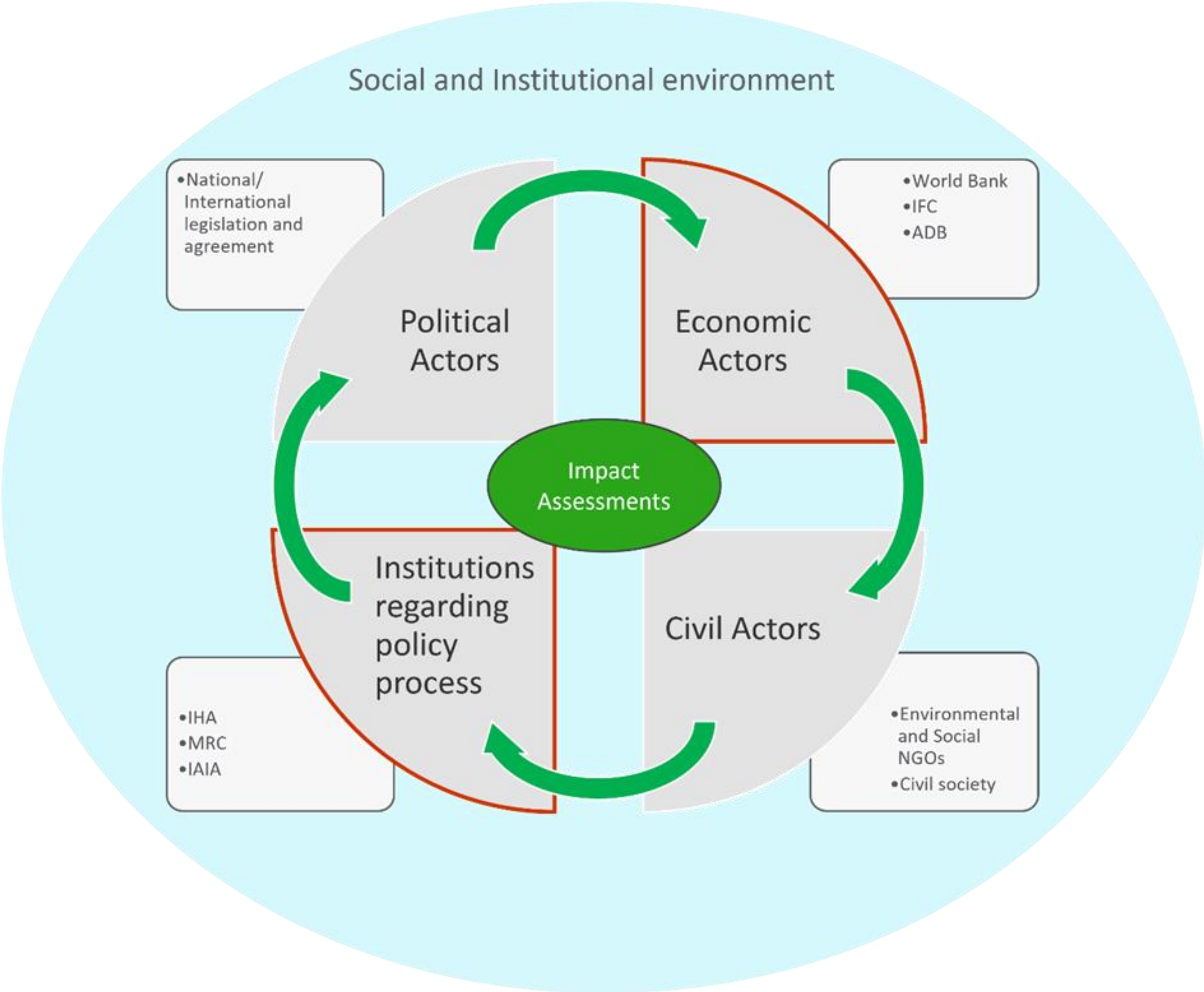

Figure 8: Actor interaction in the evolution of impact assessment. Adapted from EGS framework (Vatn, 2015)

4.2.1 Evolution of the ESIA in Financial institutions

Despite the introduction of impact assessment in many countries' legislation, the development of the controlling and enforcing legislation has been lacking in certain regions of the world. In an attempt to address this gap, several multilateral financing institutions developed their own specific policies. They would demand environmental and social assessment to be made in order to guide decision making with regards to funding and requirements of different development projects (Dendena & Corsi, 2015). Similarly, to the EIA legislation and process, the policies put into place by financial institutions have evolved over the years. This is in line with the increasing awareness and understanding of environmental and social project related issues. This shift has also led many financial institutions to incorporate ESIA in their policies and standards.

One of the most influential landing institutions is the World Bank, which has been instrumental in the adoption of environmental and social safeguards in the financing sector.

4.2.1.1 The World Bank

In 1971, the World Bank recognised the need to review the environmental aspect of projects, in particular hydropower. This was also catalysed from criticism from environmental NGO's and a general shift in mentalities regarding externalities from development (Li, 2008). Consequentially, they established an environmental reconnaissance section for hydropower projects that specifically looked at project financing of hydropower development (Modak & Asit, 1999).

The World Bank was the first international funding body to implement Environmental Assessment (EA) in their policy (Table 3). In 1989, they introduced the Operational Directive (OD) 4.0 that made EA standard for bank-financed projects. During the 90s the World Bank built upon the OD and implemented ten Operational Policies (OP) to serve as a guide and address individual aspects of environmental and social requirements, and legal aspects for project approval. This is known as the World Bank Environmental and Social Safeguard Policies (Dendena & Corsi, 2015) and was formally adopted in 1997 by the World Bank (Danis & Beddies, 2011). Criticism about the imbalance between the social and environmental dimension was voiced, similar to the EIA (Dendena & Corsi, 2015).

Table 3 : Different iteration of the World Banks environmental and social policies. Sources: (Dendena & Corsi, 2015; World Bank, 2020)

Year of implementation	Policy regarding lending requirements
1989	Operational Directive 4.0
1997	World Bank Environmental and Social Safeguard Policies (Do no harm Policies)
2012	World Bank Performance Standards
2013	Sectors of project implementation Water resources management, power and energy, agriculture and agroindustry, local development, infrastructure, waste management, tourism, commercial activities, manufacture development
2018	Adoption of the Environmental and Social Framework (ESF)
2020	Update to the ESF

In 2012, the World Bank Performance Standards (PS) were adopted, addressing social issues in equal value to environmental matters (Table 4). Contrary to previous Safeguard Policies that only counted two OP dedicated to social issues, the new PS counted four out of the eight PS related to social issues. These PS drew from the IFCs Performance Standards on Social and Environmental Sustainability that were developed in 2006 and implemented in 2007 by the IFC. Here the ESIA methodology is incorporated for the first time (Dendena & Corsi, 2015). Furthermore, we see an increased focus on sustainability by both the World Bank and IFC. The latest development from the World Bank came with the adoption of the Environmental and Social Framework (ESF) on the 1st of October 2018 (Table 4). The ESF is currently implemented for all new investment project financing while ongoing projects are still referring to the previous Safeguard Policies. These paralleling policy systems are estimated to be in place till 2025 (World Bank, 2018). The new framework is in a bid to better endorse, align, and implement the UN's SDGs as well as to aide in climate change countermeasures (World Bank, 2020).

4.2.1.2 The International Finance Corporation

Table 4: Different iteration IFC lending policy. Sources: (Dendena & Corsi, 2015)

Year of implementation	Policy regarding lending requirements
1998	Environmental and Social Safeguard Policies
2006	Adoption of Performance Standards on Social and Environmental Sustainability
2012	Adoption of the revised IFC Sustainability Framework

The adoption of environmental and social standards by the IFC stems from its commitment to environmental and social issues and is intertwined and overlapping with the World Bank policies. In 1998 the, IFC adopted its Environmental and Social Safeguard Policies that were formulated off the World Banks Environmental and Social Safeguard Policies (Table 4). In 2007, the IFC adopted its own Sustainability framework. This Framework reflected the IFC commitment to sustainable development and consisted of 8 performance standards, equally divided between environmental and social issues (Dendena & Corsi, 2015). This is, incidentally, the framework the World Bank refers to for their 2012 Performance standards. In 2012, the IFC release their revised Sustainability framework. This revision was done in order to strengthen the IFCs previous environmental and social commitments but also to strengthen their commitment to climate change, corporate governance and enhancing social issues (Dendena & Corsi, 2015). At the core ESIA are defined as an important element of project financing requirement (Pope, et al., 2013).

An important contribution the IFC made to the wider adoption of impact assessment in financial institutions is the creation and adoption of the Equator Principles (EP). Despite the adoption by both the World Bank and the IFC of environmental and social safe grades, many big projects were still being built without environmental or social consideration thanks to funding from other sources without such stringent guidelines. To address this problem, the IFC invited other major funders in 2002 to discuss their own adoption of environmental and social assessment for related project financing. The discussion led to the launched of the Equator Principles in 2003 (Dendena & Corsi, 2015) (Table 5).

Table 5: Different integration Equator Principles (EP). Sources: (Dendena & Corsi, 2015; Equator Principles, 2020)

Year of implementation	**Policy regarding lending requirements**
2003	Launch of the Equator Principles
2006	First revision e EP II
2013	Second revision e EP III
2020	Third revision EP IV

This was a major advancement for the global implementation of the environmental and social assessment in private sector financial institution and bilateral lending (Morgan, 2012).

> *"The adoption of the Equatorial Principles was a very important step for the recognitions of EIA and worldwide adoption as well as implementations from financing bodies."* Interview 3

The adherence by financial institutions to the EP is still on a voluntary basis, however. It is intended to provide lending institutions with minimum standards for their decision-making process and guidelines for establishing and assessing environmental and social risk resulting from project implementation. The EP itself refers to the IFC Sustainable Framework and incorporates its Performance Standards. As the Performance Standards have undergone revisions, so too has the EP. The first EP revision was in 2006 and adopted in 2007 and is known as EP2, followed by EP3 in 2013 (Table 5). EP3 is important as this is the first time where ESIA are central to the impact assessment procedures. Furthermore, according to the EP3, a full ESIA is explicitly needed for projects that fall under Category A and, are full or partial dependent on the need in projects of Category B (Dendena & Corsi, 2015). ESIA is put forward as the main tool for establishing the ESMP and is a fully integrated environmental and social assessment as for the first-time social issues are not considered as a subordinate assessment to the environmental one. The latest iteration of the EP 4 came into effect on the 1st of October 2020. In this version, the EP seek to better align and support the goals set during the 2015 Paris Agreement as well as with the SDGs (Equator Principles, 2020). To date, the EP has been adopted by 118 financial institution in 37 countries around the world (Equator Principles, 2020). As such, the EP has contributed to the wider spread and formalization of the shift from EIA to ESIA as the main tool for project related impact assessments (Dendena & Corsi, 2015)

4.2.2 Actors involved in the evolution and implementation of ESIA in Hydropower

Thanks to the growing scrutiny from social actors, NGO's, and the national and international agreements passed for sustainable development as well as majors financial institutions aligning themselves with said agreements, there is a push to develop hydropower in a sustainable way. Hydropower has been identified as one of the key sources of renewable energy by multiple agreements and the IEA (Peters, et al., 2021). Due to the potential externalities of hydropower this must be done in a well-regulated way. This is reflected in the tools used by decision makers to determine the environmental and social project related impacts. At the heart of the current project related impact assessment tool is the Environmental and Social Impact Assessment (ESIA) and is the result of the complex interaction between different actors (Figure 9).

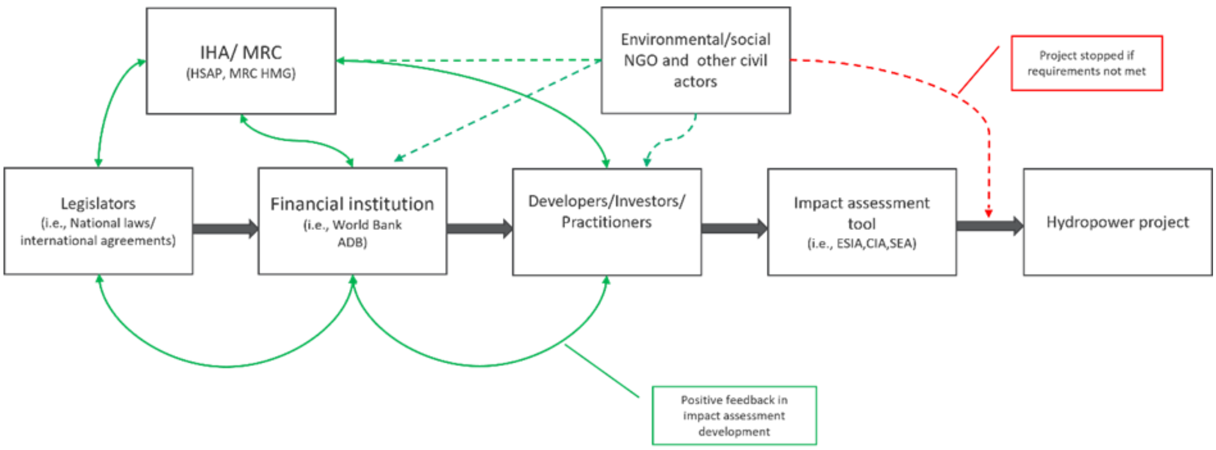

Figure 9: Actor's interaction in development and implementation of impact assessment in hydropower. Adapted from EGS framework (Vatn, 2015)

The knowledge of what to integrate has been built up over many decades, however, as mentioned before one of the crucial events leading to the development of more attuned tools for sustainable hydropower development is the publishing of the World Commission of Dams

(WCD) report in 2000. The report and follow-up report were targeted at dissemination of this information and the implementation tools to governments. However, according to Dr Helen Locher, this report did not get the endorsement of the hydropower industry due to concerns about some of its recommendations being impractical to implement:

> *"The World Commission of Dams unfortunately did not receive the endorsement of the industry. The WCD went through an extensive global research and consultative process to gather information but rushed the closure. They didn't release a draft report to get comments, but just published the final report. The industry did not agree with some of the things, and sadly, they didn't endorse it."*

This points out the importance of having practitioners with real world experiences involved in formulating tailored goals and tools. In response to this dissatisfaction, the World Bank initiated, through the IHA, the Hydropower Sustainability Assessment forum that brought together representatives from financial institution, developing and developed nations, experts from the hydropower sector, NGOs with environmental aspect and some with social aspects (Locher, et al., 2010). Nevertheless, the industry as a whole showed their interest in having better sustainability-oriented tools as is in line with the general impact assessment direction post 2000. And according to Interview 2 there are now good industry standards and tools provided by the IHA, World Bank and IFC as well as MRC for good project related ESIAs. These tools outline the scope and very importantly the timing of the ESIA intervention in the project development process (Helland-Hansen, 2008). Timing of ESIAs and proper planification are essential part of sustainable hydropower development. As the effectiveness of the proposed avoidance, mitigation and compensation measures are greatly dependent on how early in the project phase the environmental and social issues are identified (Glasson & Riki, 2019). ESIA is considered a mature and well-respected project decision-making tool. It is incorporated into many national and international legislation as well as Multilateral financial institutions requirement. However, despite this long history there still are variations and limitations to proper ESIA implementation in hydropower today, as Dr Helen Locher states:

> *"Firstly, the requirements for the individual issues to be addressed by the ESIA are set by the national laws and regulations. If the project is externally funded, then requirements set by the lending institution(s) can come in to*

play. So, there can be variations in ESIA requirements depending on the location in which the project is conducted, as well as the financial arrangements."

The World Bank and by extension the other financial institution having signed the Equator Principle, try to address the problem of sometimes lacking or not robust enough national environmental and social regulation with the implementation of the Environmental and Social framework and the Performance standard from the IFC in their lending policies. However, as Interview 3 states

"(…)they (World Bank/IFC) are influential in the design phase and construction phase but once the project is built, and the money is spent, they can have very little influence on the operational phase of the project".

Furthermore, less scrupulous investors or developers might turn to other financial institutions with less strong environmental and social safeguards requirements from lending approval with Interview 1 expressing concern about hydropower development financed by Chinese banks (no specifics) in countries with little legislation concerning environmental and social safeguards (again no specifics) As a result, political willingness is one of the key issues identified by nearly all the participants interviewed for good quality ESIA and sustainable hydropower development. Nevertheless, it is important to recognise the power of NGO and local communities.

"(…) this (ESIA) need to convince the NGOs, about why we are doing this project and not another project. (i.e.) That took place in Uganda many years ago when they wanted to have a new dam on the Nile. They had not done a proper job at convincing the local NGOs and the people in the neighbourhood that this was the best option. Therefore, the whole project was stopped.". Erik Helland-Hansen

This is relevant as at the beginning, the EIA process was in response to the growing acknowledgement of environmental damage (Pope, et al., 2013). Furthermore, institutions are very important to evolution of ESIA and their implementations. Dr Daniel P. Loucks:

"If you're going to make a difference in the world, you better worry about the institutions that are going to make that difference as you are working through these institutions and so there has to be some [institutions such as IHA and MRC in the case of hydropower]"

For the particular case of hydropower, the IHA, the MRC, IFC and World Bank are examples of institutions that are widely referred to in the industry as standard setting. The IHA is relevant as it has produced good industrial practice guidelines and provides guidance for the writing of sustainable hydropower development legislation (with the ESIA integrated). The World Banks Environmental and Social safeguard policy for all project development including hydropower must include ESIAs (Helland-Hansen, 2008). The IFC has even produced a guide specifically for hydropower that includes ESIAs (International Fincance Corporaration, 2015). The MRC is more context specific to the Mekong basin and provides support to the riparian nations in establishing their hydropower and energy master plans as well as providing guidance to practitioners, feedback on specific project related ESIAs and monitoring and data collection (Li, 2008 and Interview 2). The MRC is also striving to become a platform for better communication between the riparian countries and provide them with good data to better understand and account for transboundary effects and benefit sharing (Interview 2 and Dr So Nam). These institutions have produced guidelines and tool for sustainable hydropower development like the "Hydropower Sustainability Assessment Protocol (HSAP)" from IHA, a "Hydroelectric Power: A Guide from Developers and Investors" by the IFC and implemented also by the World Bank, and "The MRC Hydropower Mitigation Guidelines". All these documents have incorporated ESIAs as well as other impact assessment to address the specific needs of hydropower. However, there is a consensus in the interviews that in terms of better implementation of sustainable hydropower and ESIA practices, it is still down to nation legislation and political willingness to adopt and enforce the industrial good practices.

> *"the strength of the environmental and social safeguards put in place by the laws and internal requirement from financial institutions will then greatly influence the quality of the ESIA. As the project contractors will refer to those documents and laws and if it is not set in law or regulated, they will often do the minimum required."* (Interview 2)

The incremental evolution that ESIA has undergone shows the dynamic nature and interaction between practitioner, regulation, academics, and civil society (Glasson & Riki, 2019). Arguably some of the most important contributors to the implementation of ESIA are regulators and practitioner (Zeleňáková & Zvijáková, 2017). As they respond and innovate according to cumulative experienced gained and the growing requirement of civil society for better impact avoidance and mitigations of impacts from projects (Morrison-Saunders & Arts, 2005). However, despite to date some 50 years of evolution that resulted in good ESIA theory, in practice the most important actors are still the regulators.

This is the case for example in hydropower development in the Mekong basin, were despite the countries having poor legislation at the beginning, the World Bank and the Asian Development Bank (ADB) were instrumental in bringing in world class EIA practices to the region (Li, 2008).

4.3 Current scenarios in hydropower with examples from the Mekong

Figure 10: Xayaburi dam on the lower Mekong. Source Multiconsult

Project related ESIA's in hydropower face certain challenges that are unique to the industry. The underling goal of the ESIA is to ensure the sustainability, however, in hydropower this is multi-dimensional. Often hydropower projects must deal with multiple dimensions of sustainability as is shown by the multiple SDG that hydropower is cited to help achieve (Makkanen & Plummer Braeckman, 2019 and Peters, et al., 2021). Decision-makers must compromise between economic development, answering growing energy demands, achieving sustainability goals, national GHG emissions targets, and ensuring environmental and social sustainability (Moran, et al., 2018, Breeze, 2018; Helland-Hansen, 2008). This is in line with the general trend of inclusiveness of impact assessment, however, to achieve this Dr So Nam points out that:

> *"Environmental experts have to work closely and regularly with the economic experts and the social experts, to have this relationship and to have understanding in the balancing of benefits"*.

For this reason, ESIA's are essential as they try and bridge the gap between environmental and socio-economic impacts and promote a holistic and interdisciplinary approach that is essential for cost benefit analysis in hydropower development (Dendena & Corsi, 2015 and Moran, et al., 2018). Scoping of the geographical and temporal boundaries of hydropower is difficult, as the projects can have far reaching environmental and social consequences through the damming and fragmentation of the river system (Nautiyal & Goel, 2020). Dr Rafael Schmitt provides an example of the complexity of scoping and what compromises must be taken into account by decision-makers in hydropower:

> *"If you think about ecosystem services, like for example related to geomorphology of rivers and notice the ecosystem services of supplying sediment to the Mekong delta and building climate resilience until 2100. The problem is if you discounted the value of delta land that will be lost due to rising sea levels and erosion at a typical discount rate of 6 or 8%, then the present value of land lost in the far future is very low. Whereas a dam creates immediate benefits as soon as a turbine starts spinning but only for the project's life span."*

Furthermore, the true cost and benefits of hydropower projects, in particular of large dams, have generally failed to be properly evaluated by decision-makers. The economic returns and construction cost have often been undervalued as well as the environmental mitigations cost being underestimate or even excluded. This is evidenced by the Three Gorges Dam project where China had to spend an estimated USD 26 billion on ecological impact mitigation alone (Winemiller, et al., 2016). This shows the challenges of comparing and compromising long-term environmental and social impacts and (usually) short economic benefits. Cumulative impacts, secondary impacts, and less tangible socio-economic ramification from changes to the ecosystem are also challenging to integrate in the ESIA as their scope is often very broad (Mandelik, et al., 2005). This implies the need for a long (temporal) and large (geographical) scoping process (Mandelik, et al., 2005). This imposes a choice for the decision makers between environmental and social safety and decisions making efficiency (Snell & Cowell, 2006). With increasing scope comes the risk of having to deal with cumulative impacts that are not related to the planned hydropower project. Here, decision-makers are often reticent to acknowledge impact that are not directly linked to the project itself in the cost-benefit analysis as in the end they want a return on investment and not linked to indirect costs (Interview 3). Due to the complexity of assessing environmental and social impacts of hydropower, institution such as the IHA and the MRC were created (Makkanen & Plummer Braeckman, 2019). Building off the EIA framework already developed, these institutions have the produced protocols and guidelines specifically designed to address sustainability, impacts assessment and management in hydropower. These guidelines, and protocols such as the previously mention HSAP from the IHA and the MRC Hydropower Mitigation Guidelines are highly regarded in the industry. Furthermore, these institutions are essential for the development of sustainable hydropower as note only do they provide good standard and methodology for practitioners, but they also provide guidance for policy makers concerning the hydropower sector. The role played by these types of institutions is particularly relevant in countries that do not yet have strong environmental and social legislation surrounding hydropower development (Li, 2008).

However, despite the multitude of tool and methodologies for "good" ESIA implementation and despite the good intentions regarding sustainable hydropower development, due to the inherent complexity of environmental ecosystems and social systems as well as how the two interact, in practice the outcome is not always in keeping with the objectives:

> *"(…) there are a lot of moving parts, as societies and environmental conditions change alongside environmental and social issues management efforts of the developer. Given this, even with the best intentions, the best resources and the best plans, the outcomes are not always as one would hope." (Dr Helen Locher)*

This might reflect challenges of data collection study of the ESIA as Interviewee 2 says. He also mentions that this is particularly challenging in the Mekong region and is one of the core functions of the MRC is to provide good data for practitioners. Baird et al. (2021) argues that this might also be down to poor scoping and planning, as the downstream environmental and social impact are generaly poorly accounted for. Lastly, the cumulative impacts of multiple dams have to be taken into acount but this assessment has historicaly been poor as well. When looking at development of river basins, it is very important to look at the whole connectivity and transboundry effects. Dr So Nam states that the development in this area is very poor. However, there have been some limitations regarding the quantification of the impacts in the cost benefit analysis (Moran, et al., 2018; Intralawan, et al., 2018). Intralawan, et al., (2018) proposes to use full environmental cost accounting based on Ecosystem Service (ES) valuation approach to quantifying environmental loss and the subsequent impacts to society. This paper evaluates the cost benefit analysis of 11 planed mainstream dams in the Lower Mekong Basin (Figure 11) and mainly uses the economic valuation of provisioning service from fisheries.

Figure 11: Mainstream dams on the Mekong (Planned, under construction and operational) Source: (Loucks & van Beek, 2017)

This study shows that at a cost of $18 billion, reduction of fish stocks and the socio-economic consequences that this has on livelihoods fare outweighs the gain from electricity production, flood control and irrigation. The MRC Hydropower Mitigation Guidelines recommend the integration of ES into basin planning to better understand the underlining benefits and services provided to society from the environment (MRC, 2019). This is in line with the current push for better integration and understanding of sustainability at larger scales (basin and catchment level). This is supported by both Dr Rafael Schmitt and Dr Daniel P. Loucks, and their scientific work. The need for better impact prediction tools and models is essential for better decision making (Schmitt, 2019). This is particularly relevant in the current push towards basin level assessments and for understanding of climate change adaption and resilience. Schmitt (2019) argues the need for better strategic analysis of sedimentary transportation in the Mekong river basin and how the lack of proper planning will threaten one of the worlds larges freshwater fisheries as well as the resilience of the Mekong Delta to rising sea levels due to climate change. This was achieved by the use of:

> *"(…) very simple conceptual model of the Mekong Delta that allowed us to make this translation from the biophysical property of sediment supply (i.e., the ecosystem service provided by the Mekong basin) to the endpoints of land lost in the delta by 2100 and translating the biophysical strategic assessment results into an endpoint metric that is more related to a real monetary value." Dr Rafael Schmitt*

However, both studies point out the difficulty when assessing ES as some ES are more "easily" identifiable and quantifiable (i.e., fisheries production and sediment transportation) and others less so (i.e., health services and avoided cost from conservation of natural habitat) (Schmitt, 2019; Intralawan, et al., 2018).

The timing of an ESIA involvement is often too late. According to Li (2008) this is a recuring problem during hydropower development on the Mekong river despite the World bank and the ADB being influential in the area. It often comes after the location for the project has been decided, the design has already been established, thereby making the ESIA a mere formality (Li, 2008). This is an issue in the Mekong region according to Li (2008). Due to the fact that hydropower projects are expensive projects and often having long planning phases where investors are unwilling to commit to establishing an exhaustive ESIA study if they do not have surety of economic return. By delaying the ESIA it is difficult to apply the mitigation hierarchy to its fullest and the avoidance of environmental and social impacts by selecting a new dam location is often not envisaged. This is important as a dam site selection is the most important element to avoiding negative environmental and socio-economic impacts (Winemiller, et al., 2016). This leads to the ESIA becoming an exercise of minimisation and compensation of impacts and reduces greatly the effectiveness of the ESIA itself. Li (2008) attributes this to lack of political willingness reflected in the asymmetry of institutional power. When there is more preoccupation of economic performance or technical constraints this leads to a trade-off between short term economic gains against long term environmental damage and the social impacts associated. Most often than not it is at the detriment of the environment (Bond, et al., 2012). However, Dr Rafael Schmitt argues that:

> *"I think it's not necessarily that they (ESIA) are brought on at the wrong time. It's that in many countries the first step is missing. The first step should be a strategic assessment of a country, or even better, at river basin level."*

This is evident in the change of agendas from IHA through the HSAP and the MRC through the MRC Hydropower Mitigation Guidelines (Figure 12) that both promoting the uses of basin scale analysis prior to projects ESIA (MRC, 2019; IHA, 2020).

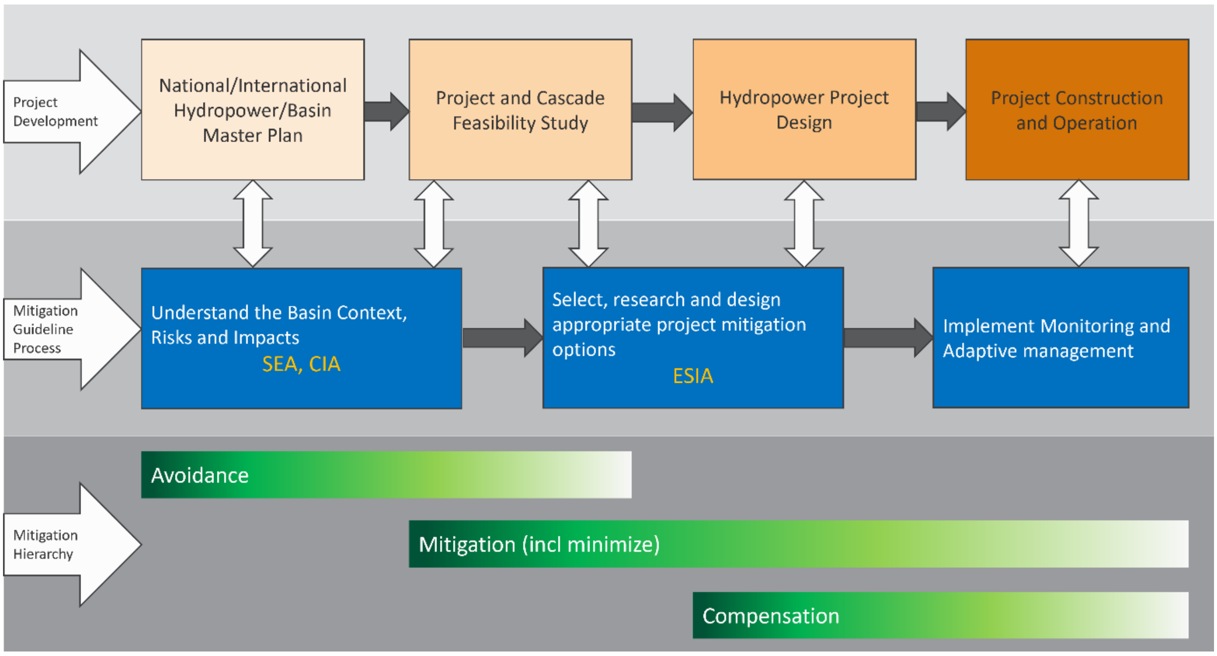

Figure 12: MRC Generic Process for Risk and Impact Mitigation-Project Life Cycle. Source: (MRC, 2019)

The planning and location are an essential part for the proper implementation of the mitigation hierarchy, as it is only in the planning phase that the best avoidance measures can be taken (Figure 12). This is backed by scientific literature such as Schmitt (2019) and Intralawan, et al

(2018). This shift in planing of hydropower development and analysis of river system is observable by the growing number of basin scale studies conducted (Figure 13).

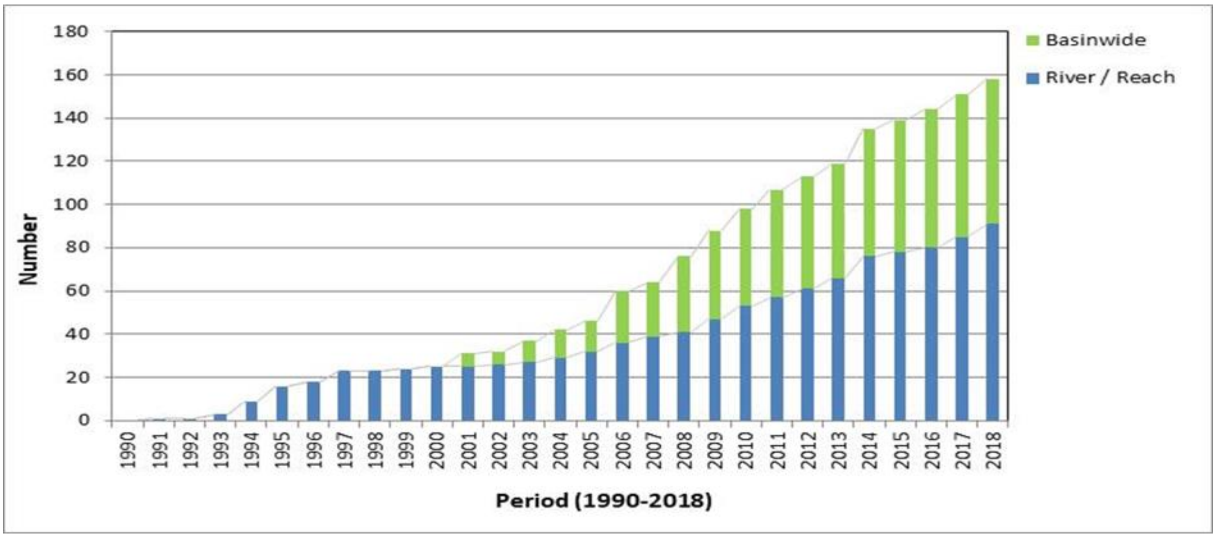

Figure 13: Evolution in the implementation and scale of EFlows assessment and DRIFT methodology. Source: (Brown & Jourbert, 2021)

In the current push for sustainable hydropower and the need to meet environmental and sustainable development goals the hydropower industry is shifting their focus to better implementation of CIA, SEA and basin management plans. This is in line with the general change observed in global agendas for sustainable development and social awareness. At the heart of this new strategy is better hydropower planning and more comprehensive analyse of river systems and transboundary effects as well as CIA. ESIA's still play a central role as project decision making tools but should be incorporated as a secondary analysis after the primary hydropower development strategy at larger scales has been established (IHA, 2019; World Bank, 2020; MRC, 2019; Mandelik, et al., 2005). This approach and the tools to implement are also supported by scientific research conducted in different fields of sustainable development, impact assessment and environmental resource management (Winemiller, et al., 2016). This is relevant as Dr Rafael Schmitt states:

> *"Environmental Assessment make most sense if you embed them into a systemic perspective on the entire river system"*

5 Discussion

The analysis in chapter 4 applies an evolutionary perspective to examine how changes in the larger social and institutional landscapes have influenced practices in environmental governance. This has instigated incremental changes that led to the advent of the ESIA and its contemporary mode of application in ensuring the sustainability of large hydropower projects. Social norms, institutional setups, and regulatory regimes have constantly aligned with the increasing scale and scope of environmental and social issues. Impact assessments have followed this expansion, and ESIA's currently covers a broad range of sustainability and climate resilience aspects. Identifying different actors within this social and institutional landscape made it possible to disentangle the complex interactions that drove the need, evolution and implementation of the ESIA. The actors reflected changing social and institutional requirements for more inclusive and holistic assessment methods of environmental and social externalities in the development of the numerous impact assessment tools used today. However, some actors were more central than others, in the evolution of ESIA/impact assessments in hydropower, and some normative changes had bigger impacts than others on the perceived value of hydropower. Understanding this is important to develop robust tools for environmental governance considering the increasing pressure to develop river basins in vulnerable environmental and social contexts in the Global South.

The ESIA has evolved as a consequence of social pressure, social demands, and changing national and international agendas regarding environmental and social issues as presented in Chapter 4.1.1. It was an incremental evolution that built on previous interactions/iterations and the growing knowledge of how the environment and society are affected by development. This is representative of the changing scope of environmental issues being addressed. The first agendas focused on local project-related issues such as water pollution, air pollution or noise but they have grown in scale and now address issues such as basin and inter-basin impacts, climate adaption, and resilience for example. This is arguably the most important shift, as EIA went from assessing individual environmental and social impacts to a more integrative and sustainability-oriented process (Dendena & Corsi, 2015). as for the ESIA tool, it is the need for an even more inclusive assessment and evaluation of the environmental and social issues at the same level of relevance that has led to the development and implementation of the ESIA as one of the main project decision-making tools. The focus of ESIA's on project-related issues, despite better inclusiveness, is why it has limitations when addressing sustainability. This is apparent by the growing focus of international agreements, policies, and knowledge producers on the implementation of larger-scale more strategic impact assessments such as SEA and CIA. As these better address the issues of sustainability on a national, international to regional scale. This is also exemplified by the studies by Kolk & Mauser (2002) that identified a change in the application of environmental management models from linear models to more elaborate models that include different components of management and performance. The shift in global agendas is also noted by the reassessment of the value and role of hydropower as explored in chapter 4.1.2. with the environmental awakening during 1960-1970, the popularity of dams dropped and so did the new capacity-building for this energy source from 1970 until the late 1990s.

With the recognition of the need to address climate change and a move away from a carnon based energy source by the international community hydropower development regained momentum as it was seen as an integral part of achieving sustainable goals and reduction in GHG emissions. The energy industry reacted to the non-sustainability of large mainstream hydropower plants, despite their large advantageous electricity production, and has been mostly moving away from this (Nautiyal & Goel, 2020). Nevertheless, the growing energy needs of the world combined with the strong sustainability drive, in particular the need to address climate change, is pushing for more hydropower development (REN21, 2020). To achieve sustainable hydropower, the ESIA has had to increase its scope. This is corroborated by a review published by Nautiyal & Goel (2020) on the sustainability assessment of hydropower projects. However, Morgan (2012) argues that it is the desire from decision-makers for better tools to address environmental and social issues that have mainly driven the evolution of ESIA's and the impact assessment field. This is understandable as those that are criticized if a project does not fulfill the environmental and social requirement are the decision-makers – particularly the politicians and funders.

The technical evolution and implementation of ESIAs in hydropower have been brought on by the interactions between certain key actors that were explored in chapter 4.2. Firstly, social actors such as NGOs and environmental and social protection groups were instrumental in voicing concerns about the practice and impacts from the hydropower sector and demanded better regulation (Dendena & Corsi, 2015). This concern and growing acknowledgment from legislators and regulators, such as national/international policymakers and financial institutions, were important in implementing the EIA practices in hydropower development. There was a consensus during the interviews with industry leaders that National legislation and financial institutions were key to implementing the EIA practices in hydropower. It is noted, however, that the diffusion of the EIA practices in developed countries is primarily from external pressure from the international science community, the international financial community, international environmental organization, and international conventions – this needs to be adressed. Li (2008) identified that, in relation to one of my main case studies, the World Bank and the ADB as the main contributors to EIA implementation in the Mekong riparian countries. Despite the adoption of EIA practices there still were concerns voiced by social actors due to the complexity of implementing impact assessments in hydropower development. This pushed the creation of institutions specifically tailored to addressing hydropower development like the IHA or the MRC of which is one of its roles in the Mekong River Basin. These institutions were essential in producing knowledge and developing tools better addressing sustainability in hydropower. IHA and MRC are key as they produced tools that pulled from the cumulative experience from different actors like practitioners, scientists, legislative actors, financial actors and incorporating the changing sustainability agenda to giving a more holistic approach to impacts assessment of hydropower. The incremental evolution reflects the interaction between all these different actors and the changing agendas. This pattern of interaction is reminiscent of the interactions identified in Vatn (2015) and the environmental governance framework he developed. The actors involved are similar to the actors involved in the general evolution of ESIA’s and impact assessments with a few exceptions for the context of hydropower. Furthermore, Winemiller, et al. (2016) details some economic motivation behind the need for better evaluations of impacts as there can be important economic consequences of overestimation of electric generation, undervaluing the cost of hydropower construction and underestimating the environmental and social impact mitigations costs. For this reason, there is a push for a more holistic cost-benefit analysis to better define the value of any hydropower project. To achieve this incorporation of the project analysis into a basin scale analysis is necessary.

The changing agendas, the growing demand for inclusiveness, and how the different actors have integrated these are the reason why ESIA’s in hydropower are the way they are today. They have evolved in order to address the needs of environmental and social aspects of hydropower in a holistic way. The ESIA process has also evolved in this direction since single project ESIA's in hydropower struggle to fit the growing scope needed to truly address global large scale sustainability issues, as discussed earlier, like including cumulative impacts as is shown in chapter 4.3. Despite the current attempts at increasing the scope of the ESIA studies, like including better evaluation methods such as ES, as well as different modelling techniques to better understand the sustainability of a project, it is still unsatisfactory (Snell & Cowell, 2006).

To better address the sustainability of hydropower larger scale impact assessments, such as SEA and CIA, are needed at catchment and basin-scale, before conducting a project specific ESIA. This larger-scale assessment better addresses the issues of multiple dam impacts for example, together with other developments and changes, and hence gives a better understanding of the impacts incurred to the whole river system. This also allows for the most optimum development of a total river basin not only for a specific single project location. New analytical methods such as ES are better suited at these large scales and are being increasingly implemented (Winemiller, et al., 2016). This allows the creation of strategic basin management plans and hydropower master plans which will better serve the sustainability goals of hydropower (Schmitt, 2019). Nevertheless, ESIA's will remain relevant as a secondary level assessment as they will provide a greater level of detail in the mitigation measures needed for the selected development. These findings are corroborated by the latest version of the HSAP and the MRC Hydropower Mitigation Guidelines (MRC, 2019; IHA, 2020). This is argued by Mandelik, et al (2005) to help increase the effectiveness, quality, and overall sustainability assessment of impact assessment. Jager, et al. (2015) corroborate the need to formulate spatial decision to dams development at basin level and goes even further by suggesting that mainstream dams should be avoided whenever possible, and dams should be concentrated on certain tributaries, to amongst others reduce river system connectivity loss. This will further address many of the environmental and social issues still attributed to hydropower and keep steering the industry in a more sustainable direction. This is supported by Loucks & van Beek (2017) as they identify planification on basin-scale as the best way to manage and avoid environmental and social consequences of hydropower. Winemiller, et al., (2016) also advocates the use of more holistic and sophisticated planning in hydropower. Furthermore, to achieve true sustainability in hydropower development, project scale assessments should go beyond project location and integrate the cumulative impacts of existing dams (and other known planned dams), as well as account for likely climate change. This can be achieved by using a two-phased scoping process according to Mandelik, et al. (2005), where the project is incorporated into a previously done basin-wide assessment has been conducted. This way could address issues that are encountered in the timing and scope of hydropower project impact assessments, as the first study would address issues related to basin-scale and dam site location and the ESIA could focus on direct project impacts.

This study exemplified the usefulness of looking at current environmental movements and tools through an evolutionary and historic perspective. It will help better identify what are the actions that have produced the most amount of change in the management of environmental issues. Furthermore, as Vatn (2015) explains, it is useful to understand what and how actors' interactions influence the management of environmental resources and how themselves are influenced by the wider social and institutional landscape. Looking at what historically has brought change and who brought effective change can help identify how to better proceed when tackling the current environmental issues. This will further help implement effective policies and develop the appropriate tools for environmental governance.

In the case of this study, the evolution of ESIA's in hydropower has been guided by the changing global agendas and the need for more appropriate decision-making tools to implement these changing agendas. The ESIA is considered a mature and trusted process for project decision-making today. However, the understanding of environmental and social issues in hydropower has been growing in scope. Project ESIA's has been shown to have its limitations as they struggle to incorporate cumulative impacts, less tangible secondary effects, and overall sustainability. For this reason, we see the shift in the hydropower industry towards better pre-project decisions through hydropower basin- and masterplans that incorporate national or basin-scale impact assessments. This study served to better understand the history of ESIA development and could be used as an introduction to a study analyzing the future of impact assessment in hydropower. Further study could also be conducted on how project ESIA can be effectively integrated into larger-scale assessments, and how beneficial this is to the overall sustainability objective.

6 Conclusion

The evolution of ESIA in hydropower has come from the ever-growing acknowledgment of the environmental and social externalities of projects. The push from the industry has been for a more integrated impact assessment as the understanding of the multilateral and dimensional nature of impacts is more and more evident. This is supported by the World Bank, IFC, MRC, IHA who have developed and are developing tools to better implement sustainability. ESIA's play an important role in the sustainability of projects. However, there appears to be some limitations that ESIA's encounter in Hydropower. Due to the high "up-front" investment cost of hydropower development, investors and lenders are often reticent of conducting an ESIA before the project predesign and feasibility have been produced and this lessens the ability of ESIA's proposed mitigation measures as the decision-makers have usually already invested heavily in the project location and design – being too committed to turn back. Cost is also one of the major limiting factors for the scope of an ESIA as investors are not willing to pay for the study of the whole river system for their single project, as they would see very little return on investment. For this reason, there is a push towards larger-scale assessments such as SEA and Basin Management Plans in order to better identify possible project locations with minimum impacts. However there must be a political willingness, such is the will to address climate change issues, to implement proper large-scale assessments as they are costly with little direct return. On a similar line for transboundary rivers, there must be high levels of coordination between riparian counties for there to truly be sustainable development and a unified approach to this. Effective means to quantify environmental and social impacts such as ES and EFlows must be more widely implemented. Finally, the ESIA should continue evolving to be part of an integrated assessment process. Hence, the ESIA's should be integrated as a more executive tool following the larger-scale policy impact assessment tools at basin/catchment level studies including SEAs and CIA's. To successfully implement this vision, there has to more recognitions and drive to achieve sustainability targets from the world's governments and different international institutions. This is particularly relevant in developing countries where environmental and social legislation are relatively weak and hydropower potential is great.

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Appendices

Appendix A: Confirmation of Consent

Confirmation of Consent

Do you want to participate in the research project
"The Evolution of Environmental and Social Impact Assessments using hydropower as a case study

This is for your consent to participate in a research project for a master thesis. The purpose is to learn about the evolution of ESIA in hydropower. I am interested in your opinion on the evolution of ESIAs since there implementation and the advent of ecosystem services in sustainable hydropower development.
In this letter, I give you information about the purpose of the project, how the research will be conducted as well as how data and confidentiality will be secured and ensured.

Purpose
The purpose of this research and thesis is to understand which actors have been instrumental in the evolution of ESIAs over the years bought in theory and in practice as well as understanding how ecosystem services is and will be integrated into sustainable hydropower projects.

Who is responsible for the research project?
I, Guillaume Quigley, am conducting this study as a master student from the Norwegian University of Life Sciences (*Norges miljø- og biovitenskapelige universitet*, NMBU).

Why are you asked to participate?
You have or have had some involvement with ESIAs either in theory or in practice. This give you some perspective of the evolution of ESIAs over the year from a certain perspective. As I am interested in the different perspective of the different actors involved in the evolution of ESIAs and ecosystem services this makes you a candidate for this research.

What does it mean for you to participate?

If you choose to participate in the project, it means that I will interview you. The interview will have open question where you can talk of your experience and express your opinion. It will take approximately 30-40 minutes. Your answers from the interview will be recorded for transcription later.

It is voluntary to participate

It is voluntary to participate in the project. If you choose to participate, you can withdraw your consent at any time without giving any reason. All your personal information will then be deleted. It will not have any negative consequences for you if you do not want to participate or later choose to withdraw.

Your privacy - how I store and use your information

You have to option for how your data is processed: anonymous or cited.

Anonymous:

I will only use the information about you for the purposes I have described in this article. I treat the information confidentially and in accordance with the privacy regulations. Only I will have access to the data. To make sure your data is safe, I will replace your name and contact information with a code. I will be in possession of a scrambling key and will be the only person to have access to it. This is to ensure that I only know which participants gave what information.

<u>In the final thesis it will not be possible to recognize that you were a participant in this study.</u>

Cited:

If you agree to be cited in this thesis, I will process your data in a similar fashion as previously mentioned in the anonymous process but there will be no coded name. I will cite your argument in text and with your name, but no other personal information will be revealed. You can always ask to see the information that will be used at any time during the writing of this thesis.

Please highlight one of the options

- I desire to remain anonymous.
- I agree to be cited in relation to my quotations.

What happens to your information when we end the research project and thesis conclusion?

The information is anonymized during the project (till June 2021). Your personal information and any recordings will be deleted after the thesis is concluded.

Your rights

As long as you can be identified in the data material, you have the right to:
- access to which personal information is registered about you, and to receive a copy of the information,
- to have personal information about you corrected,
- to have personal information about you deleted, and
- to send a complaint to the Data Inspectorate about the processing of your personal data.

What entitles us to process personal information about you?

We process information about you based on your consent.

On behalf of Guillaume Quigley, NSD - Norwegian Center for Research Data AS has assessed that the processing of personal data in this project is in accordance with the privacy regulations.

Where can I find out more?

If you have questions about the study, or want to exercise your rights, please contact:

Guillaume Quigley: guillaume.quigley@nmbu.no

Lars Kåre Grimsby (main supervisor): lars.grimsby@nmbu.no

Leif Birger Lillehammer (co-supervisor): leif.birger.lillehammer@multiconsult.no

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Declaration of consent

Participant name:

Date and place:

Signature of participant:

If you have questions related to NSD's assessment of the project, you can contact:
NSD - Norwegian Center for Research Data AS by email (personverntjenester@nsd.no) or by phone: 55 58 21 17.

Kind regards

Guillaume Quigley

Appendix B: Interview Guide

Interview Guide

- In your experiences, how have ESIA evolved since the advent of EIA in the 70s?
- What actors have been instrumental in the development of ESIA both in theory and in practice?
- Why are ESIAs important in hydropower?
- How do you define a "good" ESIA?
- What are the current limitations of ESIAs today?
- What are the causes for these limitations?
- If limitations → What needs to change in order to address the limitation and what actors are best placed to address the limitations?
- Since the Millennium Ecosystem Assessment how has the issues of sustainability been addressed in hydropower?
- How dose ecosystem services (ES) assessment and valuation contribute to ESIAs.
- How do ES valuation influence the mitigation hierarchy?
- How do ES valuation in ESIAs change the environmental and social management plan (ESMP)?
- What challenges are there to the implementation of ESIA and ES theory into guidelines and practice?
- What barriers might different actors (governmental, private, financial) encounter in "good" ESIA development and implementations?
- What actors have the biggest influence on the proper implement of ESIA and ES?
- How are SHP guideline, best practice and proven best practice established?

- What is the possibility for sustainable HP in the future and how will ESIA and ES contribute to it?

Appendix C: Equator principal requirements

Non exhaustive environmental and social issues to be addressed in the ESIA document according to the Equator Principles 2020

1. assessment of the baseline environmental and social conditions
2. consideration of feasible environmentally and socially preferable alternatives
3. requirements under host country laws and regulations, applicable international treaties and agreements including the 2015 Paris Climate Change Agreement
4. protection and conservation of biodiversity (including endangered species and sensitive ecosystems in modified, natural and Critical Habitats) and identification of legally protected areas17
5. sustainable management and use of renewable natural resources (including sustainable resource management through appropriate independent certification systems)
6. use and management of dangerous substances
7. major hazards assessment and management
8. efficient production: total energy consumed per output scaling factor18, delivery and use of energy
9. pollution prevention and waste minimisation, pollution controls (liquid effluents and air emissions), and waste management
10. greenhouse gas emissions level and emissions intensity
11. water usage, water intensity, water source
12. land cover, land use practices
13. consideration of physical climate risks and adaptation opportunities, and of viability of Project operations under changing weather patterns/climatic conditions
14. cumulative impacts of existing Projects, the pr anticipated future Projects
15. consideration of actual or potential adverse Huma if none were identified, an explanation of how the absence of Human Rights risks was reached, includin groups and vulnerable populations (if present) were analysis
16. labour issues (including the four core labo occupational health and safety
17. consultation and participation of affected parties and implementation of the Project
18. socio-economic impacts
19. impacts on Affected Communities, and disadva groups
20. gender and disproportionate gender impacts
21. land acquisition and involuntary resettlement
22. impacts on Indigenous Peoples, and their unique values including impacts to lands and natural r traditional ownership or under customary use
23. protection of cultural property and heritage
24. protection of community health, safety and secu impacts and management of Project's use of security
25. fire prevention and life safety

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